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Investigating Urban Environments as Habitat for Pollinators, in Budapest, Hungary

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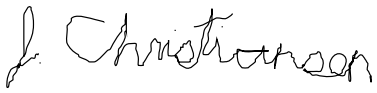

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ABSTRACT OF THESIS submitted by:
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Bee populations are declining worldwide. As key indicator species across trophic levels, there is great concern for food security, loss of species diversity and extinction of many plants and animals. This paper will focus on the plight of wild bees, and how the situation can be ameliorated, with a focus on urban environments, using Budapest, Hungary as a case study location. It is globally recognized that bees serve essential ecological services through pollination. Pollination serves to produce higher crop yields, while increasing and maintaining genetic and species diversity, and abundance of flora. The European Commission has been working over the past 13 years to further understanding the plight of European bees. And the EC has been making efforts to guide European Union Member States in stopping the decline of bees. This study will explore policies and initiatives taken on by the European Commission, by Member states and finally by NGOs and individuals. An exploratory experiment was conducted to explore the value in restoring urban habitat for pollinators, as it is a recommended action for helping bee populations. Theoretically, urban bee populations have better chances of survival, as they are not exposed to agrochemicals.

Keywords: wild bees, urban bee habitat, pollinator, policy, biodiversity, bees

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1.0 Introduction

Globally, the Hymenoptera order has seen declines in population diversity and abundance. These losses are attributable to loss of suitable habitat, agricultural chemicals (insecticides, herbicides, and fertilizers), land disruption and fragmentation, urbanization, loss of forgeable flora, and viruses and illnesses. This paper will focus on the plight of wild bees, and how the situation can be ameliorated, with a focus on Budapest, Hungary, in Central Europe. Bees are viewed as key indicator species across trophic levels. Their role as top pollinators impacts a wide range of plants and animals. It is globally recognized that bees serve essential ecological services through pollination. Pollination serves to produce higher crop yields, while increasing and maintaining genetic and species diversity and abundance of flora. Each bee species has adapted with certain species and shapes of flowers, to best address reproduction and dietary requirements of plants and bees respectively. For instance, tubular shaped flowers tend to attract long-tongued bees, whereas other flowers such as fox gloves require that bees enter the flower, bumblebees are considered among the best pollinators, especially for agricultural crops, as their large furry bodies collect and hold pollen. As the bumblebees forage, they continue share the pollen with other flowers.

This study focuses on urban bee populations, and will explore which bee populations are most important in urban environments; managed honeybees or wild bees? Although honeybees are economically valuable by their abilities to produce honey and other apiary products, wild bees are linked to greater plant diversity and higher crop yields. All bees continue to provide essential ecological services, to humans, as pollinators. This study is investigating whether the declines in bee populations have impacted Hungary, and whether wild bees are in decline. Finally can bee populations be brought back through urban habitat restoration?

To amend the situation of declining bee populations, this paper will look at various political levels to where action is taking place. Public policies, to protect pollinators must be adopted and enforceable. The European Commission has actively taken measures over the past 13 years, to learn more about the plight of bee. Several EU Member states have also taken action, while Wales has adopted a countrywide pollinator action plan.

Apart from policy this paper also investigates projects and initiatives that are have been put into action, by individuals at the grassroots level. An urban bee monitoring study was carried out in the city of Budapest, to determine the value in restoring urban habitat for pollinators, as is it a recommended action for helping bee populations. Theoretically, urban bee populations have better chances of survival, as they are not exposed to agrochemicals. This investigation was performed with an experimental case study on what individuals can do in urban environments,

such as Budapest to create and maintain suitable habitats for unmanaged native bee species. The intended outcome of this experiment is to create a simple and replicable model by the average individual. This model is designed to encourage the growth of urban bee populations to thrive and forage, and to reduce natural fragmentation from urbanization.

2.1 Bees

Over the past decade, scientific studies have demonstrated global declines in bee populations (Godfray et al. 2014; Memmott et al. 2010; Biesmeijer et al. 2006). This is of great concern for all, as bees are considered keystone species. They are directly linked to flora species diversity and they are globally recognized for providing essential ecological services for people (Dias et al. 1999). Globally there are approximately 19,500 species of bees (Byrne and Fitzpatrick 2009), 2,500 of which live in Europe (European Commission 2008). Declines in bee populations have been linked to the use of agrochemicals, the lack of suitable habitat, fragmentation, pollution, deforestation, urbanization, disease and parasites (Kosior et al. 2007).

2.1.1 The important role of hymenoptera

All bees belong to the Hymenoptera Order (Byrne and Fitzpatrick 2009). "Bees are recognized as highly valuable pollinators, who are essentially responsible for the survival and maintenance of plant species, and for ensuring production value in crops" (Kosior et al. 2007). Pollinators and their landscape are highly interrelated, as Hymenoptera share a special symbiotic relationship with plants, which makes them ecologically invaluable and ultimately a keystone species (Woodcock 2012; Byrne and Fitzpatrick 2009; Biesmeijer et al. 2006; Paoletti 1999; Kevan 1999). This relationship between Hymenoptera and plants is described here, by Woodcock (2012) in simple terms: while hymenoptera feed gathering pollen and nectar from plants, they collect pollen on their bodies and either with or without intention transfer genetic material from the anther of the male flower, to the female stigma of another flower. It is estimated that as much as 90% of higher plant species depend on pollination from animals for fruitful reproduction (Memmott et al. 2010). For the plant to produce viable seed-bearing fruit, enough pollen must be delivered through multiple pollinator visits to fertilize the ovules (Woodcock 2012). It is important to note that there are many other animals that pollinate plants; i.e. butterflies, hoverflies, true flies, moths, wasps, some bird and bats. However, Hymenoptera are considered the world's most important pollinators (Greenpeace 2013; Campbell 2010; Byrne and Fitzpatrick 2009). For

Figure 2.1.1 Black currants (*R. rubrum*) require spring bee cross-pollination, for summer fruits (Woodcock 2012)

instance, Canadian apiarist Brian Campbell (2010) stresses this point through the example of a water melon. Each water melon flower must receive at least seventy bee visits to produce a nice round fruit. With less than seventy bee visits, the fruit will lack its characteristic round uniform shape. With fewer than forty visits from pollinators, the plant will abort the flower and no fruit will be born. This is a small example of how important pollinators are in food production, and more importantly their relationship to plant reproduction and survival. Due to the close relationship between bees and plants, bees are also used as bioindicators. If one critical species perishes in an environment, so will the other species with which they share this symbiotic relationship (EU Commission 2014).

Table 2.1.1 **Global Estimate of the Economic Value of Pollination (Greenpeace 2013)**

Euros	**Authors of Value**
88 billion	Costanza et al. 1997
115 billion	Gallai et al 2009
265 billion	Lautenback et al 2012

Globally bees are economically important. One-third of all crops grown require pollination by bees, for fruit and seed production (Dias et al. 1999). On an individual level, one out of every three teaspoons of food consumed, by people, has been made possible through bee pollination. It is estimated that bees contribute 265 billion euros per year to the global agricultural market sector through pollination (Lautenback et al. 2012). As seen from table 2.1.1, these calculated values continue to increase annually, as the global need for food increases (Greenpeace 2010). Some crops require the help of animal pollinators to produce fruit (i.e. Blueberries and almond), while others are enhanced by animal pollination (i.e. strawberries and tomatoes) (Greenpeace 2013). They are enhanced genetically, in production yields and in quality (Greenpeace 2013). Out of the European Union's 294 agricultural crops, approximately 80% require the aid of animal pollinators (Chauzat et al. 2013). The relationship between bees and crop yields is further demonstrated, as crop fruit and seed yields are significantly reduced in areas where bee populations and numbers are declining (Byrne and Fitzpatrick 2009). This in turn can lead to further population declines for both hymenoptera and flora populations (Greenpeace 2013).

2.1.2 The plight of bees

Globally the Hymenoptera order has seen declines in population diversity and abundance (Godfray et al. 2014; Memmott et al. 2010; Sároskpataki et al. 2005). In 1998, global delegates, pollinator scientists and specialists gathered in Buenos Aires, Argentina, at the third Conference of the Parties (COP3), to discuss "Conservation and Sustainable Use of Agricultural Biological Diversity". Here pollinators were identified as a global priority, because of the concerning global trend of decline in species diversity and in number (Dias 1999). Since 1998, there have been a number of studies performed around the world that look into the pattern of declining pollinators

(Greenpeace 2013). The declining trend of bees was also seen in Hungary (Sároskpataki et al. 2005). In 2005, Sároskpataki et al. published a study that assessed the status of bumble bee species (*Bombus*), and found that the overall trend was one of population decline, and several cases of species extinction. The results of this study were further supported by similar trends for the same bumblebee species in other European countries (Sároskpataki et al. 2005).

This trends in bee species and population decline has been attributed to many causes:
from the most recent phenomenon of Colony Collapse Disorder (CCD) and climate change, to an overall loss of suitable habitat from land disruption and fragmentation, urbanization, deforestation, loss of forgeable flora, parasites, illnesses, fungi and the use of agricultural chemicals (insecticides, herbicides, fertilizers) (Greenpeace 2013; Godfray et al. 2014). Natural meadow ecosystems have decreased in size throughout Europe. Urbanization continues to expand as agricultural practices become industrial and favour the production of monocultures (Potts et al. 2005). These monocultures require the use of agrochemicals (chemical pesticides, herbicides and fertilizers) in order to maintain their productivity yields. However, agrochemicals do not discriminate, and their presence in soil, in groundwater, as well as on plants is playing a critical role in the decline of bee populations (Greenpeace 2013).

Figure 2.1.2a Mason Bee Home

Figure 2.1.2b Bee in crevasse in bare soil

Habitat destruction is seen as an issue of concern, for declining bee populations (Kevan 1999). The quality of bee habitats are based on environmental factors that is directly related to both foraging and nesting requirements (Potts et al. 2005). When either set of these requirements are made scarce or are no longer available, bee populations are stressed, causing them to decline, thus these habitats are no longer suitable for bees (Jha and Kremen 2013; Kevan 1999). An example of an environment that is no longer suitable is seen in mono-culture farming practices (Greenpeace 2013; Kevan 1999). As fields increase in size, space for unmanaged fallow edges and hedgerows decline (Greenpeace 2013; Kevan 1999). When fallow fields are put into production, there are fewer wild flowers, thus less foraging space for pollinators. Urbanization is another well known cause of habitat destruction, and thus further contributes to loss in native

biodiversity (Burkman and Gardiner 2014). However, habitat destruction does not impact all bee species to the same degree. **Kevan (1999)** breaks down the following three factors of bee habitat destruction:

a) The destruction of food sources
b) The destruction of nesting or oviposition sites
c) The destruction of resting or meeting sites

These factors tend to impact wild bees more than honeybees (Kevan 1999). When land becomes unsuitable for managed bees (primarily *Apis mellifera*) apiarists can physically move the bee hives to locations where more food is available. However, wild bees are much more susceptible to habitat destruction and exposure to agro-chemicals (Bohard 1972). Where, 80% of native bees dwell in solitary nests in the soil (Campbell 2010). In efforts to help bee populations, attention has been given to restoring and recreating foraging sites for bees (Potts et al. 2005). However, bee populations also require nesting and resting sites as well, in order to thrive (Kevan 1999). It is important to note that the availability of nesting resources influences "… 10% of bee community organization" (Potts et al. 2005). Another significant factor in bee nesting resources is that different bee species thrive in many different environments; for instance mason bees will construct their homes out of clay in tubular shaped woody debris, rock crevices or snail shells (Campbell 2010; Potts et al. 2005). Carpenter bees will carve out their own homes in rotting wood, while social nesters (*Bombus, Apis mellifera*) will nest within the vacated nest of other animals (Potts et al. 2005). Many gardeners are now building bug homes to increase nesting habitat for bees and other important insects in urban environments (as shown in figure 2.1.2). It is however, just as important to leave spaces of well-drained undisturbed bare soil (Jha and Kremen 2013; Bohart 1972).

Figure 2.1.2.c Apis mellifera drinking water and resting

It is imperative for bees to also have places in which to rest and to drink water (Figure 2.1.2.c) (Campbell 2010). These places must be sheltered from strong winds and relatively safe from predators (Campbell 2010). There is now great concern as to how global climate change will impact native bee habitat, and how climate change can also hinder attempts at bee habitat restoration (Cameron et al. 2011; Memmott et al 2010; Kremen et al. 2007). As climate change alters seasonality, the emergence of different flower species changes (Kremen et al. 2007; Cameron et al. 2011). The natural adapted timing sequence between native bees and the plant species are no longer synchronized, making both species vulnerable to unsuccessful reproduction (Kremen et al. 2007; Cameron et al. 2011).

2.1.2.1 Colony Collapse Disorder

Since 2003, there have been documented cases of bee colonies disappearing from their hives (EFSA 2008). Colony Collapse Disorder (CCD) is a term that was coined in North America for the unusual new phenomenon of entire *Apis mellifera* colonies disappearing, since 2006 (Greenpeace 2013; vanEngelsdorp et al. 2009; EFSA 2008). Historically, in other cases of colony illnesses, many dead bees would have been found (vanEngelsdorp et al. 2009). In cases of CCD, by the end of a winter season, apiarists would find their bee hives virtually empty (Greenpeace 2013; vanEngelsdorp et al. 2009). The entire honeybee colonies had disappeared (EFSA 2008). They left their hives with few dead bees found (vanEngelsdorp et al. 2009). In the United States, CCD has been directly related as the cause for a significant loss of 30-40% of all commercial honeybee colonies (Greenpeace 2010; Suryanarayanan and Kleinman 2012). Similar mysterious disappearances of entire *Apis* colonies have occurred throughout China, Egypt, and Europe (Greenpeace 2010). Winter losses of *Apis* colonies throughout Europe have been estimated at 20% each year, and it is estimated that as 2010, central Europe has lost 25% of their *Apis* colonies, since 1985 (Greenpeace 2010). Initially a wide variety of factors were suspected for causing CCD; fungi, viruses, parasites, GMOs, reduced species diversity, to varroamites and viruses (vanEngelsdorp 2009). Through recent studies, the one factor in most cases of CCD has been the sub-lethal exposure to at least one of several kinds of pesticides that are commonly used in agriculture; neonicotinoids, imidacloprid or clothianidin (Mack 2014; Greenpeace 2013). These agrochemicals appear to have longer term impacts. Studies have demonstrated that the honeybees continued to appear healthy and feed as usual throughout the summer and fall; however by the end of winter, the colonies exposed to agrochemicals seemed to have disappeared. As described in an interview by apiarist Marta Borzsei, pesticides essentially weaken the bees, making them more susceptible to illness (Greenpeace 2013). The future generations of affected bees are also born weaker and more susceptible to disease (Greenpeace 2013; Campbell 2010). While out foraging, the bees become confused and disoriented and cannot navigate back to their hive (Greenpeace 2013). The *Apis mellifera* then die, before returning to their hives (Greenpeace 2013).

2.1.3 Bees ecological services

In 1999, pollination was officially recognized as an ecological service, as written in the *São Paulo Declaration on Pollinators* report that was the outcome of COP3 (Dias et al. 1999). For the purpose of this study, Garibaldi et al. (2013)'s definition of ecosystem services will be used, where *ecosystem services* are described as: the dependency of humans on many natural processes, not usually accounted for in market valuations. The ecological interactions between plants and pollinators result in favourable outcomes for plant species diversity and abundance, upon which many other

animals and organisms are dependent (Memmott et al. 2010). Needless to say, humans exploit ecosystems, by manipulating and managing ecosystem service providers, in order to achieve agricultural production goals (Swift et al. 2004).

2.2 Wild Bees vs. Managed bees

This section discusses wild bees vs. managed bees. Often in dialogue, in news articles and even within legislation, bees are often all classed together. However, with 19,500 species there are notable differences between the species and the role each one plays in pollination. For the purpose of this study the author will consider two classes of bees, "Managed" honeybees and all other bees are considered "Wild" bees.

2.2.1 Managed bees, economic, ecological importance

Honey bees (*Apis mellifera*), also known as the European Honey bee, are the most well-known bee species, popularized by their ability to make honey, beeswax, royal jelly and pollen (EFSA 2014). Honey beekeepers, apiarists, throughout North America and Europe prefer to work with *Apis mellifera*, because of their relatively docile personalities and the high yields of honey which they produce (Campbell 2010) (Figure 2.2.1). European and North American agricultural systems have become highly dependent on *Apis mellifera* for agricultural fruit and seed crops. Within the EU there are approximately 700,000 apiarists, who produce an estimated 200 000 tons of honey per year (European Union 2010). As of 2008, Hungary was the third highest honey producing country in the European Union (EFSA 2008). "Apiary makes up 1% of Hungary's gross agricultural production value, and nearly 3% of the animal husbandry." (Péntek-Zakar 2014)

Apis mellifera inside an active hive

Figure 2.2.1 Hungarian apiarist checking on his hives

Apis mellifera are generalist feeders, as they live year round, and do not hibernate, they have adapted to leaving their hive when temperatures are favourable (above 12 C) (Borzsei A and Borzsei M 2014; Westerkamp 1991). Honey bees are known to prefer foraging on large patches of dense flowers (Steffan-Dewenter and Tscharntke 2000), and they will fly distances to find such patches for foraging. As generalists, *Apis mellifera* do not

inherently know how to forage for pollen and nectar, they invest both time and energy in learning how to forage efficiently (Campbell 2010, Westerkamp 1991). In order to save time and energy, honeybees will continue to harvest the same known flower types until they are no longer available, then they will learn how to forage from new densely populated flower patches (Campbell 2010).

Figure 2.2.2.b Important agricultural crops enhanced by bee pollination esp. *Bombus*

Westerkamp (1991) argues how *Apis mellifera* are poor pollinators, because flowers have adapted to bees foraging in a certain manner. For instance alfalfa, *Medicago sativa*, has a sexual column, that when triggered by foragers will mechanically hit the forager with sticky pollen (Westerkamp 1991). This sticky pollen is cumbersome for the bees, thus honeybees learn to avoid being hit by the sexual column by feeding from the side of flower (Westerkamp 1991). Thus a much lower percentage of alfalfa will be pollinated by heavy foraging *Apis mellifera*, only those flowers that happen to be foraged by honeybees who are novices in extracting pollen and nectar from alfalfa (Westerkamp 1991).

There is concern that the practice of beekeeping, and moving colonies of managed *Apis mellifera* into new foraging environments can displace and create additional competitive stresses upon native bees (Steffan-Dewenter and Tsacharntke 2000). However, scientific studies, such as those by Steffan-Dewenter and Tsacharntke (2000), demonstrate that although there is approximately 30% overlap in foraging resources between *Apis mellifera* and wild bees, there does not appear to be significant stress to wild bee populations in Europe.

2.2.2 Wild Bees; economic, ecological importance

Native bees, also known as wild bees, are unmanaged bee populations. They are excellent pollinators, some species like *Bombus* (bumblebees) live in colonies, however most native bee species are solitary bees and live alone (Vaughan et al. 2011). For the purpose of this study, the author is taking Bohart(1972)'s definition of native bees, where all bees within the superfamily *Apoide* are considered wild, excluding the genus *Apis* (honeybees). Most native bee species live in undisturbed soil or in old underground nests from rodents or other ground dwelling creatures (Jha and Kremen 2013). Native bee populations are often overlooked in importance both ecologically and economically, as they are not managed nearly as closely as

Figure 2.2.2a Bumblebee in gullet-shaped *Digitalis purpurea*

honeybees. Nevertheless, native bees (aka wild bees) are extremely important pollinators both ecologically and economically (IUCN 2014). According to a study by Xerces Society, bee per bee, native bees are much more efficient and effective pollinators than honeybees (Vaughan et al. 2011). For instance, "only 250 female blue orchard mason bees (*Osmia*) are required to pollinate a one-acre apple orchard, whereas to accomplish this job as effectively, 15,000 to 20,000 foraging honeybees would be required (1.5 to 2 hives) (Vaughan et al. 2011). In a study by Jha and Kremen (2013), native bees are correlated to wider plant species diversity in wild meadow grasslands in Central Europe when compared with European honey bee populations. As with all ecological diverse animals, bees and flowers have adapted to one another, by when and how pollen and nectar are supplied, by how both flowers and bees are shaped and by how they behave (Brian 1957). For instance, the large hairy body of a bumble bee is very effective at collecting pollen from gullet or bell-shaped flowers, which have adapted to bumble-bees (Figure 2.2.2) (Westerkamp 1991). When it comes to feeding, bumblebees have adapted as flower generalists, as their colonies live throughout many months (Westerkamp 1991), requiring food from when they emerge in February through September; when the queens again prepare for winter hibernation (Memmott et al. 2010). While they are out foraging, there are constantly feeding, going to from flower to flower (Westerkamp 1991).

The bumblebee (*Bombus*) is considered one of the most effective wild pollinators (Jha and Kremen 2013). This statement is in agreement with the IUCN (2014)'s study on European bumblebee populations, where it was found that: out of Europe's five pollinator species of highest agricultural importance for fruiting crops, three of them are species of *Bombus*. Bumblebees greatly improve crop yields and production for foods such as fruiting plants in the nightshade family (tomatoes, peppers, eggplant etc) and many other fruiting and seed producing crops (IUCN 2014). While *Bombus* colonies feed on agricultural crops, they are still flower generalists and tend to prefer species diversity and richness over flowering flora quantity (Jha and Kremen 2013). *Bombus* have been documented flying up to 2.5 km in search of suitable foraging habitat (Jha and Kremen 2013). There are currently 68 species of *Bombus* in Europe, 46% of these *Bombus* populations are found to be declining (IUCN 2014; Memmott et al. 2010). Flying these greater distances requires more resources in terms of caloric energy, and can expose bumblebees to more threats beyond their protected home areas; ie. Chemical insecticide and herbicide sprays, and air and water contaminants (Greenpeace 2013).

