

Voluntary work placements at Auckland and Wellington Botanical Gardens 2016

By Jamie Leslie

Abstract

Thanks to Merlin Trust funding I was able to complete two voluntary work placements at Auckland and Wellington Botanical Gardens. During this experience I was able to work with the different teams at both gardens. I was also able to research into pollinating insects within New Zealand and learn about the effect of introduced honeybee colonies are having on indigenous pollinating insects and the natural landscape. On the grand scheme of things the two placements enabled me to get good experience within two of New Zealand's top gardens and I also made good contacts within the industry which will become useful in the next two years of my time in New Zealand.

Introduction

On 13th-30th September 2016 I carried out work experience at Auckland Botanic Gardens and then experienced work at Wellington Botanic Garden from 3rd - 28th October. The aim of the work experience was to; get a taster of gardening in New Zealand, gain knowledge on NZ native plants used within the gardens, to identify key plants for pollinators and find what the gardens are doing to encourage pollinators. I also intended to identify the main pollinators in the gardens however I soon realised during my time at Auckland Botanic Gardens, that I did not allow for the time and resources to achieve this.

Auckland Botanical Garden

Auckland Botanical Garden has an area of 44.2 hectares and was officially opened in 1982, before this it was privately owned grazing land. The garden gets about 969,000 visitors a year, the main majority of those visitors are people from the local community using the garden for recreation and the occasional wedding. Open spaces like the botanical garden are very important at present in Auckland as many homes do not have much of a garden or even not at all. The garden has a modern

Auckland City Council

Like all the Botanical gardens in New Zealand, Auckland is owned and ran by the council and is free entry for all Visitors. Auckland is also one of the highest funded botanical gardens in the country and this is evidenced by the high standards of the people that work there and the resources available to the public. The city of Auckland has a third of the population of New Zealand and the city is growing year after year. The botanical garden along with other open spaces has a major role in the local communities as the suburbs of Auckland become more built up. The council owned parks and open spaces are highly funded in New Zealand with Auckland being no exception. For every \$100 of council tax paid to Auckland City Council, \$27 is allocated to parks and open spaces.



Diagram showing the allocation of funds in Auckland City Council (Auckland Council, 2016).

Plants for Auckland conditions

One of the visions at Auckland Botanical Garden is to display and show off plants that perform well in the Auckland climate and suitable for the urban environment. Which in turn promotes sustainable growing within the city leading to a reduction in the use of pesticide and mains water irrigation. This philosophy is evident in many of the gardens at the Botanical garden. The Trees for urban garden

Area displays what the name suggests along with low maintenance ground cover plants. In this area there are various non invasive small-medium trees with different seasonal interests, promoting visitors to plant the right tree right place in their gardens.

At Auckland Botanical Garden there are three Rose gardens which are all managed and maintained without the use of pesticides. Within these gardens the team has selected roses that grow well in the Auckland climate and have a high resistance to pests and disease. The team also make sure the plants are kept healthy with a good layer of mulch and application of different fertilisers. Two of the Rose gardens have been planted with a different array of native and exotic plants which breaks up the monoculture that Rose gardens are commonly known for.

On my first day I was able to walk around the rhododendron and camellia collection with staff from Auckland Botanic Gardens and Auckland City Council, assessing the quality and performance of the plants. These walks take place several times a year and the health and appearance are discussed. One of the main discussion points was on whether the plant had any resistance to Thrip, which the damage was evident on several of the Camellia and Rhododendron. For me seeing Thrip damage highlighted the challenges warm areas of New Zealand have to contend with. In the UK compared to New Zealand there are limited invasive plant species and persistent pests due to our colder climate. In New Zealand I encountered pests that the British gardener would call 'glasshouse pests'.

Infestations of Thrip causes silvering to the leaf and marking on flowers, even though Thrip is unlikely to kill a plant, it will majorly affect the aesthetics of the plant. What makes Thrip difficult to remove is that there are fifteen generations of Thrip in one season and in one generation a Thrip can produce up to 80 young. There are systemic and contact pesticides that can be used to remove thrip, concentrated soaps and biological control however the best solution is prevention. Planting plants that are known to have a resistance to Thrip and keeping them stress free. This method is very much the philosophy of Auckland Botanical Gardens who are looking to promote plants that are suited to the climate and requirements of Auckland.

