



Flowers, Fronds and Forests: North East-UK

7th-20th of August 2018

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Introduction

Project Aims and Objectives

- An assessment on the native flora and conservation management in North East England and their inclusion in gardens around Newcastle.
- Build a greater repertoire of native species and their interactions within the natural environment.
- Grasp the importance of invasive species in the way they interact with our ecosystems and their impact upon the garden.
- Engage with experts in the field of botany gaining work experience and guidance to further my career prospects.

Introduction

As an apprentice at RBG Kew I'm in a most fortunate position where I'm exploring and specialising in my field. I believe that studying and understanding the British landscape and the flora it contains to be a great foundation to the cornerstone of my career in horticulture.

I visited several locations across North-East England in August which are listed below in my itinerary.

These sites carry international significance due to land-use change threatening these ecosystems across the world. The Northumberland National park for example accounts for more than 75% of moorland habitat across the world (Northumberland National Park, 2018; RSPB, 2018); and the highland grasslands of the North Pennines AONB has some of the most diverse range of wildflowers/ herbs per square meter than anywhere else in the country (NorthPennines.org, 2018).

The itinerary had to be changed somewhat to accommodate the recommendation to visit Durham Botanic Garden, also upon learning the nature of Lindisfarne island as a causeway. As a result, my initially planned three days at Alnwick got axed to one, due to the need to stay overnight on Lindisfarne to make the most effective use of the area.

Itinerary

Date	Day No#	Activity
07/08/18	1	Travel to Newcastle via train.
08/08/18	2	<p>Rising Sun Country Park On route to Gosforth and had time free in the morning prior to the scheduled botanizing at 14:00 at Gosforth.</p> <p>Gosforth Park Nature Reserve tour with botanist Professor. John Richards and Reserve Manager Paul Drummond.</p> <p>Specifically, we'll be looking at the proliferation, characteristics and importance of the <i>Epipactis helleborine</i> orchid which resides there and will be in full bloom in August (Natural England, 2018).</p>
09/08/18	3	<p>Berwick-Upon-Tweed - Lindisfarne National Nature Reserve</p> <p>The British endemic native Lindisfarne helleborine orchid (<i>Epipactis sancta</i>) And <i>Epipactis palustris</i> (Dune Orchid) resides within the dune slacks and is in flower in August (Plantlife, 2018; Bowmer, 2008).</p> <p>Gertrude Jekyll Garden Next to Lindisfarne Castle.</p>
10/08/18	4	<p>Alnwick Gardens</p> <p>Visit the garden, see the collections, understand the scope of this relatively newly conceived garden.</p>
11/08/18	5	Travel to Northumberland National Park ;
12/08/18	6	Accommodation three nights; Rest Day Sunday the 12 th of August due to heavy rain.
13/08/18	7	<p>North Pennines AONB Partnership work experience with Dr. Ruth Starr-Keddle, Assisting the delivery of the Plugging the Gaps project in the North Pennines. 4 nights hotel.</p>
14/08/18	8	
15/08/18	9	
16/08/18	10	
17/08/18	11	
18/08/18	12	Durham Botanic Gardens
19/08/18	13	Rest Day
20/08/18	14	Travelling back to London.

Report

Day Two

Rising Sun Country Park Nature Reserve

The trip began with a visit to the Rising Sun Country Park, it is a 400-acre site managed by North Tyneside council and the Rising Sun Farm Trust. It was once home to the largest colliery in Europe at the start of the 20th century. The big hill which punctuates the park was created from waste product during the operation of the plant. When the plant closed in 1969 redevelopment and landscaping began in the area with the help of the support of the local community and Heritage Lottery Funding.

The hill is colonised by grass species and *Ulex europaeus* which help stabilize the steeper slopes and prevent erosion revealing the spoil underlain. Towards the bottom of the hill swathes of purple wildflowers were seen, this was later identified as *Chamerion angustifolium*.



Figure 1: Atop the hill in the Rising Sun Country Park which was made from waste material from the colliery then landscaped. *Plantago major* dominates the grasses in this area and large thickets of *Ulex europaeus* colonise the steep slopes. To the right of the *U. europaeus* lays a large exposed area of mineral rich material which is likely to have been caused by slope failure (highlighted).



Figure 2: Pond found within the country park. *Phragmites australis* reed surrounds periphery of pond with *Lythrum salicaria* on opposite bank, blown up in size, pictured. Pond is most likely artificial, created when the park was landscaped and home to a small population of water voles according to Newcastle's BAP (2008)

Gosforth Park Nature Reserve

Gosforth Park Nature Reserve is 92 acres managed by the Natural History society of Northumbria. It's ecologically important due to the green space deficit and a SIII due to its flora and fauna (Natural England, 2018; Natural History Society of Northumbria, 2018). Several orchid species are known to reside in the reserve, during the time of my visit I was keen to see the rumored stand of about four hundred flower spikes of *Epipactis helleborine* and *Corallorhiza trifida*, both of which were due to be blooming in abundance around the time of my visit.

I booked onto a botanical walkabout which was running at the reserve which featured botanist Professor John Richards and the reserve manager Paul Drummond. We surveyed the site and when we came across an intriguing species, we'd discuss its morphological characteristics, habit and origin. The site is constantly being developed with conservation, and proliferation of native species in mind. For example, earlier last year two wildflower meadows were developed and seeded with a 'native mix'. John went on to say that these mixes whilst seemingly beneficial for increasing biodiversity, are typically harvested from meadows in Europe and the mix therefore is dominated by nonnative European species of wildflower. There appears to be a common misconception which I admit one was also guilty of

prior, that by creating and maintaining annual wildflower meadows with these mixes is incredibly beneficial in helping pollinators and important in restoring the meadow habitat.

Unfortunately, due to the uncharacteristically northern hot and dry summer which occurred in 2018, most of the orchids had flowered early and gone over by the time August rolled about. From previous botanical excursions we were shown an area where there was evidence of over 400 flower spikes of *Corallorhiza trifida* which were present alas, the flowers absent. As we ventured through the reserve, we found substantial amounts of spent flowerheads of the *Epipactis helleborine* and our likelihood to find flowering specimens was waning.



Figure 3: Picture taken from the viewing platform where several hundred flower spikes were found in previous years in August. According to Professor Richards, *Corallorhiza trifida* bloom here in a colony of several hundred and is apparently the second largest colony of this rare orchid to be present within the UK (NHSN, 2018).

Even without the presence of the orchids it allowed me to infer the ideal conditions in which the orchids are likely to thrive in. *Hydrocotyle vulgaris* is one such indicator species present here in addition to the thick thatch of mossy undergrowth which indicate moisture rich conditions as it prefers marshes, wetland and will even tolerate being partially submerged. It is within these conditions that the helleborines of Lindisfarne are also likely to reside, this information and experience has assisted me greatly in future excursions.

