Bees on Dalhousie Campus

Team Gomberg Final Report

Rylie Arnell[1],
Nicole Bird[2],
Jenna Gabriel[3],
Jie Ma[4],
Katie Mahoney[5],
Erin Wynn[6]

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With the general support of:
The Instructor of ENVS 3502, Dr. Tarah Wright
The Teaching Assistant of ENVS 3502, Ms. Eliza Jackson

Affiliations: [1, 2, 3, 4, 5, 6] Dalhousie University
Contact Information: [1]ry647848@dal.ca; [2]Nicolebird201@hotmail.com; [3]jn537431@dal.ca; [4]Jie.Ma@dal.ca; [5]kt327285@dal.ca; [6]Erin.Wynn@Dal.Ca

Executive Summary:

Implementation of an apiary on Dalhousie's Studley campus would positively impact the biodiversity of the entire Halifax Urban core. Bees are influential to our environment because of their contributions to human economies through the process of plant pollination. Currently, there is a developing raise of concern regarding bees because of detriments to their survival including habitat destruction, loss of blooming food plants, and the spread of parasites.

This project is a feasibility assessment of the Dalhousie Studley campus. The feasibility is based on a determined set of criteria. These criteria have been established based on interviews with expert and hobby beekeepers, and document review of bee care and apiary successes.

The research results will be listed as established criteria. Explanation of the decision process for determining these criteria is available, and influence of case studies on these decisions will also be described.

The discussion shares ArcGIS maps that describe the site-specific situation for apiary feasibility of Dalhousie's Studley campus. These maps were created as a visual representation of the resulting criteria to place the feasibility assessment on the real world. Application of the criteria will also be made without cartographic representation to describe how we determined the most suitable area for implementation of a bee apiary.

The final assessment pointed to the Life Sciences Centre Psychology Department rooftop for a plausible location to implement an apiary. This was determined based on bee protection and preference (environmental considerations), as well as public protection and preference (social considerations).

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1. Introduction

1.1 Objectives

The objective of this project is to determine whether or not it is socially and environmentally feasible to initiate a beekeeping program on Dalhousie University's Studley campus. Environmentally feasibility will be determined through the analysis of the ability for an apiary project to thrive, in the ecosystem where Studley Campus is located. Socially feasibility will be examined with attention to whether the project is logistically possible in terms of space, Dalhousie/HRM by-laws, funding opportunities, and existing sustainability minded goals, initiatives and programs within the university.

1.2 Research Question

This research is guided by the following question: What are the social and environmental feasibility of implementing an apiary on Dalhousie's Studley Campus? In order to place this question in a broader context we will explore two other sub questions:

1. What are the social and environmental components included in a practical framework developed or derived from the success stories of other universities (such as McMaster University)?
2. What challenges can be identified that were encountered while implementing an apiary on a university campus?

These sub questions will provide insight into the barriers and opportunities associated with implementing a campus apiary, and will help us to better understand our main research

question and to provide support for further research. We see research situated within a transformative paradigm, as it could provide a reference for future changes in sustainable promotion and management at Dalhousie.

2. Background and Rationale

2.1 Role of Bees

Bees are flying insects that are known for their role in pollination, and their production of honey and beeswax. The process of pollination for bees occurs effortlessly and unknowingly for them as they travel from one plant to another to accumulate nectar. This is a mutual benefit that takes place between the plants and bees throughout this endeavour. A bee gathers nectar from a plant by having that plant's pollen latch onto the bee. It is then carried with the bee to the other plants it visits, thus initiating cross-pollination. Bees are a crucial species within our environment and contribute significantly to human economies because they are critical in the process of plant pollination. The efficiency of pollination by bees is essential in creating future generations of plants in order to ensure consistent food supplies to our world (Wilmer, 2011). Although there is a demand for honey and beeswax, "it pales in comparison to the value of fruits, vegetables, seeds, oils, and fibres whose yields are optimized by pollinating bees" (Delaplane & Mayer, 2000).

This small insect goes unnoticed by many, but without them, it is evident that life on earth would be a lot different. Currently, there has been increased concern regarding bees, as there are studies that suggest a loss of species diversity in some localities (Delaplane & Mayer, 2000). The causes that are most influential and held responsible for the loss of bees and other

organisms come from habitat destruction, loss of blooming food plants, and the spread of parasites. For example, New Brunswick and their applied pesticides caused a great concern for the province as the native bee population had taken three years to recover from pesticide invasion (Wood, 1979).