2.3 Regulations for pollinators

Due to the increasing awareness of bee populations in decline, the importance of conserving bees is increasing (Sárospataki et al. 2005). Many different bodies from NGO grassroots initiatives to overarching government bodies, such as the European Commission, are making efforts to conserve, protect and strengthen bee populations. Much attention has been given to bees in rural environments, because of the critical role that bees play in agriculture. There have also been recent initiatives to improve and restore bee habitat in urban environments. However, a lot of attention is still centered on *Apis mellifer*a, and wild bee species continue to be overlooked.

2.3.1 Policies, regulations and programs for pollinators within the EU

The European Commission (EC) recognizes that bee populations are endangered and has made a list of goals and recommendations for member states to help struggling European bee populations. The EC has also taken numerous steps of political action towards ameliorating the circumstances for European bees. While the EC's LIFE program has funded several programs within Member states, that help to educate and restore pollinator habitat. Some member states have taken on initiatives with the goal of helping bee populations in their respective countries. For instance the UK has developed an Environmental Stewardship Scheme that provides monetary support for environmentally friendly farming practices and habitat restauration for bumblebees, in agriculturally intensive areas. The small country of Wales has been pro-active in adopted a country-wide "Pollinator Action Plan", for with specific goals for urban, rural and agricultural environments.

2.3.1.1 EC policies, regulations and programs for Managed Bees

Over the past 11 years, most European Commission policies, regulation and programs are designated for "bees", however the focus is predominantly on *Apis mellifera*. This is clearly demonstrated through the EC's webpage on "Bee Health" (2014b), where references are made to honey, apiculture products, hives etc. This focus is understandable as honeybees annually contribute billions of Euros into the European Economy, through crop pollination of economically important crops, and through the production of honey and other specialized apiary products (EFSA 2014).

Within the European Union, bees are categorized as livestock, and are dealt with accordingly. Thus for international trade, shipment and transportation, only certifiably healthy and well documented specimens are permitted (Council Directive 92/65/EC, Commission Regulation (EC) No 206/2010). The following actions were taken by the European Commission during the past 11 years, to help improve the conditions in Europe for struggling honeybee populations:

- As of **2003**, apiarists must report all incidences of colony infestations, to the governing apiary bodies of their member state. This regulation was made in order to help prevent the spread of two particular pests (the small hive beetle and tropilaelaps mite), so that the EU is made aware, and can monitor the situation (Commission regulation (EC) No 1398/2003).
- In **2008**, at the request of the EC, responding to the concern of member states regarding CCD, the European Food Safety Agency (EFSA) launched an inquiry into colony collapse disorder, weakening and dying of *Apis mellifera* populations. The outcome of this inquiry was the "Bee Mortality and Bee Surveillance in Europe".

- **2008**. The outcome of the ***"Bee mortality and bee surveillance in Europe"*** was that CCD is being caused by multiple factors, and that member states must continue to compile and report their data on the loss of bee colonies, so that CCD can continue to be studied and the situation monitored.

- In **2008**, ALARM (Assessing Large scale Risks for biodiversity with tested Methods) performed an "assessment on the magnitude of honeybee declines nationally and continentally across Europe" (EC 2014b).
- In April **2011**, The ***"EU reference laboratory for bee health"*** in Sophia Antipolis, France, was established. This EU funded laboratory has created guidelines and a template for bee surveillance studies. It provides guidance for other bee surveillance studies within Europe.
- In late **2011**, the European Commission adopted a financing decision, to financially support European bee surveillance studies. The surveillance studies took place in 2012-2013, in 17 member states.
- As of May **2012**, as promised in 2011, the EC "allocated 3.3 million Euro to support 17 member states to conduct research to survey honeybee populations in their respective Member states" (EFSA 2014). The goal of this research was to gather more information on the losses of European honeybee colonies (EFSA 2014).
- In **2013**, the EU Commission put a 2-year ban on three neonicotinoid pesticides, which pose an 'unacceptable risk' to *Apis mellifera.* (clothianidin, imidacloprid, thiametoxan) (Regulation (EU) No 485/2013). This ban has been effective as of December 1st 2013. This action restricts the use of these pesticides for seed, soil and foliar application on plants and cereals that are attractive to honeybees (EC 2014b).

Although, the European Commission has been pro-active in legislating measures to help protect *Apis mellifera*. There is concern in Hungary, that the lack of attention paid to native bees, will be detrimental to agricultural production (Tömöri and Simon 2014). For instance, the three banned pesticides can still be used by professionals on crops that do not attract honeybees (i.e. Potatoes, tomatoes, aubergine etc.), on all crops in greenhouses, and in open-air fields after flowering (EC 2014a; Godfray et al. 2014). There is concern that this ban may protect honeybees and will do little to help struggling populations of wild bee species (Tömöri and Simon 2014).

2.3.1.2 EC initiatives and programs for Wild Bees

Although the European Commission has invested many resources into studying and protecting honeybees, there is currently EC funding available, allocated for member states to conduct research into the use and impacts of these three neonicotinoids. Once more information is collected within the next two years; the EC will review the appropriate conditions of use of these pesticides (EC 2014a). The EC has also encouraged further Member states studies on wild bees and pollinators, through the support of the European Commission's LIFE[1] program. Over the past seven years, the European Commission's LIFE program has provided financial support for four projects related to pollinator protection and habitat restoration in Europe. These four projects are briefly summarized in table 2.3.1.2.

[1] "LIFE is a branch of the European Union that provides financial support for projects pertaining to the natural environment, nature conservation and climate action, within the European union. Accessed July 22. URL: ec.europa.eu/environment/life/index.htm

Table 2.3.1.2 European Commission LIFE supported programs for Pollinators			
Project Title	**Coordinated by**	**Country**	**Timescale/Budget**
Papillons- Reconstituting a habitat network for threatened butterflies (Euphydryas aurinia, Lycaena helle, Lycaena dispar) in the Walloon region	Natagora	Belgium	01/01/2009 to 31/12/2014 **Total Budget** 7,120,000 € **EU contribution** 3,560,000 €
Goals and Objectives: To re-establish habitat for three butterfly species that have been designated as priority species; by reducing population isolation, restoring natural habitat, creating a long term sustainable management plan, and educating the greater public. (EULIFE 2007).			
Project Title	**Coordinated by**	**Country**	**Timescale/Budget**
URBANBEES- Urban bee biodiversity action plans	Institut National de la Recherche Agronomique	France	01/01/2010 to 31/12/2014 **Total Budget** 2,171,842 € **EU contribution** 1,084,196 €
Goals and Objectives: This five year demonstration project (2010-2014), has the goal of "promot[ing] actions that will conserve and enhance the biodiversity of wild bees in urban habitats across Europe" (European Commission 2008) Bee "nesting devices" (i.e. mason bee house in figure 2.1.2.a) for native bees were built throughout 8000m2. Throughout this area, efforts were made to create a "network of ecological corridors". The aims of this project were: to increase urban wild bee habitat and reduce genetic isolation, while educating approximately 200 000 people to be aware of the importance of wild bees and what actions can be taken to help them. The overall project is intended to act as a model replicable throughout other European urban environments.			
Project Title	**Coordinated by**	**Country**	**Timescale/Budget**
Plant-Pollinator integrated conservation approach: a demonstrative proposal	Alma Mater Studiorum Università di Bologna	Italy	01/01/2011 to 30/06/2015 **Total Budget** 603,007 € **EU contribution** 300,966 €
Goals and Objectives: Protect the species *Dictamnus albus*, and restore the habitat for an isolated population within a regional park in the Bologna province; through timber management and shrub clearing to create nesting habitat, by adding more members of *Dictamnus albus* to the region, and by planting and maintaining nectariferous plant species on which these bees feed (EULIFE 2009a).			
Project Title	**Coordinated by**	**Country**	**Timescale/Budget**
Butterflies CZ-SK – Integrated protected of rare butterfly species of non-forest habitats in the Czech Republic and Slovakia	Agency for Nature Conservation and Landscape Protection of the Czech Republic	Czech Republic	01/01/2011 to 31/12/2015 **Total Budget** 7,122,816 € **EU contribution** 3,561,480 €
Goals and Objectives: To explore and practice patch-work management in restoring critical butterfly habitat between fragmented areas; through the introduction of new eco-agricultural practices that will lead to the incorporation of critical agricultural lands into protected areas, re-introduction of traditional management of non-forest habitats, education and awareness for the general population (EULIFE 2009b).			

2.3.1.3 EU Member policies, regulations and initiatives for bees

The European Commission has not been the only governing body to act on their concern for the plight of bees. Some Member states have instigated their own initiatives to help dwindling pollinator populations.

The UK has established "*Environmental Stewardship Scheme"* that provides monetary support for environmentally friendly farming practices and habitat restauration for bumblebees, in agricultural areas that are intensively active. As noted above, bumblebees are recognized in Europe as highly effective pollinators of agricultural importance (IUCN 2014; Memmott et al 2010). The schemes offer the farm or wildlife advisor "a series of management options", each option is allocation a certain number of points (Memmott et al 2010). The farm is assigned a goal number of points to be achieved. The number of points assigned depends on the farm's size and location (Memmott et al 2010). The farm or wildlife advisor then chooses from the series of management options, until the assigned number of points is met. Once the management options have been proven to be completed, the farm or wildlife advisor is eligible for an annual subsidy Memmott et al 2010). These management options concentrate on recreating natural space for foraging in agricultural areas; concentrating on field margins, hedgerows and fallow species-rich hay meadows (Memmott et al 2010).

Wales has recognized the gravity of the struggling pollinator populations in the UK (Biesmeijer et al 2006). In 2013, the Welsh Government launched "*the Action Plan for Pollinators in Wales*". This action plan has sprung forth, in accordance with the country's Biodiversity Policy (Biesmeijer et al 2006). The Welsh Government's Biodiversity and Nature Conservation Branch is working with a number of partners to "slow and reverse the decline of pollinator numbers in Wales" (Welsh Government 2013). The action plan outlines these four desired outcome:

1) "Wales joined up policy, governance and a sound evidence base for action for pollinators" (Welsh Government 2013)
2) "Wales provides divers and connected flower rich habitats to support our pollinators" (Welsh Government 2013)
3) "Wales' pollinator populations are healthy" (Welsh Government 2013)
4) "Wales' citizens are better informed and aware of the importance and management of pollinators" (Welsh Government 2013)

The Action Plan was set to have begun in the fall of 2013 and is currently ongoing.

2.3.2 Recent Hungarian Policies and regulations that impact local bee populations

A few recent regulations have been brought forward through interviews with a pair of local apiarists and by representatives from Greenpeace.

- Within the past two years a law has been passed that requires land owners to remove several specific weeds that are seen as nuisance allergens; parlagfű (ragweed, *Asclepias*), fekete űröm (wormwood, *Artemesia*), csorbóka (milkweed, *Ambrosia*). These same plants that are nuisance allergens also provide a lot of food for biodiveristy. Selyemfű dohány (silkweed, butterfly flower *Asclepias syriaca*), is another wild plant species that is known to feed *Apis mellifera,* is also banned, because it is considered an aggressive invasive and that reduces soil quality. two wild plants from their properties. If landowners are caught with these species flowering on their property, it is seen as a criminal act that requires the guilty party to pay fines.
- Within the past three years, the Hungarian government has encouraged agricultural activity in rural communities. In the village of Csobánka and in the surrounding region, the soil is not optimal for agriculture. The Borzsei's state that the soil is not very good, and it is difficult to grow food here. So local farmers have begun keeping livestock; sheep, goats, horses.

Between the anti-nuisance plant law, combined with increase local livestock husbandry, there is significantly less foraging sites for bees, than there were five years prior. Fields that were once fallow are now being mowed to feed livestock and to avoid fines. The anti-nuisance plant law encourages land owners to mow along roads, pathways and their yards, whereas three year ago, these are places where wild flowers grew once. The Borzsei family has noticed since they began their careers as apiarists 5 years ago, that there is significantly less forgeable space for their honey bees. Especially within the past two years, they depend more and more on flowering tree species to feed their honey bees throughout the annual growing season. With fewer species of flowers on which to forage, the Borzsei honeybees are made more vulnerable to extreme weather. For instance, this past spring during the acacia season, the region had a few weeks of cold weather with very strong winds. This cut the acacia season short. The shortened season was bad for both the bees and the apiarists, as honey made from acacia is "hungaricum", a product unique to Hungary (Tömöri and Simon 2014). This status has recently been given to honey made from acacia nectar this past spring (Borzsei 2014). After the acacia blooms, the bees then go on to feed and forage for new flowers in high densities (Steffan-Dewenter and Tscharntke 2000).

While interviewing to Mr. Simon from Greenpeace, about policies that may impact wild bee species, there are clear examples of agricultural practices that work around the needs of *Apis mellifera*. There is very little consideration for native bee species. For instance, although banned

in Europe, routine insecticide and fungicide sprays (via aircraft) tend to take place in rural Hungary (Tömöri and Simon pers.comm). They are scheduled for early morning and early evening, before dark. Through dialogue with agricultural professionals and apiarists, it was determined that it is during these hours when honeybees are very unlikely to be feeding (Tömöri and Simon pers.comm). As honeybees prefer warmer temperature and tend to emerge from their hives to feed from late morning through the afternoon in bright sun (Campbell pers.comm). Whereas bumblebees, who are also important in agriculture, tend to feed throughout the entire day from dawn until dusk (Tömöri and Simon pers.comm). As the aerial spraying of insecticides will kill all bugs that are exposed to them, those who perform the aerial sprays must notify local communities and apiarists (Tömöri and Simon pers.comm). Fortunately for apiarists, honeybee hives can be transported to safer areas (Tömöri and Simon pers.comm.).

2.4 Urban bee habitat

Although, most projects, initiatives and policies are aimed at the conservation of bee populations in rural and agricultural environments, there is growing attention around wild urban bee populations.

> "… cities should be great islands for bees, because there is not a lot of use of pesticides"
>
> *~ G. Simon Greenpeace HU, pesticide specialist*

2.4.1 Initiatives, studies and programs for wild urban bees

Around the world there has been interest in wild bees in urban environments. Initiatives, studies and programs for bees in cities can have greater environmental impacts, than solely focusing on rural protection for bees (Matteson et al. 2008). Urban environments are not exposed to the same extent of agrochemicals, as are rural environments (Tömöri and Simon pers.comm). In towns and cities, working biodiversity studies and initiatives are opportunities for environmental education (Matteson et al. 2008). Biodiversity in cities, allow for "ecological encounters" between charismatic creatures (i.e. bees and butterflies) and people (Matteson et al. 2008). People who have had positive ecological enconters tend to make more informed and environmentally friendly decisions (Matteson et al. 2008)

- **Inner city butterfly and bee species richness study,** 2003-2006: study by Matteson et al (2008). This project investigated species richness and diversity in 18 New York inner city garden spaces in Harlem and Bronx. The study found 54 species of bees, with a species richness of 7 to range of 7 to 29 species of bees per garden site measured. "…The floral area per garden had the greatest influence on both butterfly and bee species richness." Bees also responded well to increased direct sunlight and to wild,

unmanaged areas within garden spaces. Measured surrounding manicured[2] greenspace did not influence the presence of bees. Greenroofs and strategies to create more connectivity between urban pollinator habitats were suggested to increase species diversity.

- **Urban bee biodiversity action plans program,** 2010-2014: coordinated by the "Institut National de la Recherche Agronomique" on urban bee biodiversity in Lyon, France. A project that enhances urban wild bee habitat. This program is described in greater detail in section 2.3.1.2.
- **Feed the Bees**, 2011-ongoing: a grassroots community initiative, coordinated in partnership by NGO "Earthwise Society" and the Delta Chamber of Commerce, in the city of Delta, BC, Canada. This program encourages and empowers individual citizens to help struggling bee populations by educating and informing the public to plant flowering plants that feed bees and other pollinators. A study was carried out that investigated which plants, in the Fraser Valley, were most popular among foraging bees. The information from this study was used to develop a guide that helps individuals determine which plants to plant to *feed bees* at home and at their businesses. These selected bee gardens offer a continuous supply of flowers favoured by bees, throughout the entire growing season, from early spring through late fall (Earthwise Society 2012).


Figure 2.3.1.3 Feed the Bees community outreach

- **The Action Plan for Pollinators in Wales; for urban areas**, 2013-ongoing: part of a progressive countrywide action plan to promote healthy pollinator populations in Wales. The Wales' action plan for pollinators includes strategies for urban areas that "promot[e] opportunities and creat[e] and enhanc[e] diverse and connected flowering habitats in [] towns, cities and developed areas" (Welsh Government 2013). This program is described in great detail in section 2.3.1.3

2.5 Recommendations (by existing NGO's, beekeepers and Scientific Experts)

This section is a compilation of recommendations made by beekeepers, NGO's and scientific experts to help bee populations. These various authors suggest a number of actions, from re-

[2] A manicured greenspace is a highly managed and sculpted greenspace, these are managed to enhance esthetic appeal rather and often offer little to no ecological value to an environment, i.e. shortly mowed grass on a golf course.

establishing foraging space and habitat for biodiversity, to developing entire strategies to help to protect bee species. Notably, all people are being called to action, from individuals, homeowners, building developers, and farmers, to business owners and finally government bodies. The decline of bees is seen as a Worldwide epidemic, and great effort is needed at all levels, to help struggling bee populations.

Figure 2.3.2 Recommendations (NGOs, apiarists and pollinator experts)		
Author and Document	**Recommendation**	**Actions**
Sárospataki et al (2005) study on the status of threatened hungarian *Bombus*	*Bombus* in Hungary need more protection and conservation	Classify *Bombus* fauna according to the extent of their threatened status, and develop a strategy for their protection.
Potts et al. (2005) Study on the role of nesting resources in Mediterranean	Consider nesting resources and habitat, as well as foraging plant materials, when considering bee communities	Bees require both nesting and foraging materials. These are equally important components for successful habitat management.
Matteson and Langellotto (2010) - Study in determinating inner city species richness of bees and butterflies in New York	Utilize and establish floral plantings in urban areas, high in light exposure	Establish floral plants on green roofs, increase ecological connectivity for pollinators by increasing floral planting space on balconies, building terraces etc with southern exposure.
Feed the Bees (2011) – Campaign	"We need you to plant more, and we need more of you to plant" – Ian Tait	All persons are encouraged to plant for pollinators.
Greenpeace (2013) – Bees in Decline	1) Ban the use of bee-harming pesticides, starting with the top-ranked most dangerous pesticides currently authorised for use in the EU	i.e. the seven priority bee-harming chemicals imidacloprid, thiamethoxam, clothianidin, fipronil, chlorpyriphos, cypermethrin and deltamethrin.
Greenpeace (2013) – Bees in Decline	2) Through the adoption of pollinators' national actionplans, support and promote agricultural practices that benefit pollination services within agricultural systems	such as crop rotation, ecological focus areas at farm level, and organic farming.
Greenpeace (2013) – Bees in Decline	3) Improve conservation of natural and semi-natural habitats around agricultural landscapes, as well as enhance biodiversity within agricultural fields.	Change how ecosystems are managed around agricultural land margins, to practices which favour biodiversity.
Greenpeace (2013) – Bees in Decline	4) Increase funding for research and development on ecological farming practices that move away from reliance on chemical pest control towards biodiversitybased tools to control pests and enhance ecosystemhealth.	EU policy makers should direct more funding for ecological agriculture solutions research under theauspices of the CAP (direct payments) and Horizon 2020
Borzsei Apiarists (2014) – Interview	Establish compromises between apiarists, landowners and local government	Allow apiarists to bring their bees to fields important for bees (ie. Selyemfű dohány (silkweed, *Asclepias syriaca*)) for the first two weeks while the flowers are in bloom, before seeds are developed. After that period cut the fields

3.0 Methodology

This study undertaken was completed by first carrying out a literature review, then conducting several interviews, and finally through field work by maintaining two experimental garden sites for monitoring. The literature review was conducted to investigate and explore; - existing knowledge on pollinators. -To look at past and current policies, visions and regulations that impact bees. – Finally to investigate other philosophies and strategies for environmental education with policies and regulations to implement action.

3.1 Literature Review

To explore the plight of bees, with a focus on bees in urban environments, concentrating on Budapest, Hungary, in order to achieve a list of recommendations for policies and actions that will encourage bee populations to grow and thrive.

3.2 Interviews

Two interviews were conducted with the objective of obtaining Hungarian based knowledge of the status of bees in Hungary, and to obtain more information regarding EU and Hungarian policies, regulations, funding and activities which impact pollinators.

For the first interview held July2nd 2014, I met with and interviewed two apiarists who live in a suburban village on the outskirts of Budapest, called "Csobánka". This couple was suggested to me, by an advising CEU professor. The interview was conducted in a semi-structured format, with a volunteer translator. The translator was required, as only one of the interviewees could communicate in English. This person had a low comfort level with the language. Prior to the interview I had prepared several questions (Questions in Appendix XXX). While conducting the interview, I allowed natural conversation to take place, between myself, the interviewees and the volunteer translator, in order to gain a better perception of the situation, as described by the interviewees.