Plant profile: *Epipactis helleborine* var. *youngiana* -

Young's Broad-Leaved Helleborine

The identification of *E. helleborine* is not always straightforward according to Foley & Clarke (2005). Because the flower spikes can vary from lax to dense, and from relatively few to the many-flowered. The colour of the flowers can also vary appreciably (Foley & Clarke 2005:p94). Having Professor John Richards there on hand to identify and outline key features was invaluable, he also recommended spots on Lindisfarne Island where I was most likely to find the helleborines I was interested in.



From one root stock up to size stems may arise (Bowmer, 2008), so it is very likely this stand of three we located is one plant.

The flower spike can contain as many as 100 individual flowers, the ones pictures contained about 35 individual flowers. Development can take up to at least eight years from germination to flower (Bowmer, 2008).



Figure 4 & 5: The specimen pictured was identified as *E. helleborine* var. *youngiana* due to its rather pointed epichile which differs from the straight species *E. helleborine* which is broad and blunt (Folley & Clarke, 2005).

However, according to Bowmer (2008:p30) it's possible that this will matter little as the Young's orchid is likely not to be considered as a separate species due to recent phylogenetic research which has emerged from the Royal Botanic Gardens Kew.

What the author found interesting about the *E. helleborine* was its versatility in its colonisation. Due to its long thick stock its roots penetrate deeply to obtain moisture from dry banks and slopes and it has little to no mycorrhizal fungus interactions which many orchids are well known for and can grow within mineral rich disturbed environments or humus rich biodiverse forest understory like in Gosforth (Bowmer, 2008). In fact its greatest abundance in Britain is now thought to occur in suburban areas of Glasgow (Foley & Clarke, 2005). Prior to this project I was unaware of these unique traits and its ability to adapt to anthropogenic change.

The site is threatened by lack of funding, management is done primarily by volunteers and invasive species threaten the diverse undergrowth which form under the canopy.



Figure 6: Over the past four years *Rhododendron ponticum* has been sprayed off and pulled, with the intention of eradicating it from the reserve due to its invasive, smothering nature on under-canopy plants and its tendency to harbor the fungus responsible for sudden oak death. Despite the clearance and efforts five years ago in 2013 every year a plethora of new seedlings emerge from the seedbank (Figure 6), some of which were present on the tour which were eradicated by the warden swiftly as we were walking past.

As we were walking through the mixed deciduous woodland of *Betula spp.* *Quercus petraea* and *Acer psuedopplantanus*. Geomorphological quirks of the site were discussed in relation to their effect on vegetation, such as subsidence caused by previous industrial activity in the area. In the past according to Paul, the caverns were continuously pumped free of water and that is no longer the case now. As a result, the water table is increasing in height which is causing wetter conditions which some of the trees such as the *Quercus spp.* to decline in health as a result of the increased water availability (Personal Communication, Paul Drummond, 8th August 2018; NatureBlog, 2017). This may also influence the orchid population on the site, as the *Corallorhiza trifida* is quite susceptible to local environmental change and has quite a low variance threshold it can tolerate (Personal Communication, Professor John Richards, 8th August 2018). This may, if not rectified, lead to a shift in the vegetational succession in Gosforth over a longer time period. Although it's equally possible that a rise in water table could in fact make the site more resilient to climate change, which is likely to bring dryer and hotter summers.

Day Three

Lindisfarne Nature Reserve

Off the coast of Berwick-upon-Tweed resides 3500 hectares of dunes, saltmarsh and mudflats of the Lindisfarne National Nature Reserve. The British endemic native Lindisfarne helleborine orchid (*Epipactis sancta*) resides within the dune slacks in addition to the *Epipactis palustris*, *Epipactis dunensis*, *Dactylorhiza praetermissa*, *Dactylorhiza purpurella* (Plantlife, 2018; Bowmer, 2008).

The hunt was on, and off I set down the pilgrims walk by foot, off to the sand dunes in-between the mainland and Lindisfarne. Or at least an attempt was made to; the way was blocked, and I was at the mercy of the tides. I bided my time wandering along the coast of the causeway, the saltmarshes ahead were painted purple throughout my walk by a healthy population of what I found out to be *Aster tripolium* (figure 7) which were in amongst the swathes of *Juncus gerardii*. The time had come, and I embarked back towards the causeway after an hour stroll.



Figure 7:
Aster tripolium
pigmented the
landscape.

Upon entering the Lindisfarne reserve, signage warned visitors of the risks of the invasive species *Acaena novae-zelandiae*. Raising awareness and increasing the regions biosecurity; is key if we want to prevent the proliferation of invasive species of plants, pests and diseases. Such signage is rare, and members of public aren't typically savvy to site specific invasive species when going on a hike or the procedure for combating the spread. For example, highlighting the importance of sanitation to prevent the spread of unwanted pests like the *A. novae-zelandiae* which clings stubbornly to pieces of clothing and fur.



Figure 8: A familiar sight of *Chamaenerion angustifolium* emerged as vast swathes of purple stained the landscape within the salt marshes of Lindisfarne reserve. The *C. angustifolium* seems to be quite prolific across the sites I've visited so far on my field trip.

Upon further research I found *C. angustifolium* to be British native of with an initial preference for upland environments. It was rare in the 19th century but has since spread throughout the UK along the railway as a conduit for their windblown seed. This granted its common name of 'firebomb weed' when it colonised bombsites left in the wake of the Second World War in the UK (OnlineAtlasofBritishFlora, 2018).

Dunes were rather bare in places, populated sparsely and densely by swathes of *Ammophila arenaria*, which are one of the pioneer species of the dune habitat. I was surprised to see a rather bizarre looking plant which I discovered to be *Echium vulgare* through wildflower guidebook. I made my way towards The Snook, upon my way a myriad of *Acaena novae-zelandiae* was knotted within the undergrowth of the dunes. *Salix repens* and *Crataegus monogyna* were spotted growing stunted abundantly within a mosaic of groundcover. As I held the thought, a deer emerged from the long grass, behind a dune slack a few meters away from me - just as startled as I, it galloped off and crested the nearest dune and off into the distance.



Figure 9 left & 10 right: Red dotted line shows populations of *Acaena novae-zelandiae*, demonstrating its resilience and ability to colonise a dune with sparse vegetation. In RBG Kew within the Rock Garden *Acaena novae-zelandiae* was being used as a ground-cover per contra (figure 10), the risks of spreading are limited as the public aren't allowed and don't step onto the contained beds. It is possible that the on-site fauna at Kew such as the foxes and badgers could play a hand in spreading the seed unknowingly due to the plant's adamant nature. The colour and vigor of the species at Kew seemed to be greater than that of the species in situ at Lindisfarne, which I deliberate is in part due to a greater water availability in Kew. Also pictured is a lone specimen of *Pinus sylvestris* which appeared sporadically in mature form (albeit slightly stunted which I assume due to heavy winds) across the reserve.