During my time at Auckland and Wellington, a regular task was weeding and mulching. Being early spring a lot of weed seed had germinated and weeding was the main priority for all the gardeners. When I was weeding I noticed several weeds that's are common weeds in British gardens; Convolvulus, Groundsel and Oxalis. It occurred to me that NZ has to deal with most of the weeds that the UK has to deal plus so many more that us in the UK would consider as ornamentals.

On my second day at Auckland Botanical Gardens I was amongst the Magnolia and Camelia collection digging out *Passiflora caerulea* from under a Magnolia grandiflora. *Passiflora caerulea* an ornamental in the UK has become very invasive in certain parts of NZ, the seed spread effectively by birds and the plant itself climbs and smothers over native bush. At Auckland and Wellington a common weed was Agapanthus which is also highly invasive. Agapanthus in NZ is a prolific seeder, seed germinates in thick pockets growing into a dense mass of long lived Agapanthus. Agapanthus invades a lot of different habitats out competing native bush and causing a major loss of biodiversity within these habitats (Weedbusters, 2017). The worrying thought about Agapanthus in NZ is that it is available for sale in garden centres and nurseries in NZ. *Cenchrus clandestinus* Kikuyu Grass dominated the lawns at Auckland and Wellington, the kikuyu Grass also spreads into the borders requiring to be dug out. Like the Agapanthus it has thick white roots and spreads via rhizomes and stolons creating an ever expanding dense mass out competing every other grass species.

It is estimated that NZ has over 2000 species of weeds that affect agriculture and horticulture. Due to the temperate climate, most of NZ has a hot summers and mild winters which allows weed species to survive and colonise. This is evident in the Auckland area where the city has earned the title the worlds weediest city where there are around 20,000 exotic plant species and over 200 of them are noxious weed species (NZ herald, 2006). It is also estimated that each year about four exotic plant species naturalise and spread into native bush (Auckland Council, 2017). For this reason during my time at Auckland Botanical Garden there was an emphasis on weeding and applying a good thick layer of mulch on borders.

Libertia ixiodes The New Zealand Iris, endemic to New Zealand. Highly used on mass in urban plantings for its contrasting bronze foliage and small white flowers. Easy to maintain as it flourishes in most conditions, also gardeners can spread a layer of mulch over it so weed control can easily be performed making it a good plant for urban areas.

Wellington Botanical Gardens

My second and last placement was at Wellington Botanical Garden from the 3rd October 2016 to the 28th October 2016. However for my last week the gardens arranged for me to spend a week at Otari Native Botanical Garden.

History

Wellington Botanical Gardens was first established in 1868 on the Tinakori Hills just above the centre of Wellington. The Botanical gardens were first established with the purpose to import plant species and assess their economic potential for commercial use in New Zealand. One of the imported plant species still seen today and are quite prominent in the landscape of the garden is *Pinus radiata*, which many were grown from the first seeds imported to New Zealand from California. However as the garden developed other priorities were encompassed into the Botanical gardens ethos; the study of indigenous plants, establishment of exotic plant species and a place of recreation for the public. The Botanical Gardens are made up of three sections; the main gardens, The observatory at the top of the hill and the Rose Garden. I would spend a week in the main gardens and another in the Rose Garden.



Climate

Wellington has a mild temperate climate with a persistent wind coming in from the Cook Strait. Wellington normally gets their highest gusts from October to December with the occasional salt laden wind. The average summer temperatures are slightly lower than Auckland with average temperature of 17-21 degrees. Due to the mixed topography of Tinakori hill and the gardens surrounded by mature Pines, Wellington Botanical Gardens has a sheltered microclimate of its own. This allows the team at the Botanical Gardens to be able to plant a wider range of plant species.

In my first week of work experience at Wellington botanical Garden I was with the main gardens team which was a four person team which looked after; Camellia Valley, Fragrant Garden, Succulent Garden, sound shell lawn, the Duck pond and surrounding gardens. Once again due to it being early-mid Spring there was a fair bit of weeding at different times of the week. However a lot of time was taken up with planting, luckily for me the team had decided to get many plants out of the nursery and into the ground. One of the first things I planted was *Buxus sempervirens* in blocks of five along the side of the main path to the pond. Before we could plant clumps of



Ophiopogon had to be removed. The concept is the blocks of *Buxus* will eventually become pillars along the path.