The second interview was conducted July 9th, 2014, with contacts from Greenpeace Hungary. As Greenpeace had written a report in 2013 "Bees in Decline", I was interested in inquiring further into the status of bees in Hungary, and what policies, regulations and initiatives were impacting pollinators in Hungary, and in the EU in general.

After the interviews were conducted, they were transcribed and the resulting data was analyzed.

Limitations:

- The Hungarian language. I am a native English speaker, and I had to conduct these interviews in English. The data collected was available through the translation of my volunteer, and based on the ability for the apiarist and the individuals at Greenpeace to express themselves in English.

3.3 Building gardens for pollinators in community garden spaces

Experimental Design Objective: To design and build two urban garden spaces, that are easy to replicate, that will provide sources of food and habitat for native bees throughout Budapest's growing season, from early spring to late fall.

GARDEN DESIGN PROJECT:

With the purpose of designing, building and implementing two "bee garden" models, that increase urban bee habitat. With the goal that these models must be low in cost and can be easily replicated by individuals.

The bee gardens that have been set-up within community gardens can continue to be used in the future as both visual and hands-on educational tools by individuals and by the communities as large.

These garden spaces were monitored over the months of May and June, with the following MONITORING OBJECTIVES. The objectives of this monitoring experiment were to determine:

1) Can planting gardens for bees provide realistic sources of food?

a) Do these gardens attract bees? b) Are bees actively feeding at these garden sites, c) Which bees are locally more important in urban environments managed bees (*apis mellifera)* or native bees. d) Of the flowers planted and of those observed, which flowers are preferred feeding sites for urban bees?

Limitations to this experimental study are:

- The lack of earlier data records of managed and unmanaged bee populations in Budapest.

The garden design:

To support the legitimacy of the test bee gardens, at each site one control garden was installed, and one pollinator attracting garden was installed, as not all flowers, provide food for bees. The flowering plant materials at each site are identical, and they receive similar amounts for sunlight. In each garden, two additional monitoring sites were selected within the existing garden at large, to determine whether bee populations already were attracted to or fed in these garden spaces already.

These two sites were chosen in two different locations, approximately 2.73 km (Google Earth 2014) apart (as seen in figure 3.3):

- **Leonardo Kert community garden** is located in Budapest's 8th, at the North-East corner of the intersection of Leonardo Da Vinci Utca and Tömő Utca. This community garden is in its third year of production. The community is composed of 90 allotment plots each with their own gardeners. At the front entrance of the garden are five raised beds, this designed bee garden, and another shade tolerant native garden. This front area

is the children's garden, where groups of children visit the garden and learn how to maintain plants, create space for biodiversity and grow food. The Bee garden project is located at the front the entrance of the garden within the children's garden area, where community members have already taken notice and interest in the garden and its activities.

- The **CEU Japanese Garden**, located within the University campus, in Budapest's 5th district, is in a courtyard on a rooftop and is isolated by concrete buildings in downtown Budapest. The Japanese Garden is frequented by students and faculty, who regularly visit the garden space, as either a walking corridor through the campus, as a designated smoking area, or occasionally for gatherings and celebrations.

Both of these garden sites are actively used for educational purposes; - Leonardo Kert is used for educational curriculum-linked education for school-aged children, while – CEU's Japanese garden is used by the department for Environmental Science and Policy for several courses in organic gardening. Both garden sites are summarized in table 3.3.1.

Figure 3.3 Map showing experimental garden sites in Budapest

Because both of these bee gardens sites are featured in prominent locations within their gardens, it was important that the gardens appear attractive, while also providing food and habitat for bees. Another reason to keep them aesthetically pleasing is to encourage other gardeners to plant bee-friendly flowers. Thus, plant materials chosen were fewer wild flower varieties and more popular garden herbs and flowers. In order to leave lasting gardens, mainly perennials, self-seeding annuals were planted. Pollinator attracting flowers were selected based on information gathered from the UK and Canada. Most plant materials were acquired from a local Hungarian nursery "Oázis Kertészet". A list of plants and their times of blooming is located in Table 3.3.2.

Table 3.3.1 **Bee Garden Designs**	
Site: Leonardo Kert	**Site: CEU Japanese Garden**
Garden Location: 8 District Pest, at North-East corner of intersection Leonardo Da Vinci Utca and Tömő Utca	Garden Location: CEU Nador Utca, 2nd floor Faculty Tower rooftop courtyard garden.
Garden edging built from donated pallets	Custom patio garden design built from donated pallets
Control Garden	Control Garden
Bee Attracting Garden	Bee Attracting Garden
Soil donated to the Community Garden from a Cabbage Farmer	Soil that was available for the CEU Japanese Garden
Plant materials obtained from: - Ázis Kertészet (nursery), - local market vendor, -unsolicited donations*	Plant materials obtained from: - Ázis Kertészet (nursery), - local market vendor
Traditional surface soil watering	Drip irrigation system and surface soil watering
Exposed soil spaces for ground dwelling insects	Exposed soil spaces for ground dwelling insects

3.3.1 Collaborating and cooperating with communities to establish garden spaces for bees

The idea for this project was established before the garden spaces had been determined. Upon discussing the idea of building gardens, to attract bees in community garden spaces, with acquaintances who I had met throughout Budapest, a few suggestions were made.

The author had met a horticulturalist who runs the children's programs at Leonardo Kert, who was very supportive of the project ideas and purpose. It was this individual, Nelli Virag, who had suggested that the author build a garden for pollinators in Leonard Kert community garden. After sharing the proposed garden plan with the garden manager, a site was determined and the project was approved.

Garden Materials and labour

To obtain materials and to install these gardens and build the patio garden boxes, a network of community members and volunteers stepped forward to help. For instance, the wooden pallets that were used for both garden sites, to build the walls, frames and planter boxes had been donated, by a local produce distributor. Usually this produce distributor gives the used pallets to several poor families, who use them for firewood. However, in the spring, as the weather warms, more pallets are collected, than are needed for burning. Left-over pallets were donated to Leonardo Kert, for the use of other community gardeners. While networking and sharing this

project's goals with other local Hungarians, many unexpected individuals generously involved their time, resources and skills. For instance, a government working administrative assistant volunteered to take the author to Oázis Kertészet, to purchase the flower materials and to help translate necessary questions to the nursery staff. Another few volunteers kindly offered their experience in construction, gardening and building, to form the garden beds and boxes, complete with soil and new plant materials. Once this garden was complete, the educators for the children's programs would incorporate watering this garden into their regular garden activities.

Some of the donated pallets were also used to build the planter boxes for the CEU Japanese Garden. The Sustainable CEU interest group had several "volunteer garden work days", where additional volunteers helped with spring planting and building for new garden boxes, including the ones for this project. The garden boxes in the CEU Japanese garden had a more complicated model of a drip irrigation system. Where PVC piping was installed within the vertical and lower garden boxes, so that the inner soil is made wet, rather than solely surface watering. The boxes were painted for weathering, and lined with geotextile, on the top, to prevent the soil from coming out, and plastic along the bottom, to keep the soil in the planter box. A mix of compost, soil and pearlite were added to the boxes, prior to planting. Volunteers from the work parties helped to add soil and to plants to the planter boxes.
Overall, the same plant species were planted in both garden sites. A detailed plant description is located in table 3.3.2 below. Table 3.3.2 names all of plants planted in the gardens, as well as the flowering period, recorded by the author in the field notes.

Plants were chosen for the "Control" gardens, which are popular among people, however not necessary for pollinators. Attention was paid to their popularity in the spring, at the nursery where they were sold. The "Pollinator garden" flowers were selected based on bee planting for guides from the U.K. (British Beekeepers Asssociation 2014), and for Southern British Columbia, Canada (Earthwise Society 2012).

3.3.2 Monitoring pollinator garden activities

As mentioned before, the objectives of this monitoring experiment were to determine 1) Can planting gardens for bees provide realistic sources of food. A) Do these gardens attract bees? b) Are bees actively feeding at these garden sites, c) Which bees are locally more important in urban environments managed bees (*apis mellifera)* or native bees. d) Are the flowers planted at the observation sites preferred feeding sites for urban bees?

Table 3.3.2 Plant materials planted in project pollinator gardens						
Leonardo Kert				**CEU Japanese Garden**		
Months of recorded blooms	**Plants for Pollinators**	**Latin Name**		**Months of recorded blooms**	**Plants for Pollinators**	**Latin Name**
March - April	Hyacinth	*Hyacinthus*		March	Hyacinth	Hyacinthus
March - April	Deronicum			March -Died	Deronicum^~	
April-early May	Columbine	*Aquilegia*		April-mid-May	Columbine	Aquilegia
April-May	Phlox			April-mid-May	Phlox	
April-June	Armeria			April-June	Armeria	
May - early June	Borage*,^^	*Borago*		Mid-May- mid-June	Borage^^	Borago
Late May	ornamental rose*^	*Rosa var*		June-summer	Gazania X hybridus**	
Late May	Osteospermum*^			Late-Summer	Stone crop	Hylotelephium
June	Oregano	*Origanum*				
June-August	Gazania X hybridus**					
Late-June-summer	Zinnea*					
Late June-July	Thyme	*Thymus vulgaris*				
Late June-summer	Stone crop	*Hylotelephium*				
Late June-July	Mint	*Mentha*				
July-August	Black-eyed Susans*	*Rudbeckia hirta*				
	Control				**Control**	
March-June	Pansies	*Viola*		Mar-April	Tulips	Tulipa
Mid-March - April	Daffodil	*narcissus*		March-June	Pansies	Viola
Mid-March - April	Tulips	*Tulipa*		April	Daffodil	narcissus
May-July	Geranium*^	*Pelargonium x hortorum*		May-July	Geranium**	Pelargonium x hortorum
June-summer	Nasturtium	*Tropaeolum*		Mid-June	Oregano	Origanum
June-Summer	Dhalia**			July Blooming	Mint	Mentha
Late June-?	Mini Snap dragons*	*Antirrhinum*		July Blooming	Thyme	Thymus vulgaris
July	Sunflower*	*Helianthus*		No blooms	Nasturtium*	Tropaeolum
Side Notes:						
Planted from seed damage* ^^*Extensive aphid* * Added late during dearth* ^~ *Died, over-watered* **^Planted by other gardeners*				*NB: Information in this table is original to the author (Juliana Christiansen) and was obtained through collected monitoring data.*		

These objectives were determined by noting observed bee and pollinator behaviors, which demonstrates that bees are attracted to flowers or a site. Behavior such as, hovering over a site, actively feeding on flowers and actively drinking demonstrate that the bees are attracted and interested. Other observed data that was recorded were: -bees actively feeding, -from which plants did they feed, -whether a bee was native, (a bumblebee or honeybees).

As advised by Master Beekeeper Brian Campbell (2014), the sites were divided into sections of approximately $1m^2$ x $1m^2$. As seen in figures 3.3a and 3.3b, there is a planted control and bee attractant sites are divided into smaller spaces, as well as two additional pre-existing garden sites sites at each garden location. These additional sites were selected to demonstrate that bees are already attracted to flowering sites within the garden.

- At Leonardo Kert, the planted garden was divided into 5 parts (figure 3.3.2a): Site 1, Site 2 and Site 3 make up the planted bee attractant section; Site 4 and Site 5 make up the planted control garden. Site 6 and Site 7 were selected at nearby pre-existing garden spaces, one with *Nipita*, and the other was planted with sage and thyme.
- At CEU's Japanese Garden, five sites were selected (Figure 3.3.2b): Site 1 is the patio planter control box; the Site 2 is the patio planter box with bee attracting plants; Site 3 is a planter box with strawberries (later referred to as "the strawberry basket"), and two accompanied pots planted with calendula and fava beans; Site 4 and Site 5 were selected because they contain established gardens, and had flowering shrubs and more flowering plants to come.

These two garden sites were monitored, using the "Citizen Scientist Monitoring Guide" (Xerces Society et al. 20008) as a monitoring framework. The Citizen Scientist Monitoring Guide was established in 2008, by the Pennsylvania Native Bee Survey (PANBS) and the Penn State Master Gardeners program. Each garden site was measured 3-4 times per week throughout the months of May and June 2014. The garden sites were usually visited during the late morning through to the early evening. These hours were selected as bees are sensitive to shade, light and ambient air temperature (Xerces Society et al. 2008). They prefer to feed when the weather is warm and sunny. Different bees have different temperature and light thresholds (Xerces Society et al. 2008).

- The two sites were visited 3-4 times per week, between 10:00 and 18:00, throughout May and June 2014
- Tools for monitoring were: - a stopwatch, - a designated field notebook, - a pen, eyes, and - a digital camera.

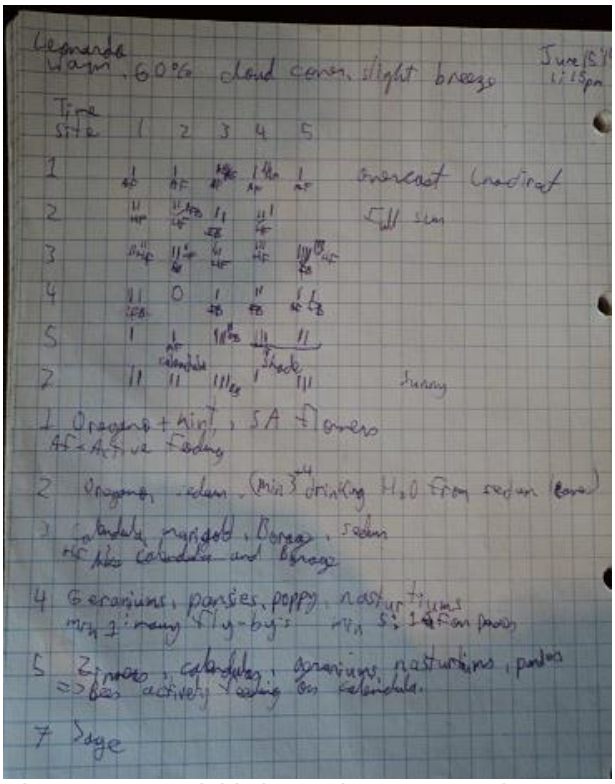


Figure 3.3.2c Field sheet, sites measured at Leonardo Kert, June 15, 2014

- Focusing on one site at a time, the timer was set for 1 min. During this one minute all bee interactions with that site were recorded, based on the interaction (i.e. 1AF, for 1 bee actively feeding), 5 times. This was performed for each of the sites within the garden (either Leonardo Kert or the CEU Japanese garden).
- An example of a field sheet is shown to the right in Figure 3.3.2c. With the corresponding field legend, table 3.3.2; this shows the short-hand word for the pollinator identified and the corresponding actions.

3.3.3 Data entry and processing

Once all data was recorded from both garden sites, the data was entered into Excel spreadsheets. This produced a fully intact electronic database of all monitoring data collected. All of this data can be found in Appendices 1a and 1b Daily temperature data was collected from AccuWeather's historical weather data, as daily averages.

In order to gather information from this data, it was processed, through the following procedures:

Table 3.3.2 Pollinators and their actions

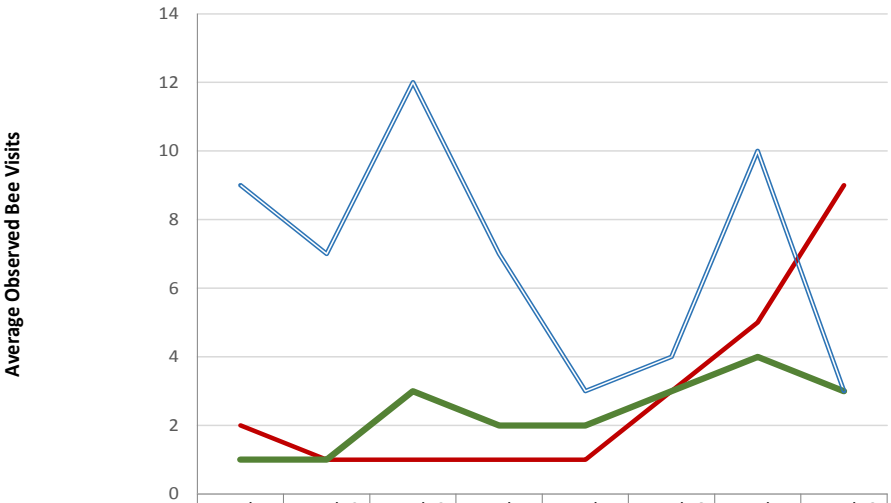
Field Legend	
AF	Active feeding
FB	Fly by
BB	Bumblebee
HB	Honey bee
HF	Hover fly
NB	Native bee
D	Drinking
In	Investigation
R	Resting
BF	Butterfly

- The numbers of bee visits per site were calculated over the full five minute period. In order to avoid double counting bees, the bees were counted based on their activity. For instance, each "fly by" was counted as one. Whereas, "1 bee, actively feeding", recorded during several consecutive minutes, was only counted as 1 bee.
- At Leonardo Kert: In order to gather information on the weekly trend of bee visits, the numbers of bee visits per site were calculated as "weekly averages". And the sites were amalgamated into the number of average weekly visits per garden. For instance, Site 1, Site 2 and Site 3 make up the "bee attractant garden"; Site 4 and Site 5 make up the "control garden"; Site 6[3] and Site 7 are each independent garden, and were amalgamated

[3] Garden site 6, was selected for is evident pollinator attracting properties early on. This pre-existing garden belonged to another community gardener, and was unfortunately removed after the fourth day of monitoring.

as "pre-existing garden". This compilation of data is presented in figure 3.3.3a below.

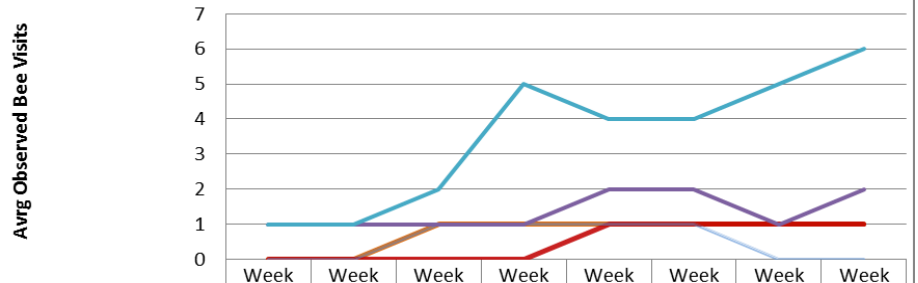
Figure 3.3.3a Leonardo Kert: Average Observed Bee Visits (garden/week)



	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Bee Attracting	2	1	1	1	1	3	5	9
Control	1	1	3	2	2	3	4	3
Pre-existing	9	7	12	7	3	4	10	3

- At CEU Japanese Garden: In order to gather information on the weekly trend of bee visits, the numbers of bee visits per site were calculated as "weekly averages". As the sites were already independent of each other, the sites were kept as is and recorded as of average weekly visits per garden site. For instance, Site 1 is the "control"; Site 2 is the "bee attractant garden"; Site 3 is the "strawberry basket"; Site 4 and Site 5 are each independent pre-existing gardens. This compilation of data is presented in figure 3.3.3b below.

Figure 3.3.3b CEU Japanese Garden: Average Observed Bee Visits (garden/week)



	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Control	0	0	1	1	1	1	1	1
Bee Attracting	0	0	0	0	1	1	1	1
Strawberry Basket	0	0	1	1	1	1	0	0
Site 4	1	1	1	1	2	2	1	2
Site 5	1	1	2	5	4	4	5	6

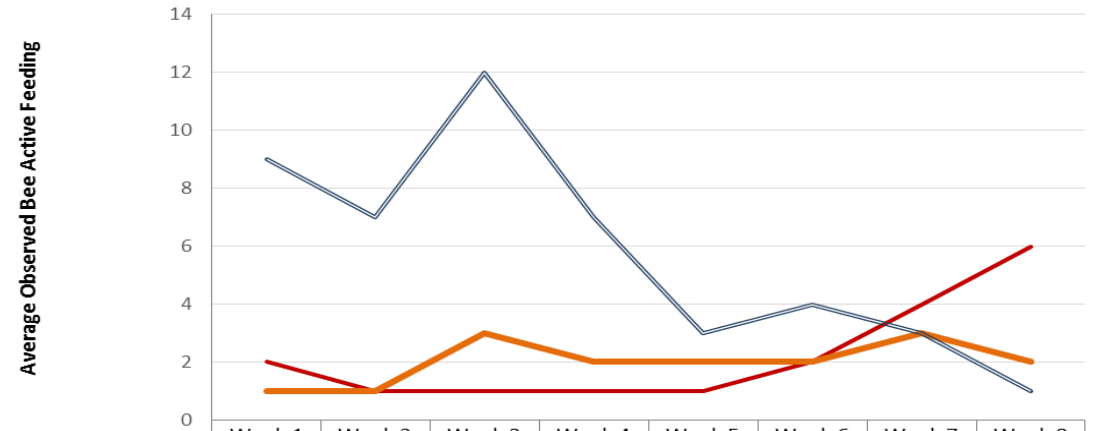
Figures 3.3.3a and 3.3.3b include all bee data, and all bee interaction to with the sites.

- The tables were then recalculated to only include "Active Feeding" bee visits.

According to the Citizen Scientist Pollinator Monitoring Guide (Xerces Society et al. 2008), active feeding demonstrates that the pollinators are both attracted to the flowers, and that they are using the flowers as a source of food. Thus, recording active feeding provides evidence for or against the main goal of this study to determine: "Can planting gardens for bees provide realistic sources of food". As this information provides answers to these questions: A) Do these gardens attract bees? b) Are bees actively feeding at these garden sites, c) Which bees are locally more important in urban environments managed bees (*apis mellifera)* or native bees. d) Of the flowers planted and those observed which flowers are preferred feeding sites for urban bees?