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Whilst venturing through the dunes I had to re-orientate myself several times with the compass and map to make sense of my location due to the island being rather limited in the way of landmarks bar the topography. I came across a large clearing with a recessed pit in the center (Figure 11), sheltered from all sides by the leeward slopes of vegetated dunes. Within the sheltered depression water availability seemed to be more abundant, which the writer inferred by with the dense mat of *Hydrocotyle vulgaris*. Within this mat sphagnum moss lined the topsoil which created a thick layer of water retentive organic matter and was interplanted with *Salix repens* in places too (figure 12). It was in that moment of contemplation that I let out a whoop of joy upon spotting the first *Epipactis* sp. which had gone over. Upon venturing deeper into the recession there was then a flurry of flowers which blanketed the entire area. *Epipactis palustris* covered this area in a large swathe of flowers, most of which had gone over but a substantial amount remained.

A selection of flowering plants I botanized and identified whilst in the reserve:

- **Figure 11:** 30x magnification on the *Epipactis palustris* which was taken with the aid of my hand-lens over an iPhone camera.
- **Figure 12:** *Echium vulgare* colonised barren sand on atop the slacks and within the rushes of the saltmarsh in various locations.
- **Figure 13:** *Parnassia palustris* which I originally thought was related to the *Ranunculaceae* family due to the radial symmetry on the petals.
- **Figure 14:** *Lotus corniculatus* was common within the undergrowth growing commonly across the landscape.

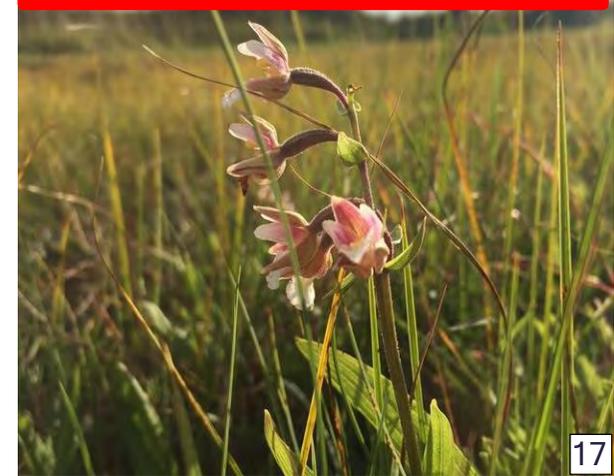
- **Figure 15:** Dune slack site where I first discovered flowering helleborines. Upon visiting and thereafter I noticed a greater abundance of orchid foliage out in the less sheltered areas of the saltmarsh/sand dune areas of the reserve, but none were flowering.
- **Figure 16:** Layer of moss, *Hydrocotyle vulagris* mixed with *Salix repens* saplings and *E. palustris*. Both of which appear particularly common as a companion plant to the *E. palustris* on dune slacks. It has a large range across Europe, eastwards towards Iran, central Asia and Japan (Bowmer, 2008: p88).
- **Figure 17:** Of the specimens that were in flower many seemed to have only several flowers present on the second receme. Whereas, many of the *E. palustris* specimens which had already gone over present in this area seemed to have a greater abundance of flowers present on each inflorescence (Figure 18).



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Bowmer (2008) states that they can have anything from four to twenty individual flowers, the abundance of flowers may be linked to the timing of the visit. In that, those specimens flowering earlier in the season which are now gone over (Figure 18) may have had a greater access to nutrients such as phosphorous to aid flower development, water and developed without the searing heat of the intense 17-day drought we had a month prior in June 2018 which had an adverse effect on the duration.



Figure 18: The gone over *E. palustris* appeared to be much larger in stature with more abundant flowering presence on each inflorescence compared with those which were still in flower (see Figure 17).

I discussed this with Nick Woods of RBG Kew as to why this may have occurred, and we came up with several theories and mechanisms as to why there was a difference (Personal Communication, Nick Woods, September 17th, 2018):

- Water table will influence the distribution of nutrients if the ground is uneven and sloped.
- Aspect will influence the flowering, it's possible the later flowering ones may not have had access to as much of the sunlight during the growing season due to the proximity of the dune slack.
- Size of the leaves and the age of the bulbs may influence it too. Those with bigger leaves will have greater stores of energy built up and therefore will produce more flowers. It's possible those around the edge are newer offsets of those more established specimens in the center of the plot.

Day Four

Gertrude Jekyll Garden - The National Trust

The garden is located on Lindisfarne island, it was initially abandoned and restored to its former glory by the National Trust in 2003. The garden was originally designed in 1911 by infamous Edwardian garden designer Gertrude Jekyll. Prior to that it was utilized as a vegetable plot for the soldiers manning the castle, the slopes aspect is south facing and the correct distance away so as not to be in the castles shadow. This was visited on the morning of my departure on the island, as I spent the prior evening until dusk botanizing in the sand dunes.



Figure 19: Geometric formal Victorian planting of the garden. *Stachys byzantina* 'Silver Carpet' as used as edging prolifically to give structure and impact to the garden. *Sedum telephium* was used for the central square bed, the yellow *Helenium pumilum* 'Magnificum' and the *Rudbeckia* looked especially stunning as did the *Cosmos bipinnatus* which populated the beds with pinks and whites. The walled trellises of sweet pea can also be viewed here either side of the avenue. Lindisfarne castle is viewed from the garden with the lowered offset wall from which you enter the garden. August was defiantly the ideal viewing period of the display.

The garden features a geometric layout and formal planting schemes, with structured forms featuring heavily in the garden. The key division of the garden is its outer periphery; high walls surround and enclose the space and make it its own (figure 20). Without the aid of such devices the garden's beauty would be detracted and appear insignificant and small, compared to the vastness of the surrounding landscape. On either side of the entrance as you walk in, two long trellises are laced with established *Lathyrus odoratus*. These run parallel to one-another, providing natural architectural form. The garden divides into avenues and smaller enclosed spaces which lead the individual to believe the garden is larger than it first appears, an interesting illusion which one believes to add mystery and depth.



Figure 20: Demonstrates the importance of the walled garden. Rush pastures surrounded the garden which indicate the presence of infertile conditions. The gardeners I spoke to said that the soil medium and mulch used within the garden was all imported to help improve the quality and fertility of the growing medium (Personal Communication, Gardener, Helen National Trust Employee, 10th August 2018).

The Alnwick Garden

Alnwick Gardens chosen for its formal contemporary style of horticulture and dynamic architecture designed for year-round interest, it's designed to be enjoyed by all your senses with a collection of over 4,000 plant varieties (VisitNorthumberland, 2018). Seeing how the horticultural elements complements and contrasts with the sculptural and man-made created a sense of the dramatic.



Figure 21: *Taxus baccata* used on the main display of topiary to offset the large feature fountain. At the top of the Grand Cascade lies the Ornamental Garden which is shown below. It was the most well-maintained area throughout the garden, where geometric formally laid out partees, trellis, pleached trees and bedding displays reigned.