2.2 Conservation Beekeeping for Biodiversity

Biodiversity is part of such a complex system that it is hard to bounce back from prevailing consequences of society's past mistakes. Despite this, there are efforts to formulate a solution and encourage growth of the bee population back to its original numbers.

In Europe, efforts for habitat conservation and improvement of the bee habitat have received much attention, however in North America it is relatively little in comparison (Delaplane & Mayer, 2000). The reason for this is because bee conservation is one of the most cost-effective ways to increase pollinators, despite having a favourable natural environment to build sustainable livelihoods in almost all developing countries (Lietaer, n.d.). Although cost-effective, "the changes brought about by conservation programs, such as habitat sanctuaries and perennial bee pastures, tend to be long lasting, spreading the cost of their installation over many years" (Delaplane & Mayer, 2000). Bee apiaries are well known for their triumph, however they are not being utilized to their worldwide magnitude. A bee apiary, or bee keeping, focuses on a collection of beehives being managed by humans. These habitats help to promote biodiversity in the area through the pollination efforts of the bees. This is used as an important sustainable tool that benefits local communities living in and around forests (Lietaer, n.d.). Beekeeping simply raises awareness about the importance of good management surrounding forestry and conservation.

As previously noted, urbanization and pollution have caused massive declines of bee populations in North America. This is harmful to the bees, their predators, and the great many flora and fauna serviced by their pollination - as bees are essential to the promotion of healthy environments, and the pollinator-plant relationship is a fragile cycle (Sheffield, Kevan, Smith, Rigby & Rogers, 2003). As Halifax continues to grow, it is imperative that all efforts are taken to ensure the promotion of sustainable urban life. Integral to the vision of maintaining urban biodiversity is the example set by beekeepers in Chicago and New York (specifically Brooklyn) (Lowenstein, Matteson, Xiao, Silva & Minor, 2014; Moore & Koset, 2013). These cities all have thriving communities of bee enthusiasts, and Halifax itself is falling more and more in line with this ideal. At last estimate, 25 registered hobby beekeepers were operating in the HRM, with an active Honeybee Society and features in many local media sources (Nova Scotia Bees, 2014). As these groups and individuals grow larger in number, the time is ripe to capitalize on this expanding field of knowledge and expertise.

2.3 Beekeeping at Dalhousie

Dalhousie University is home to the College of Sustainability, which strives to promote environmental consciousness across the campus and university community. The role of this college as steward and watchdog is amplified by its actions; promoting LEED certified buildings, promoting bike programs, and hosting regular public lectures on important issues in the environmental movement (Dalhousie University, n.d.). This college is located on the Studley Campus in the South End of Halifax, Nova Scotia. This campus acts as a hub, promoting local, effective change students can make in an urban setting. Because it is close to home gardens and green spaces (as opposed to Dalhousie's Sexton and Carleton Campuses), an apiary could

potentially prosper in this environment. The proximity to the College of Sustainability could allow an apiary and the study of bees to be incorporated into coursework and interdisciplinary studies, as the science faculty is also located on this campus. With current student groups managing the university's garden, farmers market, Nova Scotia Public Interest Research Group, and Loaded Ladle, all out of the Studley campus, it is already a mecca for proactive and environmentally minded students (Dalhousie University, n.d.; Loaded Ladle, n.d.; NSPIRG, 2012). These resources and opportunities are the reason why now is the time to research the feasibility of an apiary. As epi-ethnographers Moore and Kosut (2013) recollect in their book on raising bees in Brooklyn, rooftop apiaries are proof that bees "can live on top of the city"(p. 15) and flourish there alongside their human companions.

3. Methods

This chapter introduces the study design first, followed by the delimitations of this study. The study design consists of three data collection methods, a sampling design, and a data analysis plan, which are described in detail in the following subsections.

3.1 Study Design

This study investigated the key components included in the frameworks of on-campus apiaries in other universities and small-scale apiaries in urban areas, and by using these components as well as taking advantage of Geographic Information System (GIS) databases, we examined the feasibility for implementation of an apiary on the Dalhousie's Studley campus from social and environmental perspectives. A mix of qualitative and quantitative research methods was used in this study. The qualitative research helped us compile information on past

apiary projects of similar standards. It gave us a clear picture of what to expect with introducing a bee apiary. The quantitative research provided a more thorough analysis of statistical information that allowed us to create a feasibility study.