Other planting carried out was the planting of *Helleborus hybridus* in one of the borders encircling the pond. Also on that day in a border along the stream I planted four *Loropetalum chinense* and gave that border a weed as that along the stream is used quite often for photographs when weddings are held at the gardens. Later on that week the team and I transplanted *pulmonaria* along the stream border by digging up a few plants from each clump of *pulmonaria* and replanting them in vacant areas of the border. This should ensure the *pulmonaria* fills the border and reduce the amount of weeding that is needed in the future.

Camellia Valley

Towards the end of the week with the main gardens team we spent some time in the Camellia Valley pruning the Camellia collection. The last time the Camellia's had been pruned was about five years ago and they had been taken back hard so for a good year or two the Camellia were not a good shape and with few leaves. However they have now become a good shape and are good size but the curator was keen not to carry out the same kind of prune in years to come. So the aim of our prune was to take each shrub in by about a fifth, keeping the shape, cutting back to green growth and trying to hide your cuts. This pruning method will have to be carried out every year or

two years and hopefully this will ensure that the camellia's are kept in check and no major pruning will have to be performed.



Rose garden

For my second week of the placement I was allocated to the Lady Norwood Rose Garden. The Rose Garden team are made up of three gardeners and an apprentice gardener. The Begonia house is also encompassed in the Rose Garden with one full time and one part time members of staff which adds another two members to the team. There are several areas that the six member team have maintain and they are The Lady Norwood Rose Garden, Peace Garden, Herb Garden, Begonia House and Truby King Garden which overlooks the airport on the other side of town from the Botanical Gardens. The Lady Norwood Rose Garden was completed in 1953 and in years following, the Begonia House and peace garden were installed.

One of my first tasks with the team was to start and check the pop up irrigation within the Rose garden. When the irrigation was running we used bamboo canes mark where there were leaks and where the pop ups needed to be lifted. On the whole the main repairs were digging down to the pop ups and lifting them so the spurt of water was not interrupted.

On one of the days I was able to go with the team to Truby King house and garden where they carry out maintenance once a week. The property was home to Sir Truby King who was responsible for child health reform and the founder of the Plunkett Society. The property was bought by Wellington City Council in 1990. While we were there we carried out general maintenance of weeding, using the leaf blower to clear roads and paths of debris. We also planted a row of *Rosmarinus officinalis* along part of the driveway and cleared grass from around the bottom of several *Taxus baccata* in the front lawn.

In the middle of the week I was up in the Herb Garden on top of the hill above the Lady Norwood Rose Garden. The Herb Garden was split into three areas; edible, medicinal and domestic uses but the layout of the garden is being rethought and borders are going restructuring. On the day i was in the Herb Garden we spent the day planting, transplanting and mulching. The first part of the day was spent digging out old tired scented *Pelargoniums* and *Lavendula*. In their place I planted clumps of *Melissa officinalis* and *Origanum vulgare*. In the border opposite we planted a semi circle of *helichrysum italicum* and this will be repeated at certain points along the garden to create repetition. The last job of the day was to dig up a clump of *Salvia elegans* and put them to one side, then I added two barrow loads of garden compost on to the area of soil, dug it in and replanted the *Salvia*. This was carried out because the *Salvia* was looking malnourished and tired so the adding of the compost should help the *Salvia* to perk up.



On my last day with the Rose Garden team we were up in the main gardens removing the spring seasonal bedding of *Myosotis scorpioides* and *Tulipa* sp. All the staff was there including the office staff and the outer grounds team, so it was one big effort. The digging up of the tulips was advertised on the botanical gardens website, Facebook and Twitter, because all the tulips were going to be all given away. On the day the beds were cordoned off to prevent the public getting too close and a few members of the team bagged up the tulips and gave them out to the public. The event allowed me to meet other members of staff I had not met yet and interact with visitors. The event was great for publicity and more visitors came to enjoy the garden as usual.