Much of the garden featured a myriad of topiary to offset the stark architectural forms and fountains which are dotted throughout the displays. *Taxus baccata* was used for the majority of the natural structures. Most likely due to its evergreen nature for that year-round-interest and resistance against box blight and box caterpillar which is affecting *Buxus* sp. across the UK presently. *Corylus* sp. were also utilised for some of the hedges towards the woodland and ornamental garden. At RBG Kew a diversity the hedging material used, for the largest pieces an unconventional *Ilex aquifolium* surrounds the periphery around the Rose Garden with large dumplings like the ones seen at Alnwick. A traditional box (*Buxus fruticosum*) is used around Kew Palace, careful monitoring and treatment regimes are employed to ensure that its kept free of blight and caterpillar damage.

The Poison Garden which was conceived and inspired by the oldest medicinal botanical garden of Padua in Italy was the first area I visited (GardenDesignMagazine, 2018). It was a small gated compound with a Victorian gothic theme. On the tour through the garden several of the plants were discussed and their stories were delivered, with in-depth information on the natural chemicals which are responsible for the poisons. Each of the specimens were labeled botanically and those which were perceived as of interest were contained in large bird like Victorian cages. Surprisingly though one of the most dangerous plants was without a cage to prevent public interaction, which was the *Heracleum mantegazzianum* which has phototoxic sap that actively persists causing harm to those inflicted years after incident. According to Trevor Jones (HortWeek 2018) there are plans to expand the Poison Garden and the Alnwick garden team has also recreated the idea in a garden in Scotland.



Figure 22 (Humphrey Bolton, 2010): Overhead view of the garden, with the size of the tour group and the limited time in which were permitted in the garden I found it quite hard to take a nice photo of the whole scheme. *Hedera helix* formed the large archway, present in the garden due to the purgative effects, labored breathing, convulsions and potentially coma if the ivy is ingested (ThePoisonGarden, 2018).

Within the poison garden quite a few natives resided which helped to promote the dangers of approaching and interacting with such vegetation especially in the case of young children. There were many more non-natives discussed in the garden due to their storytelling ability such as the assassination of Georgi Markov with a ricin-based compound hailing from the *Ricinus communis* plant.

As for which part of the garden I found most intriguing, the bamboo maze really spurred and enticed the individual on and through its intricately designed corridors. The bamboo used was planted onto a 3-foot elevated substrate so that the height of the specimens would create an artificial archway through the series of pathways to draw the individual into a serene, mysterious atmosphere. By having light levels reduced and vision limited, I felt it to be an immersive experience, taking you away from the garden setting and into the realms of imagination.

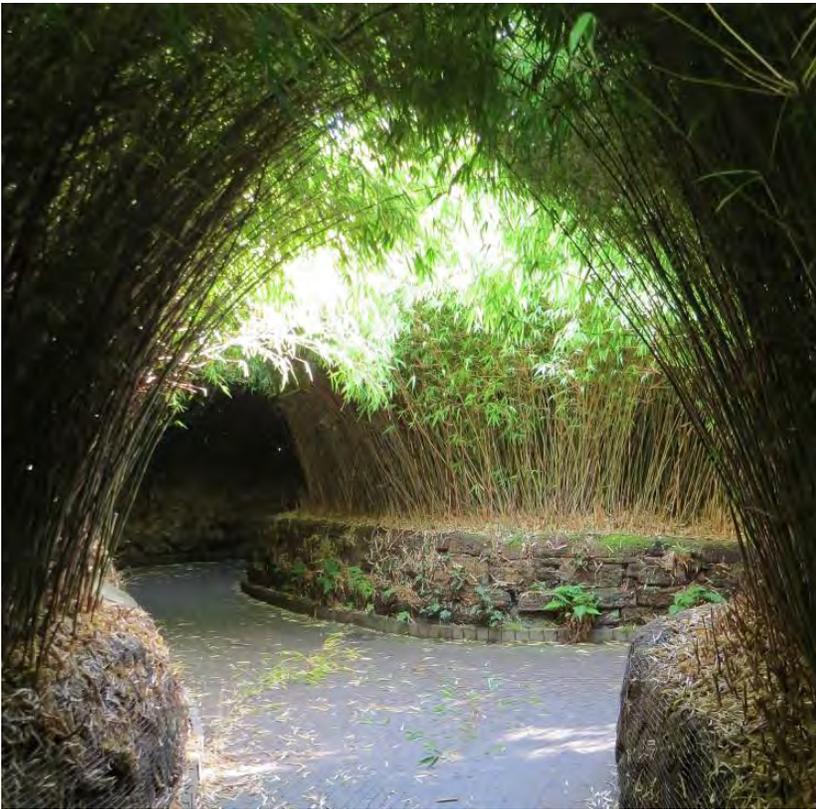


Figure 23 (Richard Jackson, 2018):

Bamboo Labyrinth at Alnwick. Curved shaded tunnels of the evergreen *Fargesia rufa* which have been planted raised on reinforced banks with side of the pathway to grow to the height required to make a naturally formed tunnel.

I liked the *Dryopteris* sp. & *Polypodium vulgare* which colonised some of the built walls within the labyrinth. The only drawback was the chicken wire mesh which was used to stabilize the soil. I felt that the crudeness of the design took away from the natural feel and immersion. It's possible the walls were original features of another area which stood prior to the bamboo maze and meshed gabion walls were a later development.

Day five

Northumberland National Park

Northumberland National Park was chosen for its moorland habitat and stunning blooms of heather. The UK according to RSPB accounts for over 75% of moorland habitat across the world which is why Northumbria's ecosystem carries international significance. The clearing of ancient forests and subsequent grazing of cattle and sheep has led to the creation of this unique environment (Northumberland National Park, 2018).

As I ventured forth, I was determined not to rely on digital forms of navigation, compass in hand, Harwood forest was the first destination along the route up towards Simonside ridge. The forest appeared to be actively managed and used as a resource, the canopy was dominated by *Larix decidua*, also present in smaller quantities was *Picea abies* along with *Betula pubescens* and *Fraxinus excelsior*. The undergrowth initially seemed to be dominated by *Pteridium aquilinum* along the margins in vast homogenous swathes. This indicates the prevalence of acidic soil, which is to be expected due to the adjacent acid heath and the presence *L. decidua* needles dropped by *sinensis* which litter the forest floor.



Figure 24: Diverse communities of the forest floor within Harwood forest. Two different heathers were found *Erica tetralix* and *Erica cinerea* in addition to *Huperzia selago* and stands of *Pteridium aquilinum*. A lone *Quercus* sp. sapling was also present in the undergrowth but very uncommon from what I could see along my walk.

Once the *P. aquilinum* stands dissipated the vegetation became more diverse within the under canopy. Yet, I was still rather surprised to find *Erica* sp. and *Vaccinium myrtillus* (billberry) amongst the undergrowth within the forest. As the elevation increased the canopy of trees let in more light and heather dominated the undergrowth vegetation. Also spotted in isolated stands were *Digitalis purpurea* at the end of their flowering with only two or three flowers left on the spike at the apex. *Picea abies* also colonised these higher reaches more readily but in adolescent form measuring on average two to three metres high. Due to being manmade in origin the forest abruptly ended and turned into a vast clearing of felled vegetation, the slopes were mainly formed of various grasses, rushes and heath in order of dominance.