3.2 Research Tools

Both qualitative data and quantitative data were separately collected by the following three methods: interviews, documentation review and GIS tools. Interviews are a useful qualitative method when direct information cannot be collected, and also allow researchers to have "control over the line of questioning" in order to gather valid data under a time constraint (Creswell, 2014, p. 191). Due to the restricting time limit of the proposed study, only four interviewees were approached. In order to avoid holes in our qualitative research, a documentation review was conducted in addition to the interviews. A documentation review saves time and money because the data is already retrieved and represented, and many public documents can be easily located on the Internet (Creswell, 2014). Finally, GIS is a surveying tool that was used to examine and represent the feasibility of developing an apiary on the Dalhousie's Studley campus.

3.2.1 *Interviews*

Qualitative interviews were conducted in an approach to get first-hand knowledge of the key components of developing a small-scale apiary in urban areas, such as challenges and requirements related to urban beekeeping. This knowledge was then examined closely to identify specific common elements that are required for determining the feasibility of a potential location. Interviewees were sampled by referral, meaning that they were chosen using a snowball sample method, according to personal connections. There are three different types of qualitative

interviews: structured (usually using a structured, pre-made questionnaire), semi-structured (using open ended questions), and depth (one or two issues are covered in great detail, and questions lead off from what the interviewee answers) (Britten, 1995). For the convenience of our interviewees and keeping in mind our time limitation, our interviews were semi-structured because it allowed us to collect the desired data (which depth might not accomplish), and was still open to information that might have been missed (which structured would not accomplish). In the circumstances of a face-to-face interview, we took notes during the interviews and verified with interviewees the accuracy of the transcription. When meeting with the interviewees was not an option, we used an email-based interview approach, which required a more structured interview to lessen the amount of back-and-forth. This took away the advantage of unexpected information. However, a new advantage of email-based interviews was that it kept our research as accurate as possible because it "eliminates any errors introduced through incorrect transcription. With e-mail interviewing the data that is eventually analyzed is exactly what the interviewee wrote," (Selwyn & Robson, 1998). Please see Appendix B for the semi-structured interview questions, and Appendix C for the structured, email-based interview questions. The full list of interviewees is attached in Appendix D.

3.2.2 *Document Review*

Three peer literature databases (i.e., Web of Science, Environmental Sciences and Pollution Management, and GreenFILE) and two other types of databases (i.e., Google and the Association for the Advancement of Sustainability in Higher Education's (AASHE's) members only databases) were searched. Keywords used were "campus apiary ", "urban apiary", "urban beekeeping", "best practices for urban beekeeping", "constraints on urban beekeeping", "campus beekeeping", "honeybee conservation/preventive honeybee conservation measures", "small-scale

apiary", "social feasibility", "environmental feasibility", "environmental requirements for apiary", "social requirements for apiary", "social requirements for beekeeping", and "environmental requirements for beekeeping". The procedure of the document review method used in this study was similar to the methodology used in the report of Roberts and Graham (2007). Search results from the keywords listed above, alone or in combination with each other, in each database were reviewed. The titles and abstracts were quickly scanned in order to broadly locate the articles that were generally relevant. Then, because of the time constraint, from the identified, relevant articles, 15 literature pieces in total were selected to identify specific social and environmental components. In order to guarantee the reliability of qualitative data gathered from the readings, three group members were assigned to verify the data by going through the selected literature together.

3.2.3 *GIS ArcMap*

Global Information System (GIS) is a surveying tool that is used mostly for representation and decision-making. GIS contains a set of tools that allows for collection, storage, retrieval, processing, and representing spatial data for a defined set of objectives (Gemelli, Mancini, Diamantini & Longhi, 2013). After collection, using all the research tools listed in this chapter for this project, GIS was used for the storage, and processing of quantitative data to help with the decision-making process. Quantitative data were retrieved from literature reviews regarding the environmental and social feasibility of developing an apiary on Dalhousie's Studley campus. Once the processing was complete, we used GIS tools to create a cartographic representation of our final feasibility assessment. All cartographic data were retrieved from the GeoNOVA Portal, Department of Natural Resources downloadable GIS data, and the Dalhousie GIS centre through consultation with either Jennifer Strang or Ray Jahnke.