Otari-Wilton's Native Botanic Garden

My third and final week was spent with the team at Otari-Wilton's Native Botanic Garden. Otari-Wilton's Garden is dedicated to the cultivation and display of NZ native plants. The garden is surrounded by ancient and regenerating native forest, nestled within the hills just five kilometres from the centre of Wellington. The Garden was established in 1926 by Leonard Cockayne, New Zealand's greatest botanist. Leonard Cockayne and his wife were both buried in the gardens (New Zealand History, 2017). The garden comprises of a visitor centre, a rock garden, a main lawn, and the rest of the garden blends into the native forest that surrounds it.



Sadly for me the week before starting at Otari I strained my back so for my week at the garden I did light duties. For the first day and the last day I was able to go to the Te Papa Museum in Wellington with the team to carry out maintenance in the native bush garden within the museum and also the plantings behind the museum along the waterfront. I was given a tour of the garden and through the different plantings within the garden, it's attempts to replicate the different biomes of New Zealand from volcanic plateau, the Canterbury plains and to temperate forest. During my time at the Te Papa Museum the main jobs was to weed the plantings along the waterfront and to carry out some pruning along the side of paths within the garden.

Due to unfavourable weather conditions I was able to help out with propagation in the nursery area. For that morning I took cuttings of *Pimelea actea* which is on the critically endangered species list. *P. actea* is a low growing shrub endemic to coastal areas of New Zealand however at present *P. actea* can only be found growing naturally on one site. We took the cuttings from the material available, stripped the cuttings of most of their leaves and dropped them in a bowl of water. Later we inserted all the cuttings into a seed tray filled with perlite, this was the first time I had used 100% perlite medium for cuttings, whereas before I had always used a 50/50 mix of perlite/compost.



The team started the restoration on one of the hillside paths however due to my back I was only able to help with cutting back the overgrown shrubs and lever out some of the smaller rocks. As the path was on a slope there were steps at points along the path to make the descent easier to walk down. The goal of the restoration was to secure all the edging rocks and add an extra step to make the descent more gradual. I would have liked to have been fully fit and at Gardens for longer as this project would have given me good experience of establishing and maintaining paths within a garden setting.

During my time at Otari I was able to look more closely at New Zealand native plant species and the varied way they have adapted to life on these two islands. Two of the most interesting adaptations are divaricating growth habit and heteroblasty. Divarication is when the plant produces small leaves and tough wire-like stems. Furthermore the stems form as zigzag branching, creating a close tangled mass making it difficult to be eaten by herbivores. Around 10% of New Zealand native plant species have a divaricating growth habit (Dunedin Botanical Garden, 2010). Divarication is not a characteristic of one single family or genera, though it is specific to a species. An example of this at Otari is *Pittosporum tenuifolium* and *Pittosporum obcordatum*, same genus however the two species have adapted differently.



Heteroblasty is when a plant displays a distinct change in growth habit between its juvenile and adult forms. Some of the heteroblastic native plants produce a divaricating growth habit in the juvenile stage but then in its adult form produce typical lush green growth, an example of this is *Sophora microphylla*. The juvenile stage can also produce thin spiny unattractive leaves like *Pseudopanax crassifolius* which then turn into larger rounded leaves in the adult form. Once again heteroblasty is not family specific. In 1911 Cockayne of Otari estimated that there were around 200 native plant species across 37 families that exhibited heteroblastic growth stages (Mukerji and Manoharachary, 2006). An example of heteroblasty at Otari is *Pseudopanax ferox* which displays the same growth habits as *Pseudopanax crassifolius*.



So why has certain New Zealand native plants evolved with divarication and heteroblasty growth habits. In some research one explanation for heteroblasty is an adaptation to environmental conditions such as low light levels and high winds (Burns and Dawson, 2006). This would possibly be an explanation for some forms of heteroblastic plants, like *Hedera helix* which changes leaf shape from climbing growth to non climbing growth when the plant has reached the sun, however this is unlikely for New Zealand native plant species. The more likely explanation for the growth habit adaptations are, to prevent browsing by herbivores. Up until the 1300s the Moa a large flightless bird thrived in New Zealand however within a hundred years of the first humans arriving they became extinct. The Moa plus other smaller plant browsing bird would have been the dominant