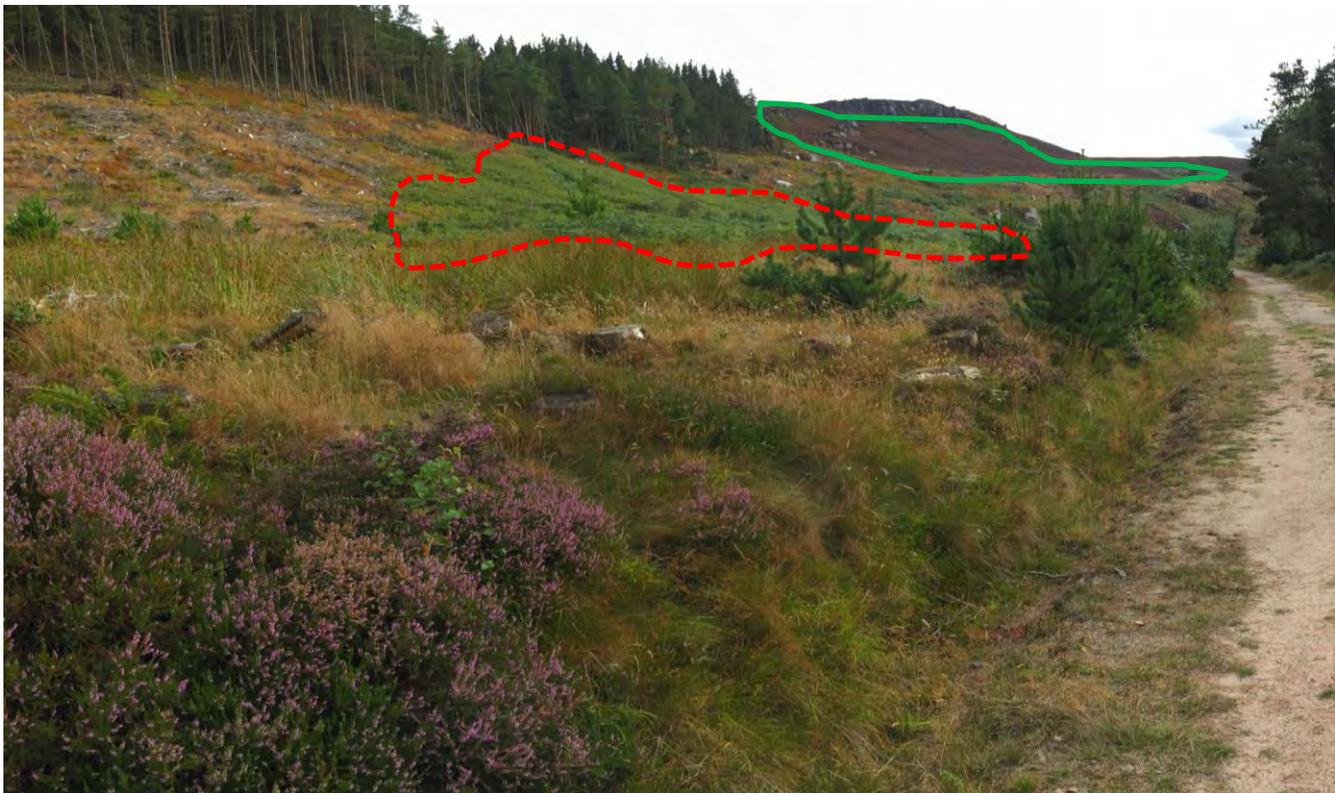


Figure 25: Felled clearing, grasses, and rush dominate with intermittent stands of heather and *Picea abies*. I've highlighted in red a large monoculture of *P. aquilinum*, control methods and management of the invasive is unknown. In areas of the UK where the land is managed for game the selective herbicide Asulam is sprayed from plane or helicopter to control the spread. The problem with blanket spraying is it will also non-selectively kill all the other types of ferns within the area too in addition to the risk posed to walkers due to being public land. It was evident that this area was once an area of dense forest from the decaying stumps left in situ, it's possible that this area will be encouraged back into a wooded area once more, but no new planting was sited. A pleasant hue of purple greeted me in the distance with the stark contrasting cliffs above and I knew this at once to be Simonside ridge. As the summit got closer a hill was crested and shades of red covered the landscape in amongst the felled trees. Upon closer examination I could see vast swathes of *Vaccinium myrtillus* dyed the colour of blood. One believes this to be due to the recent drought we had over the summer and the colour change of the leaves being indicative of stress.



Figure 26: Panoramic of Simonside Ridge in its autumnal bloom. Several different heathers are intermixed within the landscape to create the overall effect. They are *Erica cinerea*, *Erica tetralix* and *Calluna vulgaris*. Rush species line the periphery of the pathways through the moorland which are *Juncus effusus*, *Juncus squarrosus*, *Juncus bulbosus*, *Juncus acutiflorus* and *Juncus articulatus* (MoorPLANTS, 2018). Upon making my way through the pathway I was surprised to find a clearing (figure 27) which broke away from the moor archetypal vegetation and was dominated by *Deschampsia flexuosa* and *Molinia caerulea* with a clump of *Succisa pratensis* (Figure 31). At the time of taking the photo I was unaware of the species of wildflower but after spotting and asking about it with Dr Starr-Kedde later in the fieldtrip the mystery was solved. This species isn't normally present in the actively managed field meadow due to its late flowering and seeding nature. *S. pratensis* will only begin flowering late July early August and set seed in September and most fields are harvested late July early August depending on the land managers requirements it can be earlier in the season.



- **27:** *Oreopteris limbosperma* which I was surprised to find was actually lemon-scented when a bit of the foliage is crushed.
- **28:** *Cirsium palustre*: only one or two specimens found emerging from the vegetation, the summer may have been too dry for them.
- **29:** *Potentilla erecta* Tormentil was in abundance I really like its sessile leaves.
- **30:** *Blechnum spicant* found uncommonly within the undergrowth.



Day seven

North Pennines AONB

The North Pennines was my next destination, there I was to work alongside Dr. Ruth Starr Keddle on the Plugging the Gaps Project, which she led and funded by the Heritage Lottery Fund. Its aim is to assist in the restoration of upland wildflower meadows, of which only eleven acres left exist in the UK. The project was chosen to operate from the North Pennines AONB as it has some of the most diverse range of wildflowers per square metre than anywhere else in the country (NorthPennines.org, 2018). The project was nearing the end of its two-year timescale and most of the sites have already been selected and surveyed. I did however get the rare opportunity not only to visit and survey two new sites I also got to see the wildflower nursery up in Allendale prior to the plants being delivered to their various new homes.