The graphs and tables resulting from solely looking at "Active Feeding" are depicted below, in Figures 3.3.3c and 3.3.3d.

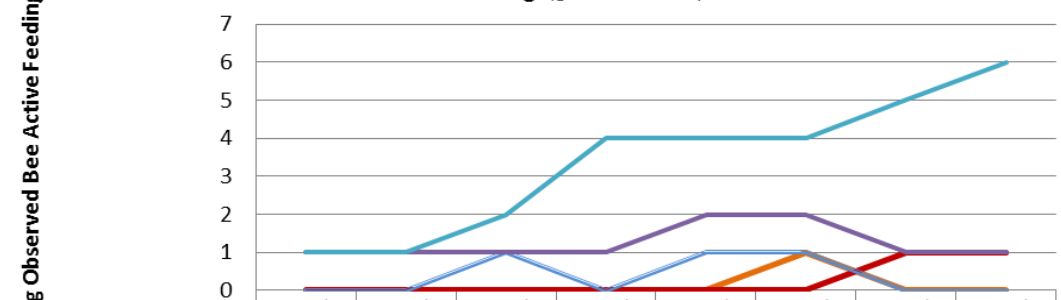
Figure 3.3.3c Leonardo Kert: Average Observed Bee Active Feeding (garden/week)



	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Bee Attracting	2	1	1	1	1	2	4	6
Control	1	1	3	2	2	2	3	2
Pre-existing	9	7	12	7	3	4	3	1

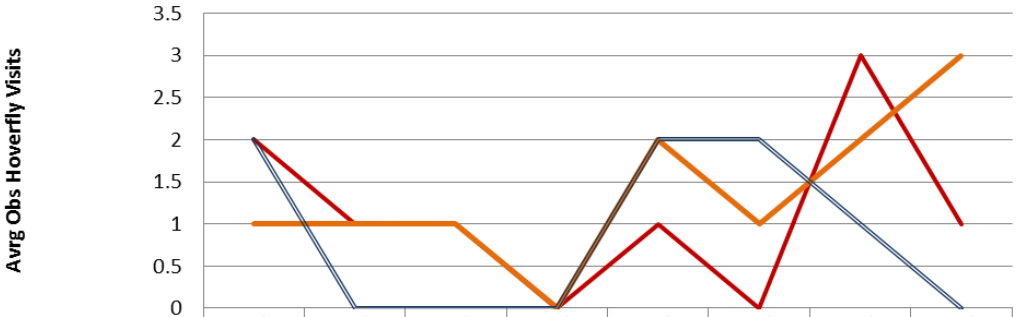
- Hoverfly visits were recorded while monitoring at both gardens. As this monitoring experiment was looking at pollinators, other known important pollinators (i.e. butterflies and hoverflies) were also recorded. The hoverfly visits are displayed graphically and in table form for both gardens in the following figures 3.3.3e and 3.3.3f.
- As bees generally feed in warmer, nice weather. Figures 3.3.3g and 3.3.3h graph the relationship between bees recorded in the respective garden (Leonard Kert or CEU Japanese Garden) and the daily average temperature. The sum of the number of bees who visited the garden is placed along the x-axis vs. the "daily high temperatures" which are displayed along the y-axis.

Figure 3.3.3d CEU Japanese Garden: Average Observed Bee Active Feeding (garden/week)



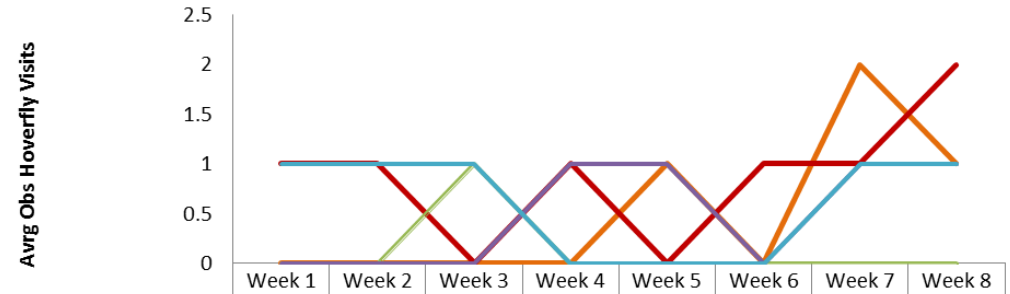
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Control	0	0	0	0	0	1	0	0
Bee Attracting	0	0	0	0	0	0	1	1
Strawberry Basket	0	0	1	0	1	1	0	0
Site 4	1	1	1	1	2	2	1	1
Site 5	1	1	2	4	4	4	5	6

Figure 3.3.3e Leonardo Kert: Average Hoverfly Visits Observed (garden/week)

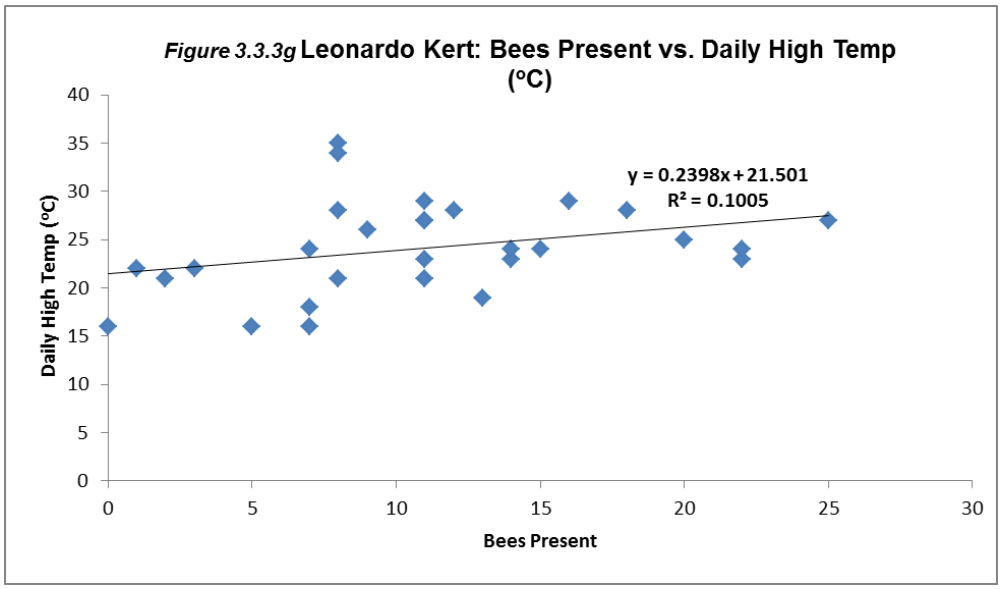


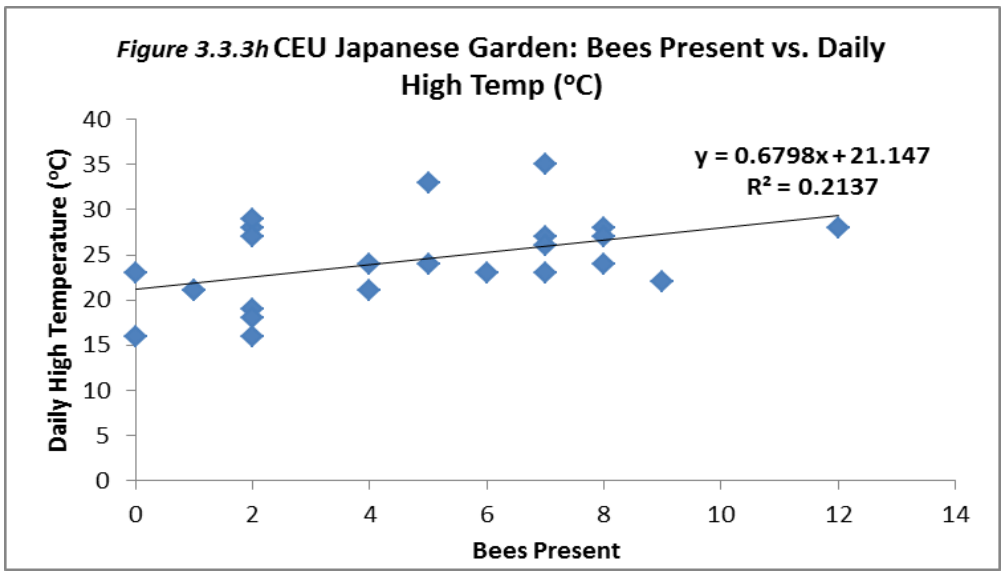
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Bee Attracting	2	1	1	0	1	0	3	1
Control	1	1	1	0	2	1	2	3
Pre-existing	2	0	0	0	2	2	1	0

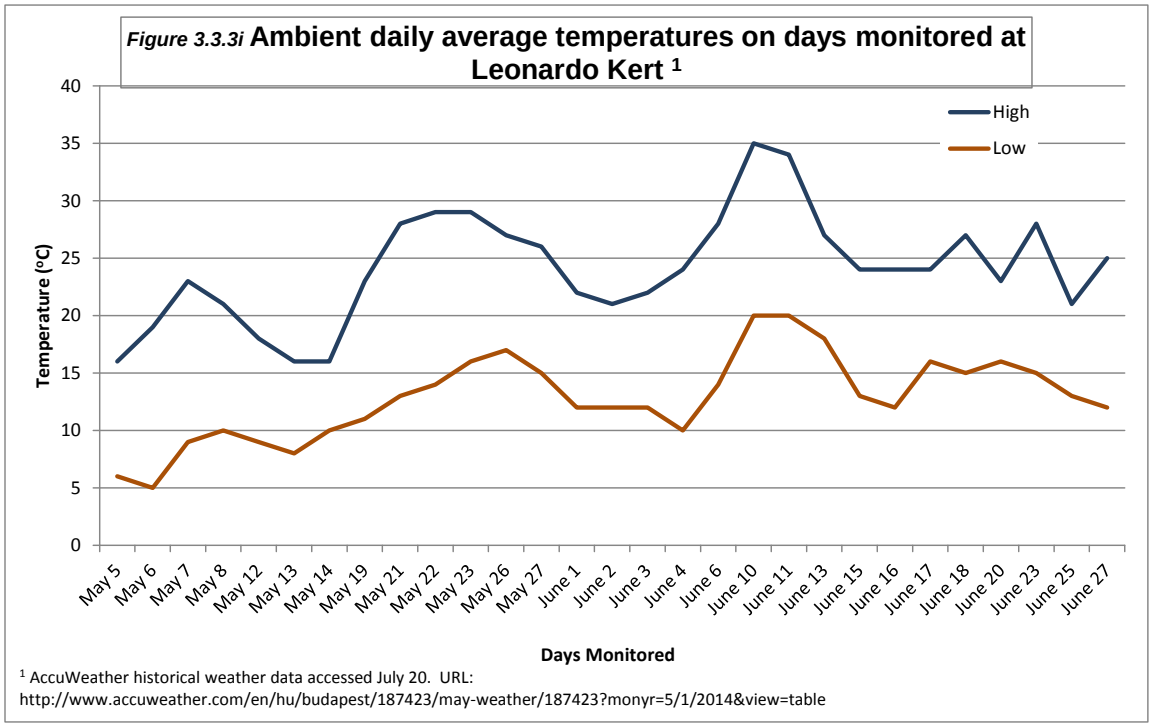
Figure 3.3.3f CEU Japanese Garden: Average Hoverfly Visits Observed (garden/week)



	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Control	0	0	0	0	1	0	2	1
Bee Attracting	1	1	0	1	0	1	1	2
Strawberry Basket	0	0	1	0	0	0	0	0
Site 4	0	0	0	1	1	0	1	1
Site 5	1	1	1	0	0	0	1	1

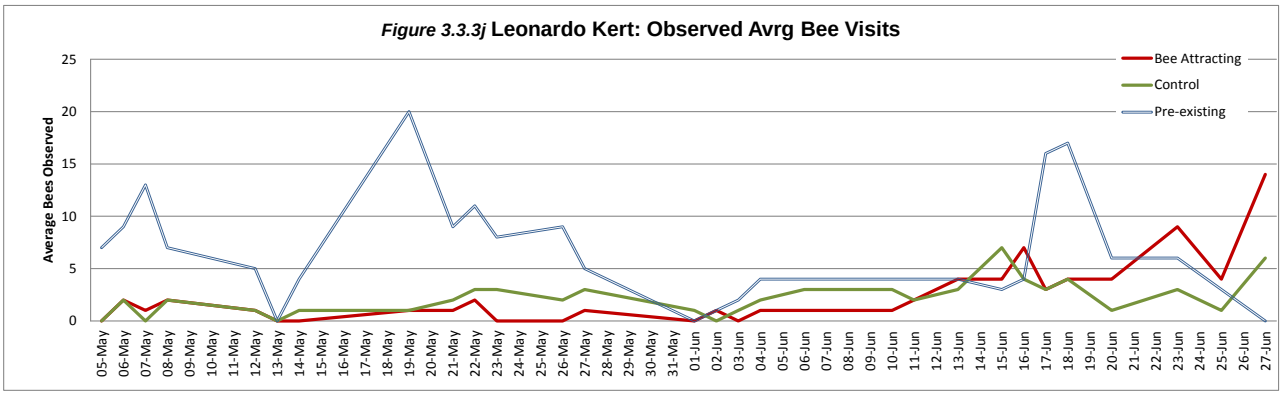


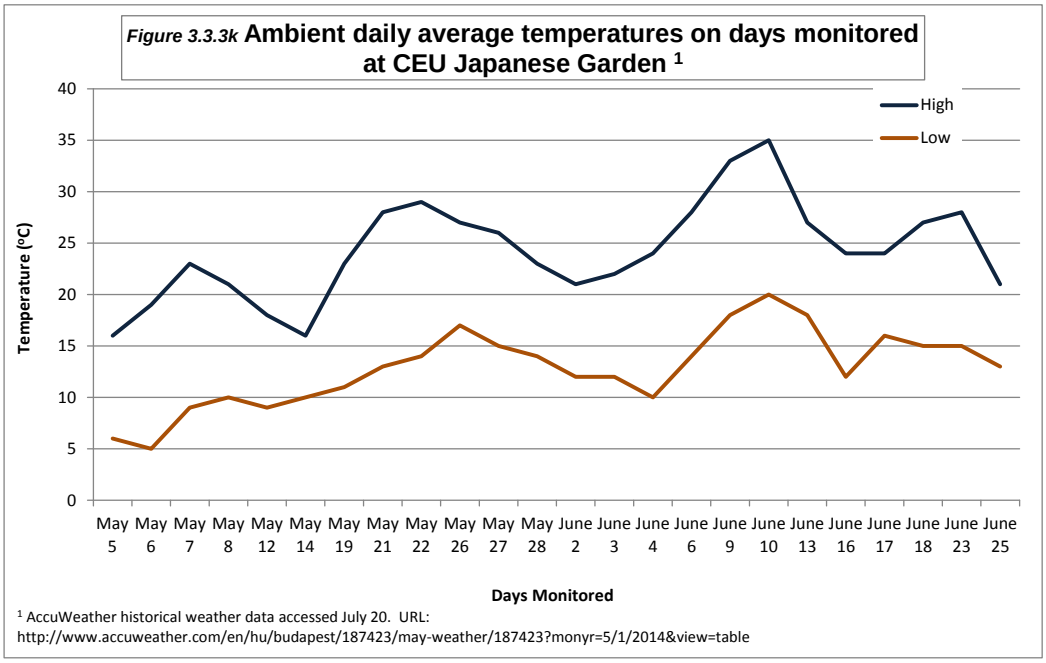


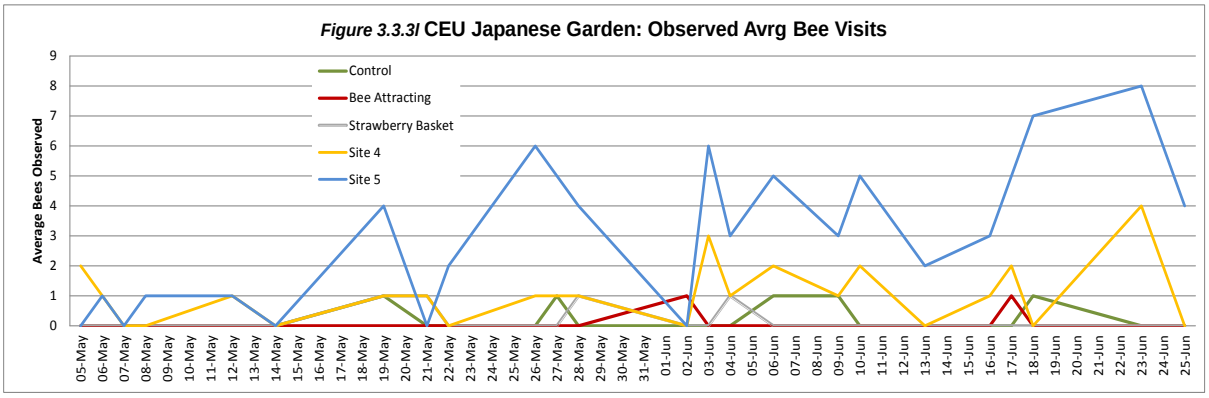


[1] AccuWeather historical weather data accessed July 20. URL: http://www.accuweather.com/en/hu/budapest/187423/may-weather/187423?monyr=5/1/2014&view=table

- The daily temperature high and low temperatures (in degree Celsius) are depicted in figures 3.3.3i and 3.3.3k. These show the temperature trends, and can be compared with the bees' daily garden visits in figures 3.3.3j and 3.3.3l.







Limitations:

- The time allotted for thesis writing for CEU's MSc in Environmental Science and Policy allows for only a short window of time for thesis projects. As the thesis itself must be submitted by the end of July 2014, the project's seasonal observation of flowering vegetation could only take place beginning from the end of February until the end of June 2014. The monitoring of the bees within the established gardens took place during the months of May and June 2014.
- My novice gardening experience has taken place in Canada, along the South Coast of British Columbia.
- The author is a native English speaker, and does not know the Hungarian language, thus the literature review and interviews for this study were carried out in English.
- Because of the language limitation, flora chosen for the gardens were sought out as "bee loving" based on literature from the United Kingdom and from previous knowledge in Canada. (Earthwise Society 2012)
- As, the author did not have access to a calibrated scientific thermometer, historical temperature data, for daily high and low temperatures was obtained from AccuWeather.
- The values are daily average high and low ambient air temperatures for the Budapest area.
- Both garden sites have their own microclimates, due to surrounding environments and infrastructures. These differences are not taken into account with the daily average temperature values.
- Despite careful planning, there were dearth periods in sections of the gardens, as there were no blooming flowers present at certain times.
- These gardens are located in community environments, thus plant material was added to the Leonardo garden site, reduced the ability to hold control gardens.

4.0 Discussion

The global decline in bee populations and species is globally recognized as a priority problem. The interrelated relationship between bees and plants creates serious threats to food security, species diversity and the potential of mass extinction among many species of flora and fauna. The apiary industry is heavily monitored, because of its direct economic value in apiary products. It is the large-scale losses of *Apis mellifera* colonies that have gathered global attention. This attention is an example of how honeybees are good indicator species. However, presently, there is still limited knowledge as to the status of wild bees.

Currently, the Europe Commission is addressing the need to protect pollinators as a priority. This is evident through; the many changes to policy, the establishment of new French research institution, the *EU Reference Laboratory for Bee Health*, and the many projects and initiatives that have taken off throughout many EU Member states, supported by the European Commission LIFE program. There have also been initiatives and projects that have been started up solely by Member States, i.e. the U.K.'s *Environmental Stewardship Scheme*, and Wales' *Action Plan for Pollinators in Wales*, which is a legislated government initiative. Much of this momentum to address pollinators has taken place within Western Europe; these countries appear to have been most impacted by pollinator declines. However, this may be attributed to the many resources that have been invested into studying the decline of bees within these areas. Despite the attention paid to the decline in bees in Western Europe, this problem also persist within Central and Eastern Europe, including Hungary among native bee populations, most notably *Bombus*.

4.1 *Apis mellifera* as the key indicator species for bees

From the comparison in the literature review between honeybees and wild bees, it is understood that all species of bees are valuable. Each bee species is closely adapted to their environment, food foraging, resting and resources. *Apis mellifera* plays important role agriculture, both as a pollinator and as an apiary food and product producing animal. Honeybees are an irreplaceable species, and they play very important ecological roles in our environment and in our agricultural system. That being said, that is merely 1 out of 19,500 species of bees. Humans have studied, managed and have developed a deep understanding of the honeybee. This time invested into dedicated research and population management of *Apis* mellifera has not yet been invested into other bee species. There is still much to be discovered about the ecological roles played by each bee species. This lack of information on bees makes it challenging to pinpoint direct causes in bee declines, especially when current population estimates of wild bee species remain unknown. The loss of honeybees is currently being addressed. Honeybees have an advantage over other bee species, as apiarists will fight for and speaking on their behalf. However, it is not evident for

the average westerner that global food supplies are in imminent danger, because wild bee populations are disappearing. For *Apis mellifera*, medication and fungicides can be applied to help them resist illnesses; however, such pharmaceutical treatments are not an option for wild bees.