animals in New Zealand, so it is likely that endemic plants would have had to adapt to plant browsing birds. The two adaptations of divarication and heteroblasty would protect the plants from against the browsing birds. To further evidence the hypothesis of Moa bird browsing, Bond et al (2004) stated that at least ten heteroblastic tree species displayed their adult growth stage above the height of 3 metres an example of one of these tree species is *Pseudopanax ferox*. Chatham Island 800km off the coast of New Zealand was never inhabited by the Moa bird and many of the plants do not display any heteroblastic growth stages. *Pseudopanax chathamicus* has no heteroblastic growth stages whereas the New Zealand mainland *Pseudopanax* do (Trees for survival, 2017). Adaptation to plant browsing birds has made New Zealand endemic plants iconic.

Plants of interest Otari

Cyathia dealbata is the most common tree fern in New Zealand and is found in native bush and forest. *C. dealbata* is only half hardy, so to recreate the New Zealand native bush in a garden in the UK, a tree fern from the genus *Dicksonia* however tree ferns are slow growing, not ideal for instant impact.



Cleanthus maximus is an endangered New Zealand native shrub, at Otari-Wilton's Native Bush Garden is trained as a wall shrub. Highly endangered in the wild due to no defence against browsing animals such as deer and is also out competed by invasive weeds such as Gorse and Buddleja. It's clusters of striking red flowers would make it an attractive shrub for a glass display house.



Corokia x virgata 'Geenty's Green' spiral hedge at Otari-Wilton's Native Bush Garden. Highly used small hedging plant throughout most of New Zealand and is probably used as much as *Buxus* in small formal hedges in gardens. *C. x virgata* would only be hardy in the south of England, elsewhere it would have to be treated as a specimen and protected in winter.



Pseudowintera colorata 'Red Leopard' and *Pittosporum tenuifolium* balls at Otari-Wilton's native bush garden. Both plants are hardy throughout most of the UK and have colourful evergreen foliage offering all year round interest. These plants I find are underused in the UK and are a good alternative to *Buxus* topiary.



Pollination

During my time at Auckland and Wellington I wanted to look into pollinators of New Zealand and compare the current research to what is perceived in the UK. I was interested in looking into pollinating insects while I was in New Zealand because of a report by the Royal Horticultural Society RHS.

In summary the report stated that insect pollinators had no preference for either native or exotic plant species and it was best to plant a good mix of both in gardens, as this increases and extends the amount of pollen sources over the course of the season. With this in mind I was interested in whether it was the same line of thought in New Zealand, especially with the current culture of planting New Zealand plant species. I had intended to identify pollinators within the gardens however I had underestimated the time and resources this required, so instead I focused on what current research in New Zealand is saying about the status between pollinators and plants.

So why are pollinating insects important? From an agricultural point of view they are very important as, three quarters of the global commercial crop species require pollination by insects (Litchwark, 2013). The main worldwide pollinating insect is the western Honeybee *Apis mellifera*, which is native to Europe, Western Asia and Africa. This honeybee has been introduced by humans to other continents since the 1600s (Hammond and Blankenship, 2009). The honeybee is the main worldwide pollinator because of its pollinating efficiency, easy to transport and the ability to produce honey. The production of honey is especially important for New Zealand as Manuka Honey is mainly produced in New Zealand, sold for high prices and shipped all over the world. Like most of the world the honeybee is the main pollinating insect in New Zealand, having first been introduced for honey production by European settlers in 1839 (New Zealand History, 2017). New Zealand's agriculture and commercial horticulture like the rest of the world has become reliant on introduced honeybee colonies.

However the honeybee is in a worldwide decline, with the United States of America recording a 59% honeybee colony loss between 1947-2005 (Potts et al, 2010). The reasons for this decline are; use of pesticide in agriculture and horticulture, agricultural crop monoculture and pathogens. The combination of these factors are believed to be cause of the decline in global honeybee populations. Neonicotinoids a type of pesticide used on mass in agriculture has been found to; disorientate honeybees, disrupt colony communication and honeybees brood cycle. In turn these effects cause lower immunity and shortened lifespans (PAN, 2012). Crop monoculture greatly decreases pollen diversity, also for a certain time in the season there will be an abundance of pollen however for the rest of the year the colonies struggle to find other sources of pollen. Furthermore the lack of pollen diversity leads to a lower immunity to pathogens. Honeybee larvae are preyed on by a parasitic mite *Varroa destructor* which is a vector for the spread of viruses, *Varroa destructor* alone can cause colony collapse. The combination of these factors are causing the decline of worldwide honeybee populations (Litchwark, 2013).