During the summer of 2017, over 100 people signed up to help with the project. Eleven seed collection days were organized and a plethora of workshops to sort, plant and look after the collected plants was organized in the following months leading up to the present day (NorthPennines.org 2018). Several species of wildflowers were prioritised as they represented the ecological niche of the upland hay meadows MG3 by Rodwell's National Vegetation Classification (Rodwell, 2012). Those were *Trollius europaeus*, *Geranium sylvaticum*, *Centaurea nigra*, *Cirsium heterophyllum*, *Sanguisorba officinalis* and *Alchemilla glabra*. These were collected with permission from a variety of locations, such as roadside verges and the steep banks around the periphery of agricultural land, which was species rich in composition (due to the difficulty in farming these areas and the low level of herbicide/pesticide that was applied here).

There is a danger of 'native' wildflower mixes where the location of the seed was harvested is withheld or unknown. Such mixes are commonly sold across England to municipally managed land or community projects and could be in fact derived from Europe or hold species/sub-species not native to the local environment (Personal Communication, Professor. John Richards, 08th August 2018). Wilkinson (2001) states that the local genetic population of wildflowers are of great import to insects, specifically citing the case of the rare Marsh Fritillary Butterfly which wouldn't lay its larvae and reproduce on the flowers of *Succisa*

pratensis, which were bought in from a distant supplier. And when the reserve manager reared plants sourced from seed locally, the population of the butterfly increased dramatically thereafter. RBG's Grow Wild scheme also seeks to proliferate the importance and awareness of local provenance in its provision of wildflower seeds, they have several sets of seed; which is split into regional areas (GrowWild, 2018).

An important and interesting distinction in this project was how the specimens collected from a particular area were catalogued, organized and only planted out into corresponding locations. This was done to preserve the local genetic populations and maintain local provenance throughout the project (Wilkinson, 2001). *Trollius europaeus* collected in Teesdale for example and would only be grown and planted on to areas within Teesdale.



Figure 32: Organisation of the nursery was location specific, areas covered were as Allendale, Teesdale and Weardale, Watering was covered on a voluntary basis by local volunteers as was potting on when specimens outgrew their containers. According to Ruth, from her experience the wildflower seemed to thrive and have a better chance of survival when a colony of species was interplanted together in one pot rather than potting up each specimen separately.

On the eighth day of my proposal, we were to meet with the Events and Commercial Supervisor Nic Cullens and the community group who manage the green spaces within the grounds of the South Tyneside Railway. This was to discuss an appeal they made to plant out wildflowers in two sites within their grounds. The day started with a round the table meeting to discuss plans, timescales and specifications of the project to ensure a planting workshop goes ahead to schedule.

The first of the two sites was adjacent to the South Tyneside Railway station carpark. It was tucked away up a hill with varying topography and two steep slopes and near vertical rocky outcrops which was colonised with ivy and ferns. It was proposed that this site be used for planting plug plants. However, it was noted that except for the presence of the *Urtica dioica*, the site had an ideal mix of native woodland herbaceous scrub. Notwithstanding, it was recommended that the *Urtica dioica* was continually removed to prevent large stands from forming and carpeting the vegetation and where necessary the colonizing *Fraxinus excelsior* removed to maintain the present state of succession.



Figure 33: A mosaic of lush green foliage filled the area, underlain by a carpet of sphagnum moss and offset by the contrast of the exposed bedrock. Pictured also was Nic, events coordinator and the community group responsible for the landscaping at the South Tyneside railway.

The Second site was a small bank of redeveloped land adjacent to a new Slaggyford Railway carpark. The plots which were to be planted with wildflowers were newly raised banks surrounding the periphery of the car park and two beds where several young trees were recently planted. The present vegetation on the banks was dominated by grasses and rushes as well as *Rumex acetosella*. The presence of the *Juncus* sp. Indicates the presence of moisture in the soil profile. It is however likely that due to the newly raised nature of the newly developed banks, the areas are much more free draining than they once were, and it is equally likely that the rushes will decline in response to this change in moisture (Personal Communication, R. Starr-Kedde, 14th August 2018).



Figure 34: Sloped banks on the left-hand side (highlighted) of the Slaggyford Railway car parks boundary was dominated by *Juncus* sp. Three identically sized 'islands' were also proposed to be utilized for planting. Growing within one of them and the banks was the beautiful schedule 9 invasive RHS *Crocosmia x crocosmiiflora* growing in small isolated stands in two of the areas.

Regarding maintenance, it was recommended that the areas intended to be planted up should be strimmed prior to the planting workshop. The removal of vegetation will grant more light to the newly planted plugs and increase the rate of establishment and increase their survival chances (Personal Communication, R. Starr-Keddle, 14th August 2018).



Figure 35 & 36 below:

On our hike thereafter, we found a colossal *Fraxinus excelsior* on the edge of a riverbank, the ancient looking drystone walling underneath was assumed to form the formation of collapsed bridge sometime in the past. The side of the wall was colonised with sphagnum moss and *Polypodium vulgare* with the top of the 'bridge' covered in *Urtica dioica*.



Day Nine

A meeting was scheduled to discuss the launch of an invertebrate art trail 'Bug Corner' which will commence later in the year on the 22nd of September 2018 at the Durham Dales Centre. This event was run in collaboration with another North Pennines AONB Partnership project 'Cold Blooded and Spineless' and Plugging the Gaps was to feature in ones of the instillations to emphasise and increase awareness of the importance of wildflower meadows.



Figure 37 Paul Steele, 2017; & 38 © Ruth Starr-Kedde, 2018: Proposed spot for the installation to raise awareness of the Cold Blooded and Spineless project and the importance of pollinators in the environment. At the time of the visit only the head and blade of grass was built so I contacted Ruth for pictures of the final grasshopper and planting event. Wildflowers were planted within the border of the *Taxus baccata* hedge, so the lawn could be maintained as a sward and the edge cut as a meadow yearly.

Sam led the discussion who is the lead in the Cold Blooded and Spineless Project Officer at North Pennines AONB Partnership. Three members of the Durham dales center were joined by the artist Graeme Hopper who designed and made the installation which was to be the central feature of the event. It was insightful to gain further industry understanding about the project delivery and events planning, building on my previous work experience as a Park Ranger at Festival Gardens, Liverpool. The meeting was a success and the project was to go ahead as planned and it was even proposed that the event could potentially incorporate the

Plugging the Gaps project to increase awareness of the threat to our upland meadows by planting plug plants around the sculpture and in adjacent beds.

Thereafter we travelled to the office as reports needed to be written up and events planned. There I participated in sorting through the seed of *Alchemilla glabra*, *Geranium sylvaticum* and *Trollius europaeus*. Sites were selected for their ease of access and rights of way, it's important to note that when collecting on private land permission must be attained prior.



Figure 39: *Vicia sepium* was collected (myself demonstrating) on a bank which ran alongside the South Tyneside Railway line. Care had to be taken to ensure that the seedpods were ripe enough to collect, in the case of this specimen only seedpods which had turned black were suitable.