4.2 Looking small scale initiatives

It is possible for government policies and regulations to advise and encourage ecologically sound management practices in rural environments. However, policies and regulations are both difficult and financially expensive to enforce. Conversely, in urban environments such as towns and cities, such policies and regulations can easily evolve into community led initiatives. Pollinators, such as butterflies, moths, hummingbirds and bees, are charismatic animals (Matteson et al. 2008). When individuals are educated about the important biological roles that pollinators play, they are concerned. People would like to help, as long as the required efforts are simple and straightforward. While the author performed the monitoring experiment at Leonardo Kert, other gardeners followed the example, by adding bee friendly flowers to their personal allotment plots. For someone who is already gardening, little additional effort is required to plant for biodiversity. Small actions, such as allowing herbs and bolted salad greens plants to go to flower, then removing the plant after the flowering period, can have large impacts in increasing foraging space for pollinators.

4.3 Urban gardens for biodiversity

It is common practice to spray agricultural fields with herbicides, which kill off wildflowers, pesticides which kill insects, and fungicides. This makes it difficult to establish uncontaminated foraging sites, as these agrochemicals end up in the air, in the water, on foliage and in the nectar (from pesticide treated seeds). Generally urban community gardens, such as Leonardo Kert and the CEU Japanese Garden practice organic and chemical-free gardening. Chemical free gardens are urban havens for pollinators and biodiversity. It is in such locations, where environmental education is practiced and where positive urban ecological interactions take place (Matteson et al. 2008). Prominent cities and towns wi11 compete with other rivaling cities and towns. For instance, a growing trend in community garden spaces is to build nesting sites for bugs. The garden manager at Leonardo Kert (per. comm.) had mentioned that community gardens in large and advanced cities such as Vienna have designated "bug hotels" (i.e. figure 2.1.2a), so it is only logical that Leonardo Kert should also built such a structure. This summer, the community garden members of Leonardo Kert had a work party, and together they had built a bug hotel.

4.4 The Garden Experiments

The garden monitoring experiment for pollinators, described in section 3.3, was looking for

supporting evidence for the following research questions:

1) Can planting gardens for bees provide realistic sources of food?

a) Do these gardens attract bees? b) Are bees actively feeding at these garden sites, c) Which bees are locally more important in urban environments managed bees (*apis mellifera)* or native bees. d) Of the flowers planted and of those observed, which flowers are preferred feeding sites for urban bees?

Although the garden sites are both located on Budapest's Pest side, within 2.73km from each other, both sites are significantly different from each. Where the CEU Japanese garden is on a 2nd floor rooftop garden, within a courtyard, the Leonardo Garden is at a street corner, in an

Figure 4.1 Map showing experimental garden sites in Budapest, with "Bee Buffers".
Orange polygon represents *Apis mellifera* foraging and nesting buffer, with a 800 m radius from garden site.
Yellow polygon represents *Bombus* foraging and nesting buffer, with a 2500 m radius from garden site.

abandoned municipal block, with adjacent urban construction sites as neighbours. Both garden sites can support small populations of biodiversity. Some bees may have established nests directly in the gardens, whereas other may have flown in from farther distances. Figure 4.1 shows two polygons, which demonstrate the range of where the bees may have flown from. Although honeybees can travel up to up to nearly 6 km from the hive in order to forage, the average *Apis mellifera* will usually only travel within 800 m of their hives (Hagler et al. 2011). Honeybees are known to search for abundant and dense patches of flowers. Once there are few flowers left to forage, they will find another large dense patch of flowers. The smaller orange

polygon shows an approximate buffer zone of 800 m around the garden locations. The larger yellow polygon shows the approximate buffer zone for wild bees. This buffer size is much larger as species of *Bombus* are known to fly greater distances, of approximately 2500 mm while foraging. Bumblebees stop to forage while they travel, seeking flowering species richness, over density and abundance.

As seen in figure 4.1, the yellow buffers overlap, which indicates that some of the wild bees may compete for foraging space within Budapest. This aerial map shows that there is urban greenspace, which may provide additional foraging space for pollinators in Budapest. Apiarist M. Borzsei (per. comm.), considers Budapest as being a great city for bees, as Budapest has many flowering trees throughout the spring and early summer, such as; Acacia, Linden and Chinese Honey Tree. Environments that are dense and abundant with flowers of few species are favoured by honeybees. Although, these flowering trees provide foraging sources, many wild bee species prefer wider varieties of flowers. Thus, planted urban garden spaces can act as food islands for bees, in city environments that are fragmented by buildings and concrete.

4.4.1 Do these gardens attract bees?

A few limitations to this experiment were the lack of pre-existing data on bees at the study sites, and the study's short observation period of two months. Social bees, such as honeybees and bumblebees live in colonies, and although they grow in number throughout the growing season, they do not hibernate and can live from year to year. In a study such as this one, additional social bees visiting a garden site can either reflect growing populations of bees, or that additional bees have "discovered" this foraging site and are now feeding at this site. To overcome these variables, pre-existing garden spaces with bee loving plants were selected as additional monitoring sites. The bee activity at the control and bee attracting sites will be compared against the pre-existing garden sites, in order to determine if bees would forage in the gardens regardless of the additional planted gardens.

Figure 3.3.3a represents the Average number of observed bee visits per week, in Leonardo Kert. This figure shows that the pre-existing garden had a lot of bee activity, as the data line shows a significantly higher number of bee visits, especially in week three. By week 7 however, it had as much bee activity as both the Control and the Bee Attracting gardens. This Control garden has few bee visits with little variability, aside from a slight increase of bee visits in the last two weeks. Whereas, the Bee Attracting garden had very few bee visits until week 5, when the number grew significantly from an average of 1 visit in week five, to 5 visits in week 7 and finally 9 average visits in week 8. Of the two garden locations Leonardo Kert had more visits and bees were more

consistently present. From figure 3.3.3b, the pre-existing garden sites had a lot more bee activity than did the Bee Attracting, the Control and the Strawberry Basket Garden sites. Site 5 had the most bee visits, with a maximum weekly average of 6 bees visiting, while Site 4 consistently had one or two bee visits. From this analysis, there is strong supporting evidence, that bees would have still visited these gardens (Leonardo Kert and CEU Japanese Garden), with or without the presence of additional gardens.

4.4.2 Active Feeding

To investigate whether the gardens merely attract bees or if they actually are a source of food for bees, "Active Feeding" was recorded, as the average number of bees "Actively Feeding" per week. Figures 3.3.3c and 3.3.3d depict these relationships at both Leonardo Kert and CEU Japanese Garden, respectively. From figure 3.3.3c the pre-existing garden shows significant activity of initial active feeding, which declines after week 5. This decline can be attributed to the end of the sage flowers, as is recorded in the field notes. The Control site maintained a steady pattern of active feeding. While the Bee Attracting garden had significantly more bees feeding from week 5 to week 8. This trend corresponds to when more flowers were in bloom, during the last four weeks of the study (Table 3.2.2). The CEU Japanese Garden saw other active feeding patterns. From Figure 3.3.3d, the pre-existing garden sites had regular occurrences of active feeding, with Site 5 showing an increase in activity over weeks 6-8. Site 4 had less occurrences of active feeding; however the number of occurrences was constant. The Control, Bee Attracting and Strawberry Basket sites had very little active feeding. In Leonardo Kert, the increase active feeding in the Bee Attracting garden could be supporting evidence for the effectiveness of planting flowers that attract bees. Observations in the CEU Japanese garden led to inconclusive results, as there was a long dearth period, and the flowers in the Bee Attracting garden bloomed after the designated monitoring period. The smaller patio-sized planter boxes, with less space for plants, could also be the reason for less active feeding. Whereas in Sites 4 and 5, many bees were actively feeding in the pre-existing garden sites, where the flowers are more abundant in densely spaced.

4.4.3 Other Pollinators

As bees are not the only important pollinators who may be attracted to garden flowers, other pollinators who visited garden sites were also counted. Hoverflies were regularly sighted, while only one Butterfly had visited the Control Site in Leonardo Kert. The average hoverfly visits per week were graphed in figures 3.3.3e and 3.3.3f, for Leonardo Kert and CEU Japanese Garden respectively. As depicted by these graphs, hoverflies were present in low numbers at nearly all of the garden sites recorded, except for the Strawberry Basket site. This provides supporting evidence towards the legitimacy of planting for pollinators.

Figure 4.1.3 Hoverfly resting on oregano in CEU Japanese Garden

The hoverflies appear to be less impacted by the size of the garden. Although, Leonardo Kert saw as many as 3 average hoverflies per week, CEU Japanese Garden persisted in having hoverflies visit both the Control and Bee Attractant planter boxes.

4.4.4 Temperature

A critical environmental factor that impacts bee activity is weather. Bees prefer feeding on warm days in the sun, and some species are more sensitive to shade than others (Xerces et al. 2008). For instance, bumblebees are more tolerant to shadows and feed from early morning until dusk. Yet, honeybees are sensitive to shade and shadows and prefer to feed during the warmest times of the day, from late morning until late afternoon. To test this relationship between bees and temperature, daily bee visits were graphed against the average daily high temperatures figures 3.3.3g and 3.3.3h. From these two scatterplots, the trendlines reveal little to no significant relationship, between the recorded bee visits and the daily high temperatures. The r^2 value in figure 3.3.3g for Leonardo Kert shows a value of 0.10. While the r^2 value in figure 3.3.3h for the CEU Japanese Garden is 0.21. The r^2 value for the CEU Japanese Garden is larger than that for Leonardo Kert, yet neither graph provides significant supporting evidence to show relationships.

Although this relationship is not evident through these scatterplots, there appears to be a relationship between daily temperatures and bee visits, when comparing figure 3.3.3i with figure 3.3.3j and figure 3.3.3k with figure 3.3.3l. Where figures 3.3.3i and 3.3.3k illustrate the average number of bee visits observed, in Leonardo Kert and CEU Japanese Garden respectively. And figures 3.3.3j and 3.3.3l show the daily average temperatures recorded in Budapest on the days monitored, for Leonardo Kert and CEU Japanese Garden respectively. The warmer temperature trends coincide with days of higher bee activity, while the cooler weather trends correspond with

days of less bee activity. Despite the results from the scatterplots, a relationship does appear to exist between daily temperature and bee activity.

4.4.5 Important bee species managed vs. wild

Figure 4.1.5a Honeybee feeding on lavendula in CEU Japanese Garden

While monitoring the garden sites, at both Leonardo Kert and CEU Japanese Garden, managed and wild bees were observed actively feeding. While many of the bees at the CEU Japanese were *Apis mellifera*, there were also wild bees actively feeding on the same foraging materials predominantly in Sites 4 and Site 5. At Leonardo Kert, there were some honeybees, yet there were many more native bees present at this site. Note that bee identification requires a high level of knowledge about the physical characteristics of various bee species. As the author of this report, does not hold such knowledge at this time, it will be noted that both managed and wild bees were recorded in the field notes, when the bees were identifiable. Both managed and wild bees are present and were monitored actively feeding in the garden sites, thus both species are locally important in Budapest.

4.4.6 Bees favorite flowers to forage

While observing bees feeding activities, the flowers from which they were feeding were noted. The bees fed from all flowers except: *Gazania x hybridus*, *narcissus*, *Tulipa, Pelargonium x hortorum, and Topaeolum*. The favourite plants at the CEU Japanese Garden were located in Site 5: *Prunella, Lavendula* and coriander, and in Site 4: fava bean flowers and calendula. While the favourite plants for foraging at Leonardo Kert were in the pre-established site: sage and thyme; in the Control site: pansies, snapdragons, poppies and calendula; and finally all bees foraged on all flowers in bloom within the Bee Attracting garden.

Figure 4.1.5b A sweat bee feeding on oregano in Leonardo Kert

4.6 Recommendations

While looking through recommendations made by NGOS, bee experts and specialists in section 2.5, many of the actions recommended can be taken on by individuals. For the purpose of this

study, the Bee monitoring experiment gardens were built and designed for foraging pollinators. By assessing the outcome of these garden sites, many of these recommendations have been taken. For instance Potts et al. (2005) suggests "considering nesting resources and habitat, as well as foraging plant materials, when considering bee communities". While Matteson and Langellotto (2010) recommend "utilizing and establishing floral plantings in urban areas, high in light exposure". Finally Ian Tait from Feed the Bees (2011) recommends that individuals plant more flowers that feed bees.

The gardens, for this monitoring study, were designed with pollinators in mind, complete with plants for foraging, patches of bare soil, framed by wooden pallets with nooks and holes where wild bees might nest. The gardens were placed in prominent locations within the community garden spaces with the desired outcome that these gardens lead to further environmental education, as well as positive ecological encounters with pollinators, while also feeding bees. After two months of monitoring these sites, wild and managed bees are attracted to these gardens and feed actively at the garden sites. Meanwhile, the gardens have becoming conversation pieces, as interested gardeners frequently stop the author to discuss bees.

This study does not focus primarily on rural and agricultural environments; however they are important habitats for bees. Human food security requires healthy bee populations to nest and forage in agricultural areas. In order to maintain rural and agricultural bee populations, maintaining spaces for bee nesting and foraging space must be integrated into rural land management practices. Note the following four recommendations made by Greenpeace (2013) for the EU:

1) "Ban the use of bee-harming pesticides, starting with the top-ranked most dangerous pesticides currently authorised for use in the EU"
2) "Through the adoption of pollinators' national actionplans, support and promote agricultural practices that benefit pollination services within agricultural systems"
3) "Improve conservation of natural and semi-natural habitats around agricultural landscapes, as well as enhance biodiversity within agricultural fields."
4) "Increase funding for research and development on ecological farming practices that move away from reliance on chemical pest control towards biodiversity based tools to control pests and enhance ecosystem health." (Greenpeace 2013)

These are progressive suggestions, which EU State decision makers could adopt into legislation to ensure the best possible support for struggling bee populations, and to avoid future food shortages.

In Hungary, there does not appear to be a concern for declining bee populations, while *Apis mellifera* are being used as the indicator species. However, studies such as the study on Hungarian *Bombus* populations by Spataki et al. (2005), should be a strong indicator that not all is fine with Hungarian bee populations. More studies are required to better understand the status of wild bee populations in Hungary. With the European Commissions' ban on the use of neonicotinoid pesticides, funded has been allocated for Member States to conduct their own research on the effects of neonicotinoid pesticides on pollinators. These studies are supporting arguments against neonicotinoid pesticides, as they are highly correlated to instances of CCD. Hungary could utilize such financial resources to gather a better understanding of the bee populations within Hungary, and what impacts agrochemicals are having on them.

5.0 Conclusion

For the past 13 years the European Commission has been actively working to better understand what is causing the decline of honeybees. The European Commission has allocated financial resources in research and development, in order to better understand the plight of honeybees and to find the better rural land management practices that will improve environmental conditions for honeybees in Europe. Yet more attention should be dedicated on other species of bees as well.

There are projects and studies, currently underway, which focus on pollinators. These are being carried out by EU Member States, and are financially supported through the European Commission's LIFE program. Projects such as the "Papillons" project in Belgium, and the Urbanbees project in France appear to coincide with other initiatives that are been put into practice in other countries, such the "Feed the Bees" program, in British Columbia, Canada. These initiatives are working to restore pollinator habitat to help threatened pollinator species. The habitat is restored, by creating biodiversity networks, which reduce fragmentation and genetic isolation. The pollinator monitoring experiment that was conducted for this study is an example of what can be done by individuals to help urban bee populations. Through the analysis of the data from this experiment, these garden spaces, especially Leonardo Kert are additional foraging sources for pollinators. These EC LIFE initiatives, mentioned above, are carrying out similar projects, but at larger community scales. When these projects are shared by communities, the desired outcome will significantly larger in magnitude. Further studies are required, to determine whether the gardens at Leonardo Kert and CEU Japanese Garden are better sources of food for bees next year, as the perennial plants mature and increase in size and density.

From this study, Budapest appears to have both wild and managed bees living within the city. Further research should be conducted to gather a better understanding of the status of wild bees in Hungary, as the last study was performed 9 years prior, concluding that there are some species of *Bombus* at risk and extinct. With Budapest's long growing season, greenspace, and patios, free from agrochemicals, it is a great city for individuals who would like to do more for biodiversity, especially for pollinators.

The Wales political move, of adopting a pollinator action plan for their country, sets an example for other EU Member states and for other countries around the world. Declining bee populations is a very serious matter, which requires strong and immediate action. Although, improving environmental conditions for bees can appear pleasant and trivial, it is a critical task for the survival off bees. In terms of global food security, pollination is no less important than a farmer planting seeds to feed people.

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Appendix 1.a Field note data: Leonardo Kert

Leonardo Kert

Date	05/05/2014	Weather	70% overcast w/ clouds		*Temp C*	*13*			
Time	10:30am		cloudy/sunny		Wind	NNW	8 km/hr		
	Time (min)	1	2	3	4	5			
	Site								
	1	0	0	0	0	0			
	2	0	0	0	0	0			
	3	0	0	0	0	0			
	4	0	0	0	0	0			
	5	0	0	0	0	0			
	6	6	-	-	-	-			
	7	8	-	-	-	-			
Date	06/05/2014	Weather	20 % Cloud cover		*Temp C*	*17*			
Time	11:53		sunny		Wind	N	9 km/hr		
	Time (min)	1	2	3	4	5			
	Site								
	1	0	2FB	1AF	2	1AF			
	2	0	1	1	0	1			
	3	1	1	0	0	0			
	4	0	1	1AF 1HF	0	0			
	5	1	2HF	0	1AF	0			
	6	9	7	6	6	5			
	7	6	8	13	10	12			
Date	07/05/2014	Weather	40% Cloud cover		Temp C	23	accu daily avrg		
Time	13:25		Sunny, feels hot		Wind				
	Time (min)	1	2	3	4	5			
	Site								
	1	1HF	1HF	0	0	0	Chives		
	2	1	0	2HF	1HF	5HF	armera, chives		
	3	1NB 1HF	1NB 1HF	1HF	0	1	columbines		
	4	0	0	0	0	0	pansies, red geraniums		
	5	0	0	0	0	0	pansies, red geraniums		
	6	15	12	12	7	11	nipita, thyme		
	7	12	11	15	15	18	sage, thyme		
Date	08/05/2014	Weather			Temp C	21			
Time	15:45								

	Time (min)		1		2		3		4	5	
	Site										
		1	1		0		2		0	1	chives, phlox
		2	0		0		1		1	0	armeria, chives
		3	0	1HF	1		2	1HF		1HF	columbies, end of deronicum
		4	0		1	1HF	1		1	1	pansies, red geraniums
		5	0		0	1HF			0	2	pansies, red geraniums
		6	8		9		7		7	6	Nipita, thyme
		7	8		7		6		6	7	sage
	*All sites in shade at this time										

Date	12/05/2014	Weather	15% Cloud cover	Temp C	18	
Time	11:40		Sun, breeze			

	Time (min)		1		2		3		4	5	
	Site										
		1	0		0		0		1	1	Chives, phlox
		2	0	1HF			0		1	0	armeria, chives
		3	0		0		0		0	0	3 columbine (2 flowers) deronicum heads (n
		4	0		0	1HF		1BB		0	pansies, red geraniums
		5	0		0		0		0	0	pansies, red geraniums
		6	-		-		-		-		Nipita and thyme removed, 6 is no longer a s
		7	5		5		6		4	5	Sage
	*Today after weekend borage seedlings were removed and 1 small rose plant and two more plants have been planted										
	* I put up "Urban Bee Study" signs										

Date	13/05/2014	Weather	100% high cloud cover	Temp C	16	
Time	14:20		Light rain turned to heavy rainshower			

	Time (min)		1		2		3		4	5	
	Site										
		1	0		0		0		0	0	Chives, phlox
		2	0		0		0		0	0	armeria, chives
		3	0		0		0		0	0	several columbines, deronicum heads
		4	0		0		0		0	0	pansies, red geraniums
		5	0		0		0		0	0	pansies, red geraniums
		6	-		-		-		-		
		7	0		0		0		0	0	Sage

Date	14/05/2014	Weather	100% Cloud cover	Temp C	16	
Time	13:48		Mild, windy			

	Time (min)		1		2		3		4	5	
	Site										
		1	0		0		0		0	1HF	Chives, Phlox
		2	1HF		0		0		0	0	aremeria, chives
		3	0		0		0		0	0	several columbines

4	1HF 1	0	1HF	0	0	pansies, red geraniums
5	0	0	0	0	0	pansies, red geraniums
6	-	-	-	-	-	
7	4HB	3HB 1BB	2HB 2BB 1NB	2HB 2BB	2HB 2BB	Sage

Date	19/05/2014	Weather	10% high cloud cover
Time	11:48		Hot mild breeze, sunny

Time (min)	1	2	3	4	5	
Site						
1	0	1NB	0	0	0	Chives, phlox
2	0	0	0	0	0	armeria
3	0	0	0	0	0	no flowers in bloom
4	0	0	0	0	0	pansies, red geraniums
5	0	1	1HF 1	0	1	pansies, red geraniums
6	-	-	-	-	-	
7	20<	20<	20<	20<	20<	Sage

* Aphid damage to sunflowers

Date	21/05/2014	Weather	0% cloud cover	Temp C	28
Time	10:13		hot, windy (moderate)		

Time (min)	1	2	3	4	5	
Site						
1	0	1FB	0	0	0	Chives, 1 flowering phlox
2	1HF	0	0	0	0	2 armeria, chives
3	0	0	0	0	0	no flowers
4	1	0	1	1	1	pansies, red geraniums
5	2NB 1HF	1	2	1HF 1BF	2	pansies, red geraniums
6	-	-	-	-	-	
7	9	9	10	8	8	Sage