3.3 Data Analysis

Data analysis was done according to the type of data. As stated in section 3.2.3, GIS was used to analyze and represent all quantitative data. This type of analysis allowed cartographic representation of the feasibility of developing an apiary on Dalhousie's Studley campus in Halifax. Qualitative data were represented in mostly written form; however there may be instances where tables and charts more effectively represented the data. In these instances, hand-coding techniques were used in a posteriori coding scheme to code, categorize, and analyze the key social and environmental components that were filtered from the interview transcripts.

3.4 Delimitations

A delimitation regarding this study was that Dalhousie student and faculty opinions regarding an on-campus apiary were excluded from this study because of time constraints. Another delimitation was that we focused on solely the feasibility of an apiary from the environmental and social perspectives, and did not assess actual application of an apiary because of our determined scope. A third delimitation was that we were focusing on small-scale apiary operations and were completely disregarding large-scale industrial apiary data.

4. Results

The overall idea of implementing an apiary is to supply bees with an environment that they can live comfortably in. To achieve this, all of the following established criteria must be met. For the purpose of this paper we limited our scope to two criteria types – environmental and social. We understand that there are other factors that play into feasibility of an apiary. The total

criteria break down is available in table 1, with further explanations for key criteria in the following parts of this section. The criteria are the same in both the environmental and the social sections, however the explanations and reasoning for the criteria are different according to their research fulfillment purpose.

Table 1: Total criteria breakdown and where the information for each one came from.

Criteria	**Sub Criteria**	**Research Tool**
Hive Structure and Fencing	Fence or Shrubbery, Hive Placement	Document Review
Hive Equipment	Signs, Suits, Bee Race	Document Review, Interviews
Urban Hive Management	Record Keeping, Weather Conditions, Hive Density, Neighbour Consideration, Beekeeping Legislation	Document Review, Interviews
Bee Protection	Swarm Protection, Disease Protection	Document Review, Interviews, GIS
Staffing and Volunteers	Education, Commitment, Plenty, Responsibility	Document Review, Interviews
Vegetation Cover	Adequate flora, Availability	Document Review, GIS
Water	Availability, Proximity, Bowl Type	Document Review, GIS

4.1 Environmental Criteria

Ensuring that these environmental criteria are met is essential to the survival of the bee colony. These environmental criteria are set based on our research methods (interviews and document review).

4.1.1. Hive Placement

There are four sub-criteria identified from the interviews and the document review: hive structure, fence, hive location, and water, which are elaborated in detail below.

One interviewee highlighted the importance of hive structure by explaining that properly constructed hives are essential to bee satisfaction and survival. Needham (2013) supported this information by emphasizing the role of good ventilation to hive wellbeing. The interviewee also suggested potential interested Dalhousie architecture students as referrals for designing properly structured hives should the project be implemented.

Caldeira (2007) suggested backyard beekeepers have a six-foot high fence or shrubbery for their projects. This fence is meant to act as a wind barrier for the beehives. Needham (2013) also highlighted the importance of a fence by explaining that a fence can act as a windbreak when it is placed at the rear of the hive. Suggested materials for a fence are posts and burlap, which would sufficiently protect the colony from harsh winter winds. In addition to be a windbreak, a fence could also provide protection to bees from excess sun exposure (Needham, 2013).

Needham (2013) listed a number of points regarding how to select a proper location for beehives. First, the location of hives should face to the southeast, which contributes to bees' early start to foraging every day. Second, the location of the hive should be on dry, firm land rather than soft, boggy land. Third, a gully or the peak of a hill should be avoided when considering a location for beehives since these places may harm or kill bees during the winter. In addition to these requirements, New York City Beekeepers Association (2015) states that a quiet environment is also a necessary condition for bee satisfaction and survival; therefore, beehives should be located as far away as possible from noisy roads (at least 100 m, see Appendix A-2).

As for considering the carrying capacity of the environment, both the immediate area and three miles in all directions need to be carefully assessed (see Appendix A-1) (New York City Beekeepers Association, 2015).

Bees need a continuous, adequate, hygienic water supply for their normal growth development, satisfaction and survival (Caldeira, 2007; Hegić & Bubalo, 2007). Water helps bees mediate their body temperature on hot days (Caldeira, 2007). Therefore, good quality water supply for bees must be guaranteed. According to John's Beekeeping Notebook (n.d.), bees are fussy about where they get water. They tend to prefer aged water, making a half whiskey barrel water garden a perfect water supply for bees. John's Beekeeping