Two different plants were collected along the bank, great burnet and vetch. Only those seed which was ripe was collected. For the great burnet, the seed head had to have turned brown from a reddish hue and with the vetch the seedpods should have turned black.

With the vetch it was quite interesting that some of the seedpods were prevented from ripening by the action of aphids. Those which were still green in colour were covered with a thin film of aphids. On one such pod I found a small parasitic wasp impregnating aphid as they sucked the sap out of the specimen.

When collecting it is best practice to note the location by taking a note of the grid reference and ensure that only 10% of seeds from a population of plants over a hundred is collected to make sure that the population isn't adversely affected by the activity (Personal Communication, Dr. R Starr-Kedde, 16th August 2018).



Figure 38: *Geranium sylvaticum* was processed by removing most of the fleshy detritus which surrounds the seed, carefully repackaging and labeling appropriately once completing the process.

Regarding collection, due to the explosive nature of the dispersal mechanism it can be quite a difficult to harvest. Ruth found that whilst the ideal time for harvesting is written to be about three to six weeks post flowering Ripe seeds will turn dark brown, collect by pinching the flower-head to prevent the seed from ping-ponging and catapulting the seed off into the abyss (Personal Communication, Dr. Ruth Starr-Keddle, 2018, 15th August 2018).

Day Ten

The day began with a visit to Derwent reservoir with Northumbrian Water's Conservation Manager Stuart Pudney followed by office visit with additional seed sorting. Accessibility to the Derwent reservoir was rather limited by public transport so I arrived early in a taxi and explored the reserve prior to the meeting. It was a good ten-minute walk up from the carpark up the reservoir. The narrow road I travelled along was surrounded either side by a forest of *Larix decidua* and *Picea abies* which seemed to dominate the area. A vast expanse opened up once I approached the reservoir. Marginal vegetation along the water's edge seemed to be dominated by *Ulex europaeus*.

The initial proposed sites for wildflower plugs were two upland hay meadows managed traditionally to contribute towards Northumbrian Water's environmental pledge. The meadow had been harvested for hay prior to my arrival so the species diversity wasn't clear, the aim was to restore species richness in fields. Ruth informs me that the meadows had *Rhinanthus minor*, *Euphrasia arctica subsp. borealis*, *Trifolium medium* and rough *Leonton hispidus* although were missing some of the rarer upland meadow species such as *Geranium sylvaticum* (Personal Communication, Dr. Ruth Starr-Keddle, 5th December 2018).

Following the visit to Derwent we travelled to Mosswood Water Treatment Works. Dr. Starr-Keddle had assisted with laying the foundations for the development of the meadows which demonstrated how five years on, the land was settling into the shift in succession.

The land closest to the treatment works was used primarily for the depositing of treated detritus which Stuart informs me was deposited and allowed to accumulate on the site for a number of years. The medium was iron rich and red in colour, had a fine tilth and low concentrations of organic matter, vegetation grew freely, and it appeared to be free draining. According to Northumbrian Water the sediment is a class A Biosolid, which means all the offending pathogens from the waste water treatment process have been removed. The fields here were colonised with a basic wildflower mix to shift the succession back to its original traditional setting. In the first two years *Leucanthemum vulgare* dominated the mix, creating dense homogeneous stands across the field (Personal Communication, Stuart Pudney, 16th August 2018). The years following the diversity increased, to present where it stands at the five-year mark. Due to the seed mix used it resembles a southern England wildflower meadow due to the species composition rather than one local to Northumberland according to Ruth.

From there we moved on to one of the meadows in Moswood which Dr. Starr-Keddle worked on in the past in collaboration with Northumbrian Water on her Nectarworks project. The sites were initially nutrient poor improved grassland. With the addition of green hay in 2016 which was harvested in a nearby SSSI donor MG5 meadow in Weardale and was spread across the 2.95 hectares the diversity of plant species was immensely improved (Rodwell, 2012; Coronation Meadows, 2018). The mix initially contained yellow rattle, red clover, eyebright, meadowsweet and great burnet which proceeded to proliferate in the following years to present (Coronation Meadows, 2018). *Euphrasia* and *Rhinanthus minor* were found in addition to which were indicative of the previous mix where the hay originated. This goes to show the success of the project and management done right.

Subcontractors were employed to carry out the hard landscaping and grazing of the land in the way in which was specified by Northumbrian Water; to best encourage meadow vegetation to thrive. Looking after the land with an ecological restoration led approach, I found to be unique among the places I visited. This was conducted in line with Northumbrian Waters commitment to the preservation of its environment and dedication to the sustainable provision

of water and waste water services. Whilst the preservation of such sites forwards the companies ethical stance and appeal to the 'green' consumer and is normally used as a marketing gimmick I feel such acts should be conducted more regularly and without the pressure of the need to restore just because you've directly influenced the degrading of the land like areas of the sites we visited.

Day Eleven

Cold blooded and Spineless project planning day for the following weekends event, several sites were visited, their assemblages have been summarized in picture format below:



Figure 39: Baal Hill Wood Nature Reserve was a stunning mosaic of different vegetation types due to the south facing slopes in clearings creating the most diverse MG5 wildflower meadows.

Most of the earlier flowering specimens had passed but *Centaurea nigra* (pictured), *Prunella vulgaris*, *Lamium album*, *Succisa prtensis*, *Leontodon hispidus* (pictured) and *Solidago* sp. were spotted and identified.



Figure 40: Backstone bank SSSI was ancient oak/birch acidic woodland rich with *Vaccinium myrtillus* which formed a dense groundcover across the woodland floor. We didn't record a great diversity of *Hemiptera* sp. Which made it unsuitable for the weekend's activities, but this may have been due to the overcast and low temperatures of the day we visited.



Figure 41: On our way to Baal Hill Wood Nature Reserve alongside the road verge was a flowering specimen of *Geranium sylvaticum*, the first of my trip. This fellow is one of the 'big five' listed in the Plugging the Gaps mantra of important upland wildflower species which are the indicator species of the MG5 NVC upland wildflower areas (Rodwell, 2012).

Ruth inferred that due to the sudden influx of precipitation we had a week prior to my trip following the summers drought may have prompted a second flush of flowering for some wildflower species such as the one pictured (Personal Communication, Dr Ruth Starr-Keddle, 17th August 2018).

Day Twelve

Durham Botanic Garden

Visited in the last week of my journey upon the recommendation of the RHS committee. Durham's botanic gardens offered one an interesting alternative perspective into presentation and engagement in a Garden.

The garden was well attended and diverse in its collection, having both a hardy display, arboretum like collection and a public glasshouse.

Signage was well displayed within the garden. The visitor was signposted to the multiple areas within the garden frequently, it was most innovative the way the science and nature trail created a running documentary of plants of interest throughout the garden at various locations. The signage was developed in collaboration with Durham University, so it was well written, scientific in nature, informative and fully inclusive. Most of the notes would describe to the reader the histories of a specimen and others were specific to the garden's history. What's different is that the stories were told in a way as to be informative to all rather than aimed at children like most displays tend to cater for in the gardens I have visited.