* Just watered

Date	22/05/2014	Weather	80% Cloud cover
Time	13:05		Hot, breeze

Time (min)	1	2	3	4	5	
Site						
1	0	0	1	1HF	1HF	phlox, chives
2	0	0	0	1	1HB	aremeria, chives
3	0	1 in soil	1 in soil	1FB 1 in soil	0	no flowers in bloom
4	1HB	1	2	1NB	1NB	pansies, red geraniums
5	1HB	1HB	3	3	2	pansies, red geraniums
6	-	-	-	-	-	
7	9	10	14	11	12	Sage

Date	23/05/2014	Weather	0% cloud cover		Temp C	29	
Time	10:29		hot, windy				
	Time (min)	1	2	3	4	5	
	Site						
	1	0	0	0	0	0	chives, phlox
	2	0	0	0	0	0	few chive flowers, armeria
	3	0	0	0	0	0	nothing in bloom
	4	2	1	2	2	2	pansies, red geraniums
	5	2	3	2	2	2	pansies, red geraniums
	6	-	-	-	-	-	
	7	9	9	10	11	10	Sage

Date	26/05/2014	Weather	90% cloud cover		Temp C	27	
Time	14:44		warm, windy				
	Time (min)	1	2	3	4	5	
	Site						
	1	0	0	0	0	0	Several phlox, chives past prime
	2	0	0	0	0	0	several armeria
	3	0	0	0	0	0	no flowers
	4	1	1	0	1	1	pansies, geraniums
	5	0	0	1	1	2	pansies, geraniums
	6	-	-	-	-	-	
	7	9	9	8	10	9	Sage

*Began to rain slightly while monitoring sites 4 and 5

Date	27/05/2014	Weather	85% High cloud cover		Temp C	26	
Time	13:39		hot, slight breeze				
	Time (min)	1	2	3	4	5	
	Site						
	1	0	0	0	0	0	dirth
	2	0	0	NB2	NB1	0	several armeria, two tiny yellow wild flowers
	3	0	0	0	0	0	dearth
	4	3	1	0	2	2	pansies and red geraniums
	5	2	1	2	1	0	pansies and red geraniums, 1 salmon colored
	6	-	-	-	-	-	
	7	5	6	7	4	4	Sage

Date	01/06/2014	Weather	100% cloud cover		Temp C	22	
Time	11:00		warm, slight breeze				
	Time (min)	1	2	3	4	5	
	Site						
	1	0	0	0	0	0	Gazania (closed from cloudy weather)

	2	0	0	0	0	0	Dearth
	3	0	0	0	0	0	1 marigold
	4	1	0	1HF	0	1NB	pansies and geraniums (red)
	5*	2HF	0	1HF	0	0	pansies and geraniums (red), poppies (salmo
	6	-	-	-	-	-	
	7	Not measured	Not measured	Not measured	Not measured	Not measured	Site obstructed, did not monitor

*When first arrived saw 2 bombus AF on poppies on site 5

Date	02/06/2014	Weather	90% cloud cover	Temp C	21	
Time	17:35		warm slight breeze, humid			

Time (min)	1	2	3	4	5	
Site						
1	0	0	0	0	0	Gazania (closed from cloudy weather)
2	0	0	0	0	1FB	Dearth
3	0	0	0	0	0	1 marigold
4	0	0	0	0	0	pansies, geraniums(red)
5	0	0	0	0	0	pansies, geraniums, 2 salmon colored poppie
6	-	-	-	-	-	
7	1	1	1	1	1	AF, end of sage and thyme blooms (few left)

Date	03/06/2014	Weather	85% cloud cover	Temp C	22	
Time	11:42		cool breeze, humid			

Time (min)	1	2	3	4	5	
Site						
1	0	0	0	0	0*	Gazania, closed for cool weather
2	0	0	0	0	0	1 armeria bloom
3	0	0	0	0	0	1 marigold
4	0	0	0	0	0	pansies, geraniums
5	0	0	0	AF1	0	AF Pansy
6	-	-	-	-	-	
7	1HF 2	1HF 1	1HF 1	1HF 2	2HF	sage, several red poppies, small white wildflo

*Spottted bombus on poppy at this time

Date	04/06/2014	Weather	70% cloud cover	Temp C	24	
Time	11:55		warm, breeze			

Time (min)	1	2	3	4	5	
Site						
1	0	0	0	0	0	Gazania
2	0	0	0	0	0	dearth
3	0	0	1FB	0	0	1 marigold
4	1	0	1	2	2	pansies, geranium
5	1	0	1	2HF	1	pansies, geranium, salmon poppy SS, 1 calen
6	-	-	-	-	-	

7	3	3	1HF 3	4	5	sage, several red poppies, small white wildflo

Date	06/06/2014	Weather	5% cloud cover	Temp C	28
Time	11:56		hot, full sun, light breeze		

Time (min)	1	2	3	4	5	
Site						
1	0	0	0	1	1	Gazania in full bloom
2	1 AF	0	1HF	1HF 1*	0	1 aremeria bloom
3	0	0	0	0	0	1 marigold, 1 calendula
4	2	1HF 1FB	2	0	1	pansies, geraniums
5	1	2	1	2HF 1	2HF 1	pansies, geraniums, poppies, 1 calendula, 2 d
6	-	-	-	-	-	
7	5	3	2HF 4	1HF 5	4	end of sage

* Bee drinking
**earlier saw 1 large black bee and 1 butterfly in site 4

Date	10/06/2014	Weather	10% cloud cover	Temp C	35
Time	17:13		hot, mild breeze		

Time (min)	1	2	3	4	5	
Site						
1	0	0	0	0	0	Gazania
2	0	0	0	0	0	2 armeria clusters, tine wild flowers
3	0	0	0	0	2	borage, calendula SS, marigold SS
4	0	1	0	1	1FB	pansies, geranium, nasturtium
5	0	1FB	1FB	1 FB BB	0	pansies, geranium, nasturtium, dahlia, calend
6	-	-	-	-	-	
7	3	4	5	3	1HF 4	Sage (end of) and thyme flowers

* All sites in shade

Date	11/06/2014	Weather	0% cloud cover	Temp C	34
Time	10:00		hot, mild breeze		

Time (min)	1	2	3	4	5	
Site						
1	0	1FB 1	0	1	0	gazania, oregano
2	3	1	1	1	1	2 armeria, oregano
3	0	1	0	1	1	Borage, calendula, marigold
4	1	1	0	1	0	pansies, geraniums, poppies, nasturtium
5	1FB 1	1	0	1FB 1	1HF	pansies, geraniums, poppies, nasturtium, cale
6	-	-	-	-	-	
7	2	1HF 2	2FB 1	4 AF	6	sage, thyme (end of flowering season)

Date	13/06/2014	Weather	0% cloud cover	Temp C	27
Time	10:41		hot, moderately strong wind		

Time (min)	1	2	3	4	5	
Site						
1	1	1FB 1AF	3	2	4	oregano
2	1	0	2	2	2	Hylotelephium, oregano, mint
3	0	1FB 1	2	0	1FB 1	borage*^, calendula*^, marigold, Hyloteleph
4	0	1FB	1FB	0	0	pansies, geraniums, nasturtium
5	1HF 3	4	2HF	2	2	pansies, geraniums, nasturtium, dahlias, calen
6	-	-	-	-	-	
7	3	4	2HF 2	4	5	Sage

*Site in full sun

*^ sprayed calendula and borage with diluted soap mixture to aphid infestation

Date	15/06/2014	Weather	60% cloud cover	Temp C	24	
Time	13:15		warm, slight breeze			

Time (min)	1	2	3	4	5	
Site						
1	1 AF	1AF	3HF 1AF	2HF 1AF	1AF	gazania, oregano, mind
2	2HF	2HF 1FB	1FB 1D	2HF 1D	0	oregano, Hylotelephium
3	2HF 2	2HF 2BB	2HF 1	3HF	3HF 4FB	borage, calendula, marigold, sedum
4	2FB	0	1FB	2FB	1FB 1AF	pansies, geraniums, poppy, nasturtiums
5	1	1AF	2FB 3	3	2	pansies, geraniums, nasturtiums, calendula, d
6	-	-	-	-	-	
7	2	2	2 1BB	1	3	sage (few flowers)

Date	16/06/2014	Weather	75% cloud cover	Temp C	24	
Time	12:55		warm, mild breeze			

Time (min)	1	2	3	4	5	
Site						
1	7HF 2	5HF 3	3HF 3	3HF 4	2HF 3	gazania, oregano, mint
2	3HF 4	4HF 2	4HF 5	2HF 4	4HF 1	Oregano, lavendula, Hylotelephium
3	3HF	0	2HF	1HF	3HF	borage, calendual, marigold, Hylotelephium
4	1FB	0	1HF	0	0	pansies, geranium, nasturtium
5	2HF 2	2HF 1	2NB	2HF	2HF 4	pansies, geranium, nasturtium, dahlias, calen
6	-	-	-	-	-	
7	3	3	3	2	1FB 1	Sage (few flowers)

* Spoke to inquiring girl about the bee garden

Date	17/06/2014	Weather	95% cloud cover	heavy clouds	Temp C	24
Time	12:42		warm, slight wind			

Time (min)	1	2	3	4	5

	Site									
		1	2HF		3HF 1		2HF 1 1HF		4HF 1	5HF 1	Gazania, oregano, mint
		2	1HF 1		1HF 1		1NB		1FB 3	1 HF	Hylotelephium, lavendula, organo
		3	2HF		2HF		2HF		2HF	1HF 1	borage, marigolds, calendula
		4		0	1HF 1			2	1FB 1	1	pansies, geranium, nasturtium
		5		1	3HF		4HF		3HF 1FB	1HF 1	pansies, geranium, nasturtium, dahlias, calen
		6	-		-		-		-	-	
		7	1FB 1HF NB3		2HF 2FB		1HF 2FB 2		5FB	1In	Sage (end of)
Date	18/06/2014		Weather		25% cloud cover		heavy clouds		Temp C	27	
Time	14:00				Warm, windy, full sun						
	Time (min)			1		2		3	4	5	
	Site										
		1		4		5		6	3	4	Gazania, oregano, mint
		2		2		3		5	5	6	Hylotelephium, lavendula, organo
		3		0	1HF		1HF		1HF	1HF	borage, marigolds, calendula
		4		0	1FB			0	1	0	pansies, geranium, nasturtium
		5		1		5	1HF 3		1HF 3	1HF 2	pansies, geranium, nasturtium, dahlias, calen
		6	-		-		-		-	-	
		7	2FB		5FB/IN		1HF 3FB		4IN	2FB/In 1AF	few Sage flowers left
Date	20/06/2014		Weather		60% cloud cover		heavy clouds		Temp C	23	
Time	13:15				Warm, windy, full sun						
	Time (min)			1		2		3	4	5	
	Site										
			1HF		1HF		1HF				
	1*		2HB 1		1HB		1HB		2	3HF 2	Gazania, oregano, mint, thyme, 1 zinnea
	2*		2HF 1		3HF 2			2	2HF 2	2HF 1	Hylotelephium, lavendula, organo, armeria
		3		1		0		0	1HF	0	marigolds, calendula some hylotelephium
		4		0	1HF		1HF		0	2HF	pansies, geranium, nasturtium, poppies (salm
		5	3HF		1HF			0	2HF 2	2HF	pansies, geranium, nasturtium, dahlias, calen
		6	-		-		-		-	-	
		7		0	1AF			0	2IN	1FB 2AF	few Sage flowers left

*Site just watered, had seen bees on poppoes, calendula and dahlias before monitoring, while monitoring

Date	23/06/2014		Weather		5% cloud cover		heavy clouds		Temp C	28	
Time	14:20				hot, slight wind						
	Time (min)			1		2		3	4	5	
	Site										

		1		8	>10		9		9	>10		Gazania, oregano, mint, thyme, 1 zinnea
		2		7		10	8		7		8	Hylotelephium, lavendula, organo, armeria
		3	2FB		1IN 1AF		1AF		2	2HF		marigolds, calendula some hylotelephium
		4	1FB			1	2HF 1FB 1	1HF 1		3HF		pansies, geranium, nasturtium, poppies (salm
		5	2HF 1			0	1HF	1HF 1		1AF		pansies, geranium, nasturtium, dahlias, calen
		6	-		-		-	-		-		
		7		0	1AF		1AF	2IN		1FB 2AF		few Sage flowers, 1 carnation
	* 4 bee species seen											
Date	25/06/2014	Weather	100% cloud cover		heavy clouds		Temp C			21		
Time	17:15		warm, breeze									
	Time (min)		1		2		3		4		5	
	Site											
	1		0		1		1		1		0	Gazania, oregano, mint, thyme, 1 zinnea
	2		0		1IN 1 AF		2IN 1AF	1AF		2AF		Hylotelephium, lavendula, organo, armeria
	3		0		1AFF		1FB 1AF		0	1FB		marigolds, borage, calendula some hylotelep
	4		0		0		1IN		0		0	pansies, geranium, nasturtium, poppies (salm
	5		0		0		0		0		0	pansies, geranium, nasturtium, dahlias, calen
	6	-		-		-		-		-		
	7		0		1FB BB		1FB BB		0	1IN		1 sage flower, 1 carnation
	*In sites 1& 2 3 bee species seen, HB, BB and tiny bee											
Date	27/06/2014	Weather	0% cloud cover				Temp C			25		
Time	13:55		Hot, sunny									
Observers:	Volunteers											
	Time (min)		1		2		3		4		5	

Appendix 1b Field Notes: CEU Japanese Garden

Site CEU Japanese Garden

Date	05/05/2014	Weather	Overcast, high clouds							
Time	13:00		Temp C	16						
	Time (min)	0-1		2		3		4	5	Flowers in bloom
	Site									
	1	0		0		0		0	0	pansies
	2	0		0		0		0	0	armeria, phlox, chives, columbine blooms
	3	0		0		0		0	0	strawberry flowers
	4	2		0	1NB		1NB		2	cotoneaster, YfS (Yellow flowering shrub)
	5	0		0		0		0	0	Prunella, centaurea scabiosa

*(photos, noticeable water damage from vol. overwatering and no prev no holes in bottom previously)
slight root damage to borage from overwatering)

Date	06/05/2014	Weather	80% overcast			Wind km/hr		15		
Time	14:45		*Temp C*	*17*		Wind direction	N			
	Time (min)	1		2		3		4	5	
	Site									
	1	0		0		0		0	0	pansies
	2	0		0		0		0	0	armeria, phlox, chives, columbine blooms
	3	0		0		0		0	0	strawberry flowers
	4	1		0		0		0	0	cotoneaster, YfS (Yellow flowering shrub)
	5	1HF 1NB		1HF 1NB		1NB		1NB	0	Prunella, centaurea scabiosa

Date	07/05/2014	Weather	5% cloud cover		Wind km/hr		14			
Time	10:00	*Temp C*		*12*	Wind direction	ESE				
	Time (min)	1		2		3		4	5	
	Site									
	1	0		0		0		0	0	pansies , geraniums
	2	0		0		0		0	0	armeria, phlox, chives, columbine blooms
	3	0		0		0		0	0	strawberry flowers
	4	0		0		0		0	0	cotoneaster, YfS (Yellow flowering shrub)
	5	0		0		0		0	0	Prunella, centaurea scabiosa

*geraniums added night before

Date	08/05/2014	Weather	30% cloud cover	Wind km/hr	

Time	10:52	Temp C	21	cool, windy				
	Time (min)	1	2	3	4	5		
	Site							
	1	0	0	0	0	0	pansies, geraniums	
	2	0	0	1HF	0	0	chives, columbies, armeria, phlox	
	3	0	0	0	0	0	strawberry flowers	
	4	0	0	0	0	0	yellow shrub flower	
	5	0	0	1	0	0	Prunella, centaurea scabiosa, crawling purple wildf	
Date	12/05/2014	Weather	15% cloud cover	Temp C	18			
Time	14:00		windy, sun					
	Time (min)	1	2	3	4	5		
	Site							
	1	0	0	0	0	0	pansies, geraniums (pink, red)	
	2	0	0	0	0	0	chives, columbies, armeria, phlox, borage	
	3	0	0	0	0	0	strawberry flowers	
	4	1NB	1NB	1NB	0	0	yellow shrub flower, calendula	
	5	0	0	1NB	1NB	1NB	Prunella, centaurea scabiosa, dandelion, crawling p	
Date	14/05/2014	Weather	100 cloud cover	Temp C	16			
Time	15:45		cold, windy, light rain					
	Time (min)	1	2	3	4	5		
	Site							
	1	0	0	0	0	0	pansies, geraniums (pink, red)	
	2	0	0	0	0	0	chives, columbies, armeria, phlox, borage	
	3	0	0	0	0	0	strawberry flowers, fruit setting	
	4	0	0	0	0	0	yellow shrub flower, calendula	
	5	0	0	0	0	0	Prunella, centaurea scabiosa, dandelion, crawling p	
Date	19/05/2014	Weather	40% cloud cover	Temp C	23			
Time	13:16		hot, slight breeze					
	Time (min)	1	2	3	4	5		
	Site							
	1	0	0	1 In	0	0	pansies, geraniums (pink, red)	
	2	0	0	0	0	0	chives, columbies, armeria, phlox, borage	
	3	0	0	0	1HF 1HB	0	strawberry flowers, fruit setting, calendula	
	4	0	0	0	0	1	calendula	

	5	4	3	2HB	2HB	2HB	Prunella, dandelion, crawling purple wildflower

Date	21/05/2014	Weather	30% cloud cover, high clouds	Temp C	28
Time	11:36		hot, slight breeze		

Time (min)	1	2	3	4	5	
Site						
1	0	0	0	0	0	pansies*, geraniums (pink, red)
2	0	0	0	0	0	chives, armeria, borage
3	0	0	0	0	1FB	few strawberry flowers, fruit setting, calendula
4	0	1	0	0	0	calendula
5	0	0	0	0	1HF	Prunella, dandelion, crawling purple wildflower

*pansies are sickly looking

Date	22/05/2014	Weather	0% cloud cover	Temp C	29
Time	10:50		hot, still air		

Time (min)	1	2	3	4	5	
Site						
1	0	0	0	0	0	few pansies, geraniums (pink, red)
2	0	0	0	0	0	chives, armeria, borage
3	0	0	0	0	0	strawberry fruit, no flowers
4	0	0	0	0	0	calendula
5	1HB	1HB	2HB	1HB	2HB	Prunella, dandelion, crawling purple wildflower

Date	26/05/2014	Weather	95% cloud cover	Temp C	27
Time	16:20		warm, slight breeze		

Time (min)	1	2	3	4	5	
Site						
1	0	0	0	0	0	geraniums (pink, red)
2	0	0	0	0	0	borage, end of chives and armeria
3	0	0	0	0	0	strawberry fruit, no flowers
4	0	0	1	0	0	calendula, fava bean flowers
5	4	3	4	5	6	Prunella, *Centaurea scabiosa*

Date	27/05/2014	Weather	80 % cloud cover	Temp C	26
Time	12:22		warm, no air turbulence		

Time (min)	1	2	3	4	5	
Site						
1	1D	0	0	0	0	geraniums (pink, red)
2	0	0	0	0	0	borage, end of chives and armeria
3	0	0	0	0	0	strawberry fruit, no flowers
4	0	0	1HF	1HF	1	calendula, fava bean flowers
5	3AF	3AF	4AF	3AF	1FB,BB 2AF	Prunella, *Centaurea scabiosa*

*Plants were just watered

** While monitoring site 2, was approached by a middle-aged woman in a bright floral dress. She asked "are there any bees

Date	28/05/2014	Weather	85% cloud cover, overcast	Temp C	23
Time	14:55		warm breeze, med high clouds, humid		

Time (min)	1	2	3	4	5	
Site						
1	0	0	0	0	0	geraniums (pink, red, salmon**)
2	0	0	0	0	1fly	borage, several armeria, added gazania
3	0	1*	0	0	0	strawberry fruit, no flowers
4	1AF	1AF	1AF	0	0	calendula, fava bean flowers
5	1AF	1FB 1AF	2AF	2AF	1FB 2AF	Prunella, *Centaurea scabiosa*

*Just had a rain shower 30 min prior

**Added salmon colored geraniums night before

Date	02/06/2014	Weather	100% cloud cover, overcast	Temp C	21
Time	15:55		warm, slight breeze, light rain		

Time (min)	1	2	3	4	5	
Site						
1	0	0	0	0	0	geraniums (pink, salmon)
2	0	0	0	0	1*FB	borage, armeria, gazania
3	0	0	0	0	0	strawberry fruit, no flowers
4	0	0	0	0	0	calendula, bean flowers
5	0	0	0	0	0	Prunella, *fava bean plants*

*1 leaf cutter bee flew by with a piece of foliage

**added gazania

Date	03/06/2014	Weather	30% cloud cover	Temp C	22
Time	14:40		moderately warm, humid		

Time (min)	1	2	3	4	5	
Site						
1	0	0	0	0	0	geraniums (pink, salmon)

2	0	0	0	0	0	many borage, 1 bloom armeria, gazania
3	0	0	0	0	0	strawberry fruit <1cm dia, many fava bean flowers
4	3AF	2AF	2AF	0	2AF	calendula, bean flowers
5	4AF	4AF	6AF	4AF	5AF	Prunella

Date	04/06/2014	Weather	70% cloud cover	Temp C	24	
Time	10:40		lukewarm, slightest breeze			

Time (min)	1	2	3	4	5	
Site						
1	0	0	0	0	0	*geraniums (pink, salmon)
2	0	0	0	0	1HF	many borage, gazania
3	1	0	0	0	0	strawberry fruit <1cm dia, many fava bean flowers
4	0	0	1HF 1	0	1	calendula, bean flowers
5	1	2	2	2	3	Prunella

*pansies appear dead

Date	06/06/2014	Weather	40% cloud cover	Temp C	28	
Time	14:12		hot, light breeze			

Time (min)	1	2	3	4	5	
Site						
1	0	0	*1BB	0	0	geraniums (pink, salmon)
2	0	0	0	0	0	many borage, gazania
3	0	0	0	0	0	strawberry fruit <1cm dia
4	0	0	1FB 1	1	1	calendula, fava bean flowers
5	3	3	3	5	4	Prunella, lavendula

*After watering 1 bb was flying around, does it nest in this box?