In New Zealand managed honeybee populations have increased over the past decade however feral honeybee populations are at a all time low, the parasite *Varroa destructor* being the suspected cause of this loss (Peters, 2012). Though a decline in honeybees for agriculturalists is of great concern, conservationists are more concerned about the impact the introduced managed honeybee has on native pollinating insects and the natural landscape.

If history is anything to go by, when an exotic species is introduced to a place that is outside of its native range, the exotic species will have an effect on native species. The concerns about the introduced honeybee colonies is competition will naturally incur between them and native pollinating insects. Possible consequences are; competition for pollen and nest sites, spread of pathogens, inefficient pollination of native plant species and facilitation of exotic weed dispersal (Goulson, 2003). A research study in the Tongariro National Park investigating the effect honeybee colonies have on native pollinating insects. The study observed that when the abundance of honeybees increased, the abundance and diversity of other pollinators decreased. The study

highlights that introduced honeybees can be detrimental to local diversity and there are possible implications for pollination of native plant species (Murphy and Robertson, 2000).

Honeybee populations have also shown to impede specific relationships between endogenous flora and pollinator where certain plant species require a specific pollinating insect to achieve successful pollination. Inefficient pollination by introduced honeybees can result in decreased genetic diversity and possible endangerment of native flora (Beard, 2015). Honeybees are also associated with the favouring of exotic plant species when seeking a pollen source. The argument for this is many of the exotic plant species found in New Zealand are from the same geographical location as the honeybee. An example of this relationship is honeybees have been found to increase the seed set of *Cytisus scoparius* an European shrub that is a very invasive weed in New Zealand. This mutualism between honeybees and exotic plant species has also been detected in pollination patterns with *Ulex europaeus* Gorse and *Berberis darwinii* Darwins Barberry (Paynter et al, 2010). These findings show honeybees detrimental influence on the native fauna and flora of New Zealand.

With this in mind what are New Zealand gardens doing to improve indigenous pollinator numbers and what can they do. Auckland and Wellington botanical gardens have both majorly reduced their use of pesticides. The gardens team of Auckland botanical garden only use glyphosate for the hard surfaces within the garden. Even the several Rose gardens are free of pesticide use, with team concentrating on plant health and planting high disease resistance roses. Both gardens also plant natives with their exotic plant collections. Wellington has incorporated native tree species with the canopy of *Pinus radiata*, whereas Auckland incorporates natives in most plantings an example is the magnolia and *Rhododendron* collections, a lot of native ground covers as been used along with a good mix of native and exotic trees. The good mix of native and exotic plants that both gardens have planted have varied flowering times offering pollen sources all year round.

So what else could gardens in New Zealand do to improve indigenous pollinating insect numbers. Identify what indigenous pollinators are within the gardens and the surrounding area. With this information find out what plants are favoured by the pollinators and plant accordingly. In the UK beekeeping is promoted by organisations to help improve pollinator numbers and is now being associated with gardens. It is important that New Zealand gardens does not follow the UK's philosophy of beekeeping with gardens as this would be detrimental to indigenous pollinating insects.

Conclusion

Thanks to Merlin Trust funding I was able to complete two voluntary work placements at Auckland and Wellington Botanical Gardens. I was able to carry out a number of various tasks and experience how tasks around the garden are carried out in New Zealand. The experience from these two gardens has enabled me to gain contacts within the industry and I was able to obtain a job once my voluntary placements had finished. As part of the placement I researched the status of pollinating insects in New Zealand. From the research I carried out I have learned about the influences the introduced honeybee is having on native fauna and flora. The research indicates that the introduced honeybees are having a detrimental effect on indigenous biodiversity and populations of fauna and flora. With this in mind it will be important for the main gardens in New Zealand to observe these pollinating insects in the future. Working in the Botanical Gardens has broadened my knowledge of New Zealand native plants and I look forward to working with them in my future horticultural career.

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