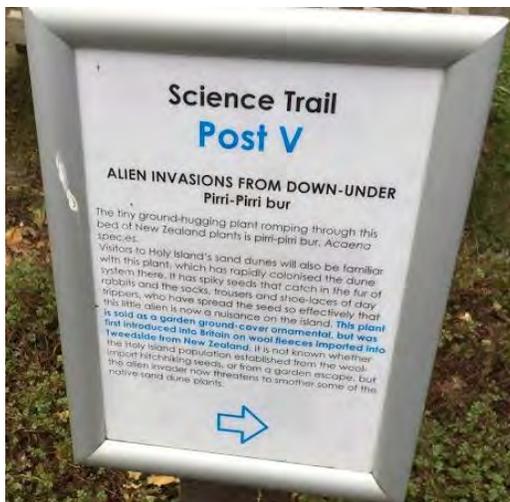


Figure 42 (left): Fact file about the invasive *Acaena novae-zelandiae* and its significance to the landscape of Lindisfarne Holy Island.

Figure 43 (right): Durham university experiment raising public awareness of the work the university does using the botanic garden as a platform for education and promotion.

The topiary was nice and well I cared for and the general standard of horticulture was high throughout the displays. Utilising a public garden to raise educational awareness, is important in addressing the issue of climate change and increasing the general populace's knowledge of the importance of the conservation of our native environment.

Also, to note was the garden's utilisation of native species and their importance in our local environment. There were stands of *Epipactis helleborine* which were apparently natural residents of one of the meadows, but signage was erected to demonstrate their importance and remove the common misconception that not all orchids are epiphytic and tropical in nature. The wildflower meadow did much of the same as did a few of the specimens of trees which had accompanying signage displayed nearby to tell their story of economical or medicinal uses (Figure 45).



Figure 44 Left and 45 Right: Annual cornfield meadow mix planted up in commemoration of the war efforts and to raise awareness of the disappearance of cornfield meadows within agricultural fields due to the use of herbicides. This mix is dominated by *Chrysanthemum segetum*, but I also spotted *Anthemis arvensis*, *Papaver rhoeas* and *Centaurea cyanus*. Earlier in the season it's likely that different species would have dominated the bed such as *Papaver rhoeas* as intended.

Conclusions

Thoughts on my Aims and Objectives:

- **An assessment on the native flora and conservation management in North East England and their inclusion in gardens around Newcastle.**

Upon hearing what tales Dr. Starr-Keddle and Prof. Richards experienced with the creating of wildflower meadows, it prompted the writer to explore the importance of the local provenance of seed. The sourcing of European wildflower seed which is widely available should be discouraged and the awareness of the risks should be proliferated to prevent adding non-native species into the local environment.

- **Grasp the importance of invasive species in the way they interact with our ecosystems and their impact upon the garden.**

When nonnatives are discussed it is always the most invasive or damaging to property price which receive the spotlight. On my travels I've been assessing the proliferation of plants which adversely affect the environment. I am intrigued in how different organisations raise awareness about invasive pests, plants and diseases, in the forms of signage on site and electronic media to help improve the local environment. I was impressed with Linsfarne Reserve with its thorough signage as well as Durham. The North Pennines and Northumberland Park had signage on the conservation work and importance of the moorland habitat but nothing about the species which potentially endanger the biodiversity such as bracken. I really liked the idea behind the Poison Garden in Alnwick, conceptually it was breathtaking, and the tour was delivered well however, the plants in focus were those with the most engaging stories to pique interest into poisonous plants aimed at a general audience. In summary, one feels that public gardens and green spaces have a unique educational platform which when utilised, can raise awareness on important issues. I think more botanic and public gardens should embrace displays of plants with invasive or harmful tendencies and proliferate awareness rather than only advocate and spread awareness of the most beautiful or economically useful plants to humans.

- **Build a greater repertoire of native species and their interactions within the natural environment.**

This project has enabled me to build and expand the breadth of my knowledge on native/non-native invasive plants, and better understand how to read and classify our landscape through the NVC which I was introduced to by Ruth. By building up a specific repertoire of plants it will allow me to take the Field Identification Skills test at a fee, with confidence. The test determines your botanical skill level on a scale from 1 (beginner) to 5 (professional) with 6 being awarded in exceptional cases (BSBI, 2018). It is becoming the industry standard for assessing botanical survey skills, which will be essential in objectively determining and demonstrating my skill to future employers.

- **Engage with experts in the field of botany gaining work experience and guidance to further my career prospects.**

I assumed initially that I'd be assisting with work within the office sorting through, inputting and categorising data/seed which was collected out in the field in addition to helping with duties within the wildflower nursery. Instead the week with Ruth was incredibly varied, visiting sites, interacting with a multitude of different clients from all backgrounds and we explored much of the North Pennines in a relatively small duration. I'm ever so grateful to the opportunity that Ruth and all those who have supported my project have provided me. I feel the experience is one, I'll carry and treasure into the future.

Future Plans

Next summer I'd like to revisit the North Pennines, especially the flower rich meadows of Teesdale to see the upland wildflowers in full bloom. Moreover, a revisit to Lindsifarne and nearby Farne Islands in the spring and summer is defiantly on the list. Additionally, I'm looking into planning a road trip to Scottish Highlands is defiantly on the horizon to look at more orchids, wildflowers, alpine assemblages and discover what awaits in Blarney Castle which houses the new poison garden inspired and designed in collaboration with Alnwick, especially now I have a full Driving License.

Budget Report

DESCRIPTION	PREDICTED	ACTUAL
Travel	£340.84 Car Hire	£292.35 Public Transport + Taxis
Administration	£0.00	£0.00
Accommodation	£375.00	£489.00 (extra accommodation in Lindisfarne)
Food/Stores	£261.00 (£19/Day)	£325.07 (£23/Day)
Equipment	£63.21	£93.77
Contingency Costs	£158.95	158.95
Admission	£0.00	£21.05 (Durham BG £4.50; Alnwick Garden £11.50; G raising Workshop £5.00).
TOTAL	£1,204.95	£1,380.19

Awards Granted:

Royal Horticultural Society	£1000
The Coke Trust Bursary Fund.	
Hardy Plant Society	£400

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Contacts

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Graeme Hopper Artist, Designer and Sculptor www.graemehopper.co.uk

Stuart Pudney Conservation and Manager at Northumbrian Water

Richard Betton Upper Teesdale Landowner and Agriculturalist

Trevor Jones Head Gardener at The Alnwick Garden

Professor. John Richards University of Newcastle and Trustee member of the Natural History Society of Northumbria's Botany and Library Committee.

Paul Drummond Gosforth Park Nature Reserve Manager.

Helen Horticulturalist working for the National Trust at the Gertrude Jekyll garden in Lindisfarne.

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