Date	09/06/2014	Weather	0% cloud cover	Temp C	33	
Time	10:50		hot, mild breeze			

Time (min)	1	2	3	4	5	
Site						
1	0	0	0	0	0	geraniums (pink, salmon)
2	0	0	0	0	0	*borage
3	0	0	0	0	0	dry strawberry fruit <1cm dia
4	0	1AF	0	0	0	calendula
5	3	3	2	3	3	Prunella, lavendula

*Saw BB on borage when arrived to site (Photo)

Date	10/06/2014	Weather	0% cloud	Temp C	35	

			cover					
Time	10:30		Very hot, light breeze					
	Time (min)		1	2	3	4	5	
	Site							
	1		0	0	0	0	0	geraniums (pink, salmon)
	2		0	0	0	0	0	borage
	3		0	0	0	0	0	dry strawberry fruit <1cm dia, some flowering fava
	4		1	2	2	1	1	calendula
	5		4	4	5	4	4	Prunella, lavendula, daylillies
			0% cloud					
Date	13/06/2014	Weather	cover	Temp C	27			
Time	10:40		Hot, moderately strong wind					
	Time (min)		1	2	3	4	5	
	Site							
	1		0	0	0	0	0	geraniums (pink, red, salmon), 1 pansy flower
	2		0	0	0	0	2HF	*borage
	3		0	0	0	0	0	dry strawberry fruit <1cm dia, some flowering fava
	4		0	0	0	0	0	calendula
	5		1	1	2	1	2	Prunella, lavendula, daylillies
	*aphid damage to borage							
			95% cloud					
Date	16/06/2014	Weather	cover	Temp C	24			
Time	15:10		warm, mild breeze					
	Time (min)		1	2	3	4	5	
	Site							
	1		0	1HF	0	0	0	geraniums (pink, red, salmon), several pansies
	2		0	0	0	0	0	*borage
	3		0	0	0	0	0	dry strawberry fruit, no flowers
	4		0	0	0	1FB	1HF	calendula
	5	1HB		1HB	1HB	1HF 1	2HB	Prunella, lavendula, daylillies
	* Just watered site							
			20% cloud cover, high thin					
Date	17/06/2014	Weather	clouds	Temp C	24			
Time	11:05		warm, breeze					
	Time (min)		1	2	3	4	5	
	Site							
	1	2HF		1HF	2HF	2HF	2HF	geraniums (pink, red, salmon), oregano flowers, sev
	2*		0	0	0	1HF	1	1 armeria bloom, borage

3	0	0	0	0	0		dry strawberry fruit, no flowers
4	0	1FB	0	1AF NB	1AF NB		calendula
5	3	4	5	1HF 5	4		Prunella, lavendula, coriander, daylillies

*Table for event was set up next to site, borage was tied up and sprayed for extensive aphid damage

Date	18/06/2014	Weather	25% Cloud cover	Temp C	27		
Time	16:55		warm, windy, site shaded				

Time (min)	1	2	3	4	5	
Site						
1	0	0	0	0	1FB	geraniums (pink, red, salmon), oregano flowers, sev
2*	-	-	-	-	-	3 armeria bloom, borage
3	0	0	0	0	0	dry strawberry fruit, no flowers
4	0	0	0	0	0	calendula
5	6	6	7	7	7	End of Prunella, lavendula, coriander, daylillies

*Could not monitor, as event was going around site. Table set up against site, with people standing and discussing around it

** Borage flowers were damaged, as a tablecloth was put on top of them

Date	23/06/2014	Weather	0% cloud cover	Temp C	28		
Time	12:50		Hot, mild breeze				

Time (min)	1	2	3	4	5	
Site						
1	1fly	1fly	2 flies 1HF	1fly, 1HF	1fly 1HF	geraniums (pink, red, salmon), oregano flowers, sev
2	0	1HF	1HF	2HF	1HF	3 armeria bloom, rucola, 1 chive bloom
3	0	0	0	0	0	dry strawberry fruit, no flowers
4	1AF	1fly 2AF	1AF	1R	1FB 1R	calendula
5	6	1HF 6	8	1HF 5	5	lavendula, coriander, daylillies

Date	25/06/2014	Weather	100% cloud cover	Temp C	21		
Time	13:16		warm, humid, slight breeze				

Time (min)	1	2	3	4	5	
Site						
1	0	0	0	0	0	geraniums (pink, red, salmon), oregano flowers, sev
2	0	0	0	1HF	1HF	3 armeria bloom, ruccola, 1 chive bloom
3	0	0	0	0	0	dry strawberry fruit, no flowers
4	0	0	1HF AF	0	0	calendula
5	3HB	4HB	4HB	4HB	4HB	lavendula, coriander, daylillies

Appendix 2 Interview with Apiarists

Transcribed interview with Apiarist Marta and Attila Borzsei, with the aid of translator János Lipták. July 2nd 2014, in Csobánka, Hungary.

[First 13 min were not recorded]
János: … important because of a sickness, sickness because of a bacterie…
Juliana: [interrupts] ok… a bacteria..
János: … aaand it's a similar
Juliana: [interrupts] he was talking about white …
János: yes similar…
Marta: [interrupts] this is the most serious..eu…
Juliana: Is this the verroa mite? Or it's a different bacteria?
Marta: It's not the verroa. Not the verroa… Verroa… eu…
János: It's because of the bacteria… yes bacteria… It's goes like when you making the glue from the bones… you know when you boiling the glue from the bones. But it's a natural glue…
Juliana: [Interrupts] oh …like a gelatin?
János: Yes, a gelatine kind of thing, when you… He told me you can check it. If you put a stick of matches inside, and you rotate it and you pull it out and it looks like glue or something like that…
Juliana: Oh ok
János: …. so you got it and after that
Marta: [interrupts] *speaking Hungarian*
János: … roth…
Marta: roth… the the *[words in Hungarian]* so the baby bees
Juliana: yeah
Marta: … uh die and start to ruth
Juliana: oh they start to rot,
Marta: uh huh
Juliana: OK
Marta: So uh yes …so
János: [interrupts] because of the protein…
Marta: you don't have … you don't will have new bees because they ruth…
Juliana: yeah they rot.
Marta: yeah They are until they is… uuuhh… a nest. You know?
Juliana: OK so…
Marta: so this… this basic things…
Juliana: yes yes
Marta: So it starts to ruth
Juliana: Ok and when you do your annual checkings for the … The House of Bees, I guess you would check for all of this stuff?
Marta: Yes yea
Juliana: Yes?
Marta: yes yes yes. This is the most important and… the the verroa article has certain rule in this issue because uh… verroa article doesn't kill the bees just make them weak.
Juliana: yes
Marta: And if the population became weak they can be infected easily by the bacteria and other. So
Juliana: yeah
Marta: So that the first step uhh in fighting against this… this very bad uuh mmm disease.
Juliana: mmhmm
Marta: Then to fight against the verroa atka.
Juliana: Yes
Marta: … Verroa because if there are no verroa atka the populations has seen.
Juliana: Ok
Marta: And strong. Because verroa atka lives on the body of the bees, and sucking the …
Attila: *Hungarian words*
Marta: … not the blood but the…
Juliana: insides
Marta: yes yes. So that's why the bees became weak. You know?
Juliana: Ok yes
Marta: So it's easily gets ill.
Juliana: OK
(2:50)Marta: by bacteria and uh *gomba*…
Attila and Marta: *exchange words with János in Hungarian*
Juliana: yeah bacteria, fungus

Marta: Fungus, yeah
Juliana: And what was Attila saying about America? Is that…
János: [interrupts] Yeah so that other part, what he said. If they get this … kind of sickness
Juliana: uh-huh yeah?
János: They have to make a big hole. They have to put everything inside. So you cannot uh … transport the bees nowhere and…
Juliana: no…
János: … no bees … and you cannot bring bees here. So you have to put everything in the ground. And you have to put petrol on it and flambe it. So…
Marta: [interrupts] And not only the bees but the whole boxes and everything.
Juliana: Yeah
János: And he told me…
Marta: [interrupts] in connection with
János: He told for us in America they tried to fix this, to help this with antibacterials. I mean antibiotics.
Juliana: Ok. And it didn't work?
János: And that's why he told me he never gonna eat honey from the US.
Juliana: Oh ok. Because they use antibiotics?
János and Marta: Yes
Marta: A lot probably in this case
Juliana: Yeah
János: because of this
Marta: Do you know the Canadian?...
Juliana: ummm some of them … well I only knew one beekeeper who was… I worked on a farm and she was doing this practice. And she would annually put in some antibacterial just to help for the verroa mite because it's a big problem there. They have been, they keep losing their queens, so they are buying them from New Zealand now.
Marta: Umhmm Umhmm
Juliana: So its …. Its been difficult. Do your queens come from Hungary or Europe?
Marta: Hungary or and … and quite often the queens are made naturally you know?
Juliana: Yeah
Marta: We bought ten … approximately ten queens this year…
Juliana: ummhmm
Marta: … but the rest of uhhh became naturally so…
Juliana: That's excellent
Marta: umhmm
Juliana: yeah 'cause I've heard of bee keepers in Canada that, at least from the Pacific Coast. They were buying them from Hawaii. But Hawaii now has varroa mite. So now they are buying them from New Zealand but they have a different season cause they're in South America… Or sorry they're in the Southern part of the Hemisphere.
Attila and Marta: *exchange words in Hungarian*
Marta: Why?
Juliana: Why? Just cause uh … of… throughout the Americas they have had such problems with varroa mite its difficult for a queen to live until the next year.
Marta and Attila and János: *speaking in Hungarian*
János: They are talking about a movie that is going on … in the uhhh cinema
Juliana: Ok
János: in the cinema now
Juliana: Vanishing of the bees?
János: Yeah, something like that. I think so and they are talking about the American bees, the Chinese and…
Marta: Austria… Austrian
János: The Austrian ones and…
Juliana: Oh Ok
János: … these kinds of … you know every part of the world.
Juliana: Yeah
(7:19) János: What kind of different beekeeping you can see\
Juliana: Ok
János: … you can watch
Marta: uhuh. I recommend see because…
Juliana (interrupts): Which one?
Marta: This film.
Juliana: What's the name?
Attila: *speaking in Hungarian*… pen drive…
János: mmmm do you have your flash drive?
Juliana: I can see…mmmm…*rustling with papers and bag, noise of zipper, more rustling*.... I can't see anything….
János: It's there
Juliana: Oh! It is. Uh… OK… igen

Juliana: And… well I know in the US the bees, I know people bring them quite far and you said you bring yours to Esztergom. Is that for… do farmers ask for that?
8:15
Marta: No, no (laughs) in Hungary there are not so big distances like in the USA. Esztergom is aaaa 40km?
Juliana: Yeah, ok
Marta: … distance. Ok we we have uh bees sometimes more further, but uhh … the most far place is approximately 200km
Marta, Attila and Jani: confirm distance in Hungarian.
Marta: Do you know Vezsprém?
Juliana: I've heard of it… my friend's from there…
Marta: Near Balaton?
Juliana: Yeah
Marta: And Laszlo lives there
9:04
Juliana: Oh ok (laughs), I have a friend from there. Yeah it's not so far.
Marta and Attila: *Speak in Hungarian together*
Juliana: You had mentioned that you and Attila went to school. How long was the program?
Attila and Marta: *speak in Hungarian together*
János: One school year, from Autumn to summer.
Juliana: Oh ok
Attila and Marta: *Speak together in Hungarian*
János: Certificated… certification
Juliana: yeah
Attila and Marta: *speaks hungarian*
10:15
János: Sooo he went to school, 3 or 4 times in a month, from the morning to the evening. And after that he has exams. uhhh
Marta: Oral and practical
János: Yes. Oral and practical.
Juliana: Oh ok
Attila: *speaking in Hungarian*
Juliana: And what's the… what's about the growing season? Or the season for bees in Hungary?
Marta: umhuh
11:13
Marta: And the flowers and the plants?
Juliana: Yeah
Marta: What they can collect you mean?
Juliana: Is it usually from February until November?
Marta: Uhh *speaks in Hungarian with Attila*
Attila: Aprilis
Juliana: ok
Attila: *speak Hungarian*
János: Its beginning in April, when the bees are collecting from the flowers and the trees. The pollen?
Juliana: Ok
Marta and Attila: *speaking in Hungarian*
Marta: sorry!
Marta and Attila: *speaking in Hungarian*
János: So in winter-time they are inside in the box.
Juliana: Ok
János: So they won't come out.
Juliana: So unless it warms up and there's flowers, they hibernate? You know, they're sleeping for the winter?
Marta: No. They're not. They don't sleep.
Juliana: They don't sleep.
Marta: They come together…
Juliana: OK
Marta: … in the beehive
Juliana: uh-huh
Attila: *speaks in Hungarian*
Marta: In the middle of the, of the box, in the middle of this ball…
Juliana: yeah
Marta: There is the queen
Juliana: uh-huh
Marta: And they they rotate around the queen and keep the temperature inside this bee ball
Juliana: ok

Marta: …35 C
Juliana: oh wow!
Marta: … even in winter.
Juliana: wow, that interesting.
Marta: So they don't sleep.
12:56
Juliana: Ok, so on a warm winter day, cause I was … um looking at bees as early as February. Umm more native bees, in Budapest. And there were some out on warm days…
Marta: Yes yes cause the temperature uh uh was above 10 - 12 C they come out. This year the winter was very light …
Juliana: Yes (laughs)
Marta: … in Hungary. So sometimes they came out even in December and January, when we had warm days.
Juliana: yes. Ok.
Marta: So this is not normal. But uh what is important this time is they reproduction is stopped.
Juliana: OK
Marta: This time. And uh the rep-reproduction begins… in February
Attila: *interrupts Marta and they continue dialogue in Hungarian*
Marta: Normally middle of February. This year it was also earlier… normal
Juliana: OK
Marta: Timing is middle of February. It means the queen start to place the eggs.
Juliana: OK
Marta: And when the temperature is above 12 C or 15… depends on the other circumstances…
Juliana: umhmm
Marta: … the wind and the rain. They start to come out. And this time in February the first uh trees start blooming. But these are not the the blooming what we used to realize what is a a flower.
Juliana: Yeah
Marta: What is a borkak … *continues speaking in Hungarian with János*
János: You know that flower what you used to use in Eastertime for example, the sticks with the gray balls…
Juliana: Yeah, oh ok, yeah at festivals…
Marta: And the *continues in Hungarian* … and and these flowers gives uh pollen, not not nectar. You know?
Juliana: OK
15:18
Marta: And it is important because the the reproduction needs the pollent
Juliana: 'cause that's the protein?
Marta: 'Cause that's the protein. And uh the bees that time uh have honey in the beehive. What the beekeeper left for them for winter. You know? So the carbonhydrate the carbonhydrate they they have but they have to collect this time the protein.
Juliana: OK
Marta: And they have to collect from these blooming trees.
Juliana: OK
Marta and János: *speaking in Hungarian about pollinating trees*
János: Hazelnut…
Juliana: Hazulnut. Yeah
János: "Fűz" I don't know what is the English name of Fűz.
Marta: Fűz
Juliana: How do you spell it?
János: F – u with two *(gestures)* – z
Juliana: Ok, I'll look it up. [translates to "Willow"]
Marta: *speaks in Hungarian*
[Attila comes out with carbonated water flavoured with bodza syrup]
Juliana: Koszonom Szépen!
János: Koszi, Koszi
Marta: *continues in Hungarian*
János: uh-huh. If you are afraid you can feed them.
Marta: If you think that…
Juliana: *Interupts* It's a long winter…
Marta: There is not enough honey. In the the beehive you can give them some sugar syrup. You know?
Juliana: Um-hum
Marta: You can be sure for that they won't starving.
Attila: *speaks in Hungarian with Marta and János*
Marta: So the bees doesn't consume too much uh uh honey wintertime. Uh during that period when no reproduction.
Juliana: uh-huh
Marta: And the majority of the honey they eat during this reproduction time.

Juliana: OK
Marta: you know? From middle of February until the time they can get uh they can collect nectar from outside. There is approximately 1-1 and half month period, and they eat the majority of the winter stock this time.
Juliana: OK
Marta: When they need more energy to take care of the reproduction and when they need to feed them.
Juliana: OK
Marta: So… the first flowers… and and plants which gives nectars are the … *speaks Hungarian to Attila* … Fruit trees fruit trees the the spring first flowers… you the *picspongazs speaks Hungarian*…
János: you know, you know that yellow flower
Juliana: um-hmm
18:33
János: When it starts, when its starts to yellow?
Juliana: A daffodil?
János: Yes it's the small ones you know…
Juliana: Oh yes…
Marta: And later you can… *gestures blowing a flower*
Juliana: Oh yes! I remember the French word… c'mon Dandelion (laughs)
Marta: (laughs) that could be, so that's and and the fruit trees that gives the first nectars. Parallel with the fruit trees and a little bit after that comes the rape.
Juliana: Yeah the rapeseed
Marta: Rape, which is very important for the bees. Then uh after rape, yes the most important Hungaricum honey comes. The acac the acacia
Juliana: Ok, oh yeah yeah!
Marta: It starts blooming from middle of May?
Juliana: OK
Marta: This year it was earlier and this year uh, during the acacia blooming there was a very bad weather.
Juliana: Yes
Marta: And there was catastrophe.
Attila: *speaks in Hungarian*
Juliana: So part of my project is to make a model for people to feed in their own personal gardens. It can be in the city, it can be on a balcony. So I'm just writing ideas, like spring flowers that produce nectar. That it's a good idea… deronicum… is it the same name? I think that's the latine name, and those ones where blooming in March. And I think you know it's like a daisy.
Marta: Yes yes
Juliana: But it's all *sárga* [yellow in Hungarian]
Marta: Sárga yes, but it's bigger than the daisy.
Juliana: Yeah. So …
Marta: ummhmm uhmm
Juliana: Do you have any other suggestions? Of flowers that people could plant?
Marta and Attila: *Speak in Hungarian together*
Marta: But uh.. but you should know
Juliana: ummhmmm
Marta: … that uh the quantity of what you can put on a balcony is really nothing.
Juliana: Its limited yeah.
Marta: Its really limited (laughs)
Juliana: But but if many people did this?
Marta: Yes yes … I bring this…
János: She's talking about that flower that is… you know we were talking about you touch it, and it makes your skin to irritate.
Juliana: Oh nettles!
János: Nettles ? is a fake one, its purple and it don't bite your skin. So they like that one.
Juliana: ok, its fake… *writing notes* . Well you know the city of Budapest, in the spring they plant their pansies and every season they take out all of the flowers and they disturb the dirt. And they put in new flowers, and they're not always good for biodiversity.
Marta: umhmm
Juliana: you know they are not always good for animals.
Marta: *Brought out her computer, speaks with Attila in Hungarian*
Juliana: The country of Whales in the UK, they have a pollinator policy for the little country, and they are just trying to put rules, for cities to plant more for pollinators, like bees and butterflies. I know Budapest has lots of lavendula…
Marta: *speaks more in Hungarian.* Anyways I think more in the cities there are quite many good flowers.
Juliana: umhmm
Marta: Naturally in the parks and the and the park trees are are quite good. I see in Budapest quite many acacia.
Juliana: umhmm

24:01
Marta: And the … also uh if we are talking about trees quite a lot of linden trees in Budapest, which is also very good. And uh there is uh … tree which calls called Chinese honey tree.
Juliana: uh-huh
Marta: And there is a lot in Budapest. Because it is quite uh um good. *Speaking in Hungarian with János.*
24:54
János: Oh… the trees doesn't care the the city smoke…
Juliana: (laughs) oh ok
János: it doesn't matter for the tree so …
Juliana: survivor
János: It does well there.
Juliana: Yeah
Marta: So there are a lot of good trees in Budapest. I was thinking sometimes at certain time of the season we should bring bee hives to Budapest, because there are so many Linden tree.
Juliana: (laughs) yeah ok
Marta: *speaks in Hungarian.* Chinese honey trees, a lot. And if you go back on this Sztendre Street (*gestures to neighbourhood*) uh *in Hungarian.*
János: You know Bekes maygar is that stop we got off of the railway the first time, with the guy from London?
Juliana: Yes
25:48
János: That stop and between the other stop where we got on. Both sides on the railway, they are full with these kinds of trees…
Marta: [interrupts] Not the railway *in Hungarian*
János: In the road, the main road.
Marta and Attila: Speak *in Hungarian*
Juliana: … yeah the dandelion
Attila and János and Marta: *speak together in Hungarian*
Marta: Summer trees are full of flowers.
Juliana: Yeah
Attila: *continues to speak in Hungarian*
Marta: On the Buda side too.
Juliana: Yes, there's a lot there.
Attila and Marta: *continue to speak in Hungarian*
Marta: … Kert Budan … (In Hungarian, in gardens in Buda)
Attila: …tanul…
János: Environmental Science y … *Says Juliana's study program in Hungarian… continues to speak in Hungarian*
Marta: Like Lazslo?
Juliana: Uhh he was in Winnipeg, Manitoba. So the prairies. (laughs) I met him here.
Marta: Este a ki, Chinese honeytree, but I don't think it's a very good picture (*shows photo on her laptop*)
Juliana: I think that's the one that we are allergic to (laughs)… allergies
Marta: I don't think that's a very good picture…
28:46
Attila and János: *speaking in Hungarian*
János: We can go and check the bees.
Juliana: OK
János: We can dress up
Juliana: OK (laughs)
Marta: This is a good picture I think. It is it is blooming now. This time.
Juliana: Ok
Marta: In July. And this is good because you know, after the acacia and ah and ah the Linden….
Juliana: Uh-huh
Marta: Much less uh…
Juliana: Flowers?
Marta: Flowers and nectar sources
Juliana: Yeah
Marta: This tree is really good. And ah full… the city is full of this trees
Juliana: That's good
Marta: Because I said that it is quite good. It is quite well tolerate….
Juliana: The city life? (laughs)
Marta: (laughs) The city life, Yes! Umhmm
Juliana: OK
Attila: *speaks Hungarian with János about János' work*
Juliana: So how have bees been in Hungary, wild bees and… do you know too much?
Marta: Wild bees?

Juliana: The status of wild bees in Hungary? Have they had similar problems?
János: Sorry one more time?
Juliana: Just about bees in general, wild bees and honeybees. Do you have any idea how wild bees are in Hungary?
Marta: (Laughs) I don't know.
Juliana: No?
Marta: *speaks in Hungarian to Attila and János.* Uh here is a a article
Juliana: Ok
Marta: The title is "*a Hungarian name"*
János: What she plans to read.
Marta: Other than acacia….
Juliana: OK
Marta: Plants which are…. [*shows Juliana a hungarian bee planting guide*]
János: A calendar for it
Juliana: Oh that's great! Can I, I'll copy the link. Thanks this is excellent!
Marta: Ok.
Juliana: 'Cause I did my own gardens in Hungary, designed them as education models for wild bees. For people….
Marta: Umhmm
Juliana: I did one at a community garden and one at the University. It gets people talking about bees and why they are endangered; because of fragmentation….
János: You can show for them. Do you have pictures of it?
Juliana: ummm probably I do, yeah.
János and Marta: *Speak in Hungarian together about the gardens built in Budapest for this project*
33:13
Juliana: Yeah so there have been some honeybees and many wild bees.
Marta: umhmm
Juliana: So. When I started planting though I do not speak Hungarian and I do not read so… I didn't know how to find a planting guide for Hungary. So I just used information from Canada and the UK, because it's a closer climate. But it was such a warm year, even though I planned to have plants from early spring until the fall, some of them came early, then I had times with no flowers….
Marta: (laughs) Yes you need local information.
Juliana: (laughs) Right? Yeah exactly. So that's my experiment… But it was interesting anyways…
Marta: But, some days ago, I visited my friend who lives on the Buda side… *speaks in Hungarian to Attila and János.* And uh and uh *something in Hungarian* I`m not sure if you know that area. They have uh similar, mmmm in her plants now in her garden. Lavendar…
Juliana: Of course
Marta: rose, that small rose and her lavender was nearly full of bees like this (gestures to her own lavender plant). In in in Buda side, in the garden.
Juliana: Yeah, Budapest is great for lavendula, it's all over.
Marta: And there was, ok not so many but two or three honeybees in the lavender, at her garden as well. And I was thinking that where could be the bee hive
Juliana: Yes
Marta: Because it can be somewhere, in Buda I think.
Juliana: Yes, because at the University, the garden is in a courtyard. I counted 8 honeybees one day.
Marta: mmhmm
Juliana: I don`t know where they came from, because it`s near the basilica.
Marta: mmhmm uh-huh u-huh. Well I think in Budapest the bees are in good.
Juliana: Mmhmmm
Marta: are in good condition, because they they can find easily uh uh food. So many Linden trees are there. I am always jealous of.
Attila: *Speaks in Hungarian to Marta*
Juliana: Are there more problems maybe in August, August – September?
Marta: Yes. And if there is no rain. It wouldn't be so big problem if the rain would be quite … normal so so … because if we step further we stop at acacia. After acacia uh there are lot of bushes. Mainly flower which are in the mountain which are really good for bees and quite soon start the Linden. And Linden has um 3 or 4 type and and uh they are blooming in different times. So if you have these different type of Linden it can last nearly a month long
Juliana: Oh ok
Marta: that the Linden is blooming, you know? And parallel the Linden, here there are quite many mmmm plants?
Nem tudon *continues in Hungarian to János.*
Attila: *continues conversation*
Marta: This is which here
37:57
… around us there are a lot. This this uh …(showing photos on laptop)
Juliana: Ok
Marta: It has a very good smell. A little bit mmm too too good! (laughs)

Juliana: (laughs)
Marta: The name I don't know. And it starts blooming after acacia.
Juliana: Ok. Acacia… I think I'm just going to copy the Hungarian name…
János: It's a J not a …
Juliana: J… ok
János: It means oil
Marta: And parallel with Linden. So Linden is important…
Juliana: mmhmmm
Marta: … and uh… the problem is uh… the the after acacia period that the plants and trees what I will mention, there are not so big places like acacia. You know?
Juliana: mmhmm
Marta: We don't have so many trees in Hungary. Acacia you can find nearly everywhere in Hungary, but uh Linden are less.
János: *Speaks in Hungarian*
Juliana: Well I've heard of the problems with acacia, that a lot of… in forest management practices in Hungary…
Marta: Yes
Juliana: They are trying to stop acacia
Marta: Yeah, yeah
Juliana: Do you see a problem with that?
Marta: (laughs) ok, I understand that there are uh forests where acacia is not very good. But here for example where if we go more up to the mountain, at certain sea levels?
Juliana: Elevations? Yeah
Marta: Acacia doesn't exists.
Juliana: OK
Marta: So if you go one or two km in that direction, and we go a little bit up towards that mountain…
Juliana: mmhmm
Marta: Acacia is stopped, and above that there is no acacia, because it is too cold or too humid or I don't know what's the problem.
Juliana: OK
40:30
Marta: But there are so parts of Hungary where other trees doesn't … can't live you know?
Attila: *speaking in Hungarian in background*
Juliana: Yeah
Marta: The other issue that Hungary is that many people use the wood of acacia for uh heating?
Juliana: Yeah
Marta: Because it's very good also for building house it is, it is very popular for building fences.
Juliana: Ok
Marta: Many people use instead of the concrete.
Juliana: Yeah
Marta: Acacia tree wood, because it is a very good hard wood. Uh it doesn't rooth in the soil. It doesn't rooth (rot)
Juliana: Yeah. Do you see from a policy point, because I study environmental science and policy um, are there policies that w… that could be changed to help work with bees just in general?
Marta: uhhh yes the agriculture and the beekeepers are somehow mmm they have opposite interests
Juliana: Ok
Marta: … many times forest business… or how can I say this?
Juliana: Forestry also?
Marta: Yes uh… for example uh the last 7 years… ok I start another side.
Juliana: OK
Marta: 5 years ago we were starting keeping bees here. The fields around this village were blooming all summer. No one cut the fields.
Juliana: OK
Marta: The the grass, and not the grass also the lot of flowers in the grass.
Juliana: The weeds?
Marta: Not weeds!
Juliana: Wild flowers.
Marta: Yes wild flowers, which is also the food for the bees.
Juliana: Yes.
Marta: The last two years, every fields are cut.
Juliana: Is there a reason…
Marta: And there are big fields which are uh… not fields anymore started to use like agricultural, you know?
Juliana: OK, they're active again
Marta: They put wheat in. So we have less less field. And the fields have are cut. And uh also the roadside is always cut. Cut cut cut and also there are a lot of flower which are good for bees. And this cutting cutting cutting you this? And I know that there is the very allergetic uh plant

Juliana: Yeah
Marta: You know?
Juliana: Allergens yeah
Marta: Speak with Attila in Hungarian. Parlagfű [ragweed]
44:06
Marta: Yeah I don't know. (*spells it on paper, shows photo on internet*) This is the parlagfű which … looks like this. Many people has the …
János: … (interrupts) allergic reaction
Marta: Yes, and sneezing the this is the guilty. But it's a study way of thinking. This plant has to cut everywhere, because you are punished if uh …
János: … you get a fee
Marta: If some in the field if someone from the office can find one this plant, you will be punished.
Juliana: really?
János: If somebody comes in front of the house and see they can report you in the government…
Marta: (interrupts) And you are punished.
János: … this kind of flower. Yes you are going to get a fee because of that because it's so so useless.
Marta and Attila: *speaking in Hungarian*
János: That's why everybody's cutting everything because they are afraid because of the fee.
Juliana: Oh ok
János: Somebody reports it.
Juliana: Why is it? Why? Is it just because the bad allegeries?
Marta: Yes uh-huh. And there are another plant. Attila will transport tomorrow there the bees, some bees. *Speaks in Hungarian with Attila* Its called selyemfű dohány [silkweed, butterfly flower]. It is not allergen.
Juliana: Ah
46:13
Marta: But uh its ruined the the soil completely. It's very aggressive. Uh its said to be. And where it lives nothing else can live you know?
Juliana: OK
Marta: But it gives a very good honey! (Laughs)
Juliana: (laughs)
Marta: So it is also a rule that it should be cut.
János: So it means velvet grass
Juliana: OK velvet grass (*writes down, looks at photo in computer screen*) And they are very nice flowers!
Marta: And it has a very good smell.
Juliana: Yeah OK
Marta: And uh and uh *speaks with Attila and János in Hungarian*
János: You have to cut it out because its grows so fast like the mint.
Marta: And now you know, beekeepers are in trouble because tomorrow you know Attila will transport bees to this. But you know, a lot of beekeepers uh there are and when he arrives there, there are no plants because it was cutted.
Juliana: Aww
Marta: So you know
47:29
Marta: So, the opposite interests.
Juliana: Yeah, conflicting interests.
Marta: So now (laughs) we hope that there is will be a normal rule because in the new government there is *speaks in Hungarian*
János: A secretary
Marta: Secretary of the agricultural ministry, one of them. The secretary of the agricultural minister is beekeeper
Juliana: Oh
Marta: So we hope that …
Attila: *Speaks in Hungarian*
Marta: He can he can lobbies that, because he said that flowers start blooming the first two week would be enough for the beekeepers and the bees and during this first two weeks, there is no seed distribution…
Juliana: That's right
Marta: You know? And it would be enough to cut the plant the end of the second week of the blooming and it would be a good…
Juliana: … A good compromise
Marta: A good compromise uh-huh. (laughs)
Juliana: (laughs) for sure
Marta: So you see it is our problem. We are not a long.
János: Bumblebees, you see? *Points to bumblebees feeding on lavendula. Points out in Hungarian*
Juliana: Yeah.
Marta: … We don't have a long beekeeping career but during these five or four years here it changed a lot.
Juliana: Yeah

Marta: This field issue.
Juliana: Why why did they change all these rules?
Marta: I think here, quite many people started to deal with other animals and they cut for goats for sheeps for horses.
Juliana: Yeah
Marta: And the other issue this. But I told you that there are certain plans which are.
Juliana: Are people farming more because of EU regulations? Or is it because the government…, are there programs that are encouraging different forms of agriculture? Because before you said that before people they weren't farming. And now they are farming.
Marta: Yes. During the last 2 years it was encourage to use the un-used fields and to make the the animal keeping were encouraged.
Juliana: Yeah
Marta: But nows not so good you know?
Juliana: Yeah for sure.
Marta: And in a way I agree that uh that here many peoples has animals goats and a lot of horses. It is basically good. But really it would be a good good compromise, what you said that after the two weeks after the blooming should be cut the fields and the the…
Juliana: Yeah
Marta: And it would be enough food for bees as well.
Juliana: Yes definitely
Marta: So that's it.
Juliana: At what level has it been encouraged? Agriculture. Is it at the Hungarian government level or at the EU level?
Marta: Hungarian Government
Juliana: OK
Marta: I think, yes. The last years the agriculture had uh has had a bigger role in the national economy *speaks in Hungarian with Attila* … in the exports also in the exports.
Juliana: Yeah
Marta: Agriculture is more important during the last 7 years. And I wouldn't say that that uh that uh it would happen against the beekeepers, because the government steps for the interest of the beekeepers.
Juliana: mmhmm
Marta: With this acacia story. I don't know if you've heard that acacia is mmm distributed as a Hungarian honey.
Attila: *speaks in Hungarian*
Marta: Acacia tree and also the acacia honey is uh Hungaricum status.
Juliana: OK
Marta: So it's a local…
János: Like the paprika
Juliana: Yes yes
Marta: Yes uh-huh and and its happened some months ago
Juliana: ahhh oh ok
Marta: So it is… it's a kind of support for beekeepers.
Juliana: yes it is
Attila: *speaks in Hungarian*
János: They are exporting a lot of honey from here to England, Germany
Juliana: Oh ok
Marta: France
Attila: *speaks in Hungarian*
János: They buy the Hungarian honey
Attila: *speaks in Hungarian*
János: The Chinese one and the argentine one.
Attila: *speaks in Hungarian*
János: And the Chinese and the Argentine one is very bad quality
Juliana: Oh Ok
Attila: *speaks in Hungarian*
Juliana: The Argentinian one is bad quality ?
János: They mix it they mix it with the Hungarian one and makes it a better quality.
Juliana: uh they mix them? Ugh
Attila: *speaks in Hungarian*
Marta: Even Hungary exports a lot of honey but you can't find in in western west-Europa shops Hungarian honey. Because they don't put on the shelfs pure Hungarian honey, but a mixture.
János: They don't know what is a good honey so they buy always a mixed one.
Juliana: aww
János: That's why he wants to export his honey…
Marta: Jar
János: Bottled one

Juliana: Yeah. Well because the Chinese ones don't they add in corn syrop sometimes? You don't know. And they don't mark that. In the US I know they buy Chinese honey as well, you know grocery stores and they don't write that there is corn syrup in it, but there is. So… (laughs) So I buy it from beekeepers.
Marta: Yeah. That's the best. So going back to the plants, the summer wouldn't be bad if the rain would be quite even and enough. Because after Linden uh there is that tree what I told you, this Chinese tree and uh and uh starts uh… there is this what I show you. This uh this uh selyemfű. And there are fields… *speaks in Hungarian to Attila and János*
János: Sour cherry tree
Juliana: Yeah
János: As a child I had to climb up always and collect for my father.
Marta: yeah. This is also a very good option if you want to make recommendation. The name of this is facélia or mézontőfű *speaks Hungarian*
Juliana: And is this a wildflower?
Marta: No it's a agricultural stuff, but it's very interesting because it is uh *speaks Hungarian*
János: So … so they grow because of the seeds. And the other reason is to make a compost. The the lines in ground from a machine, they put it.
Juliana: OK
János: In the ground with it.
Marta: They put back into the soil like a green… uh
Juliana: Like mulch
Marta: mmhmm mmhmm! Because uh this plant can collect a lot of nitrogen and uh nitrogen support to the soil.
Juliana: Yes ok.
Marta: Mmhmm. And now there is a rule in Hungary that on some part of the of the agricultural fields has to uh put this type of uh plants uh to avoid to use too much artificial chemical stuff to the soil. You know?
Juliana: Yeah
Marta: And this type of plants, usually all good for bees
Juliana: mmhmmm Lucerna as well?
Marta: Not only this but there are some other. Mustard *speaks in Hungarian*
Juliana: Yeah
Marta: őstarno, … *speaks in Hungarian with Attila*
János: You can buy that kind of seeds which is only for the bees. Directly for the bees.
Marta: It is a mixture of uh seeds. And it gives in a long period food for bees.
Juliana: Oh excellent!
János: Feed the bees
Marta: *speaking Hungarian with Attila*
Silence
Marta: This is the name of the company who sells this mixture "Omme.hu". So you can recommend to use this one. My brother-in-law this years, asked to use his neighbour garden.
Juliana: Oh yeah?
Marta: Because she didn't use the … uh
Juliana: The yard?
Marta: Yeah, and he put this facélia on the garden.
Juliana: Oh excellent! That's a good idea.
Marta: mmhmm! And the the honey's very good from this flower, and it gives quite a lot of nectar. And and which is good in this flower is that it has a short period of life. So it is 6 or 8 weeks when you put the seed and start blooming. So it's very short!
Juliana: Yeah.
Marta: And you can …umm… calculate which period you want the blooming. You know?
Juliana: Mmhmm
Marta: And also, if you know that in your area, you know which period you don't have food for the bees, you plant… you know?
Juliana: Yeah that kind of flower, that's a really good idea.
Marta: If you time that those 2 or 3 weeks will give the honey. Yes but we don't have fields here unfortunately.
Juliana: But you have forests.
Marta: Yes, some years ago we applied for this uh land but uh finally someone rented who has goats.
Juliana: Oh ok.
Marta: To tell the truth that the soil is very bad here.
Juliana: So it's better for livestock? For animals?
Marta: Yes. *Speaks Hungarian with Attila*
Juliana: Are there systems here like in the US where farmers pay you to come and…
Marta: No. At this moment no. It would be nice.
Juliana: (laughs) ok
Marta: Someone said that they didn't have any fruit this year on the apple trees and and I was thinking that we had a lot last year, and we had a lot this year.

Juliana: Yeah
Marta: And I was thinking probably because of the bees. And I was thinking to advertise next year…
Juliana: (interrupts) Really?
Marta: That we are, we give bees for the flowering. We should. I was thinking about because we should ask some price because Attila should visit the bees and he should travel and use petrol and some time.
Juliana: Exactly
Marta: And there is a cost.
Juliana: Yeah, they do that for the blueberry fields and the raspberry fields in Vancouver.
Marta: To tell you the truth there is in Hungary, quite a lot of bees. And this is a small country. More or less bees can cover nearly every places.
Juliana: Yeah that's good.
Marta: But, I think uh behind that good expected uh apple could be the bees. Because you know you know the trees one year give lot of fruits, other next year not. But I am really wondering that that uh last year there were a lot of apples on the tree. This year again.
Juliana: Yeah
Marta: And also we had a lot of cherries.
Juliana: mmhmm
Marta: So I was shocked when that American style film showed how they keep the bees. They don't deserve the bees. I will say.
Juliana: (laughs)
Attila and Marta: *speak in Hungary*
Marta: The film starts that *speaks in Hungarian* the blooming almond field. You know and this is very beautiful anyway uh… the voice of the bees this mmmmmm.
Juliana: mmhmm
Attila: *speaks in Hungarian*
Marta: He he hears….
János: (interrupts) he hear the noise of the dollars
Marta: He doesn't hear the bees, he … ahh disgusting
Juliana and Attila: (Laugh)
János, Attila and Marta: *speaking in Hungarian*
Marta: One of my cousins lives in Cleaveland. And … and she's crazy about to come back to Hungary and she said that everybody has cancer around me and I just don't want to live here. From the food probably.
Juliana: I know.

- Break -

Juliana: What kind of support is there for beekeepers?
Marta: You can get certain supports for the medicines you use.
Juliana: Oh like antibiotics?
Marta: Not only antibiotics. Anti-verroa and some kind of this. But there is a list what you can use and which is supported.
Juliana: Is it EU supported?
Marta: What?
Juliana: Is the EU supporting it?
Marta: The money comes from I think the EU, but it is uh collected by the Hungarians. And you can get uh support, financial support if you buy queens.
Juliana: OK
Marta and Attila: *speaks in Hungarian about what other things are financially supported*
Marta: And you can get financial support for sugar. Yes. Then equipment. For example uh for equipment that helps to take away the honey, I mean "*purgoter*"
János: The centrifuge
Marta: Yes the centrifuge like this. Also you can get support if you buy equipment which helps the transport, the transporting of the bees. If you buy a car or a *speaks in Hungarian*
János: You know the car that you pull behind the car… that you can pull
Juliana: Oh the trailer
Marta: Trailer yes. For this for things like this. And we have the phone number of that lady who handles this in the agricultural. I don't know if she speaks English or not.
Juliana: Is she in Budapest?
Marta: mmhmm
Interview ended with honey beehive tour

Appendix 3 Interview discussion topics with Greenpeace HU

Interview discussion topics, with Balázs Tömöri and Gergely Simon from Greenpeace Hungary. July 9 2014.

1. Discuss recent Greenpeace Bee studies, and the recent 2 year EU-wide ban on the use of 3 neonicotinoid pesticides and fibronil.
2. These neonicotinoids (clothianidin, imidacloprid and thiametoxan) are restricted in use for seed treatment, soil application (granules) and foliar treatment on bee attractive plants and cereals. Why? And What does this mean?
3. The use of these agrochemicals is still available to professionals. Why? And What does this mean? Who are the professionals?
4. The changes made by the EU were due to recommendations made by Greenpeace in these studies. Discuss.
5. What is the status of bees in Hungary
6. What does the use of pesticides in Europe at large, and within Hungary do to wild bee populations?
7. There is apparently an nuisance-plant ban in Hungary, what species are banned and could you explain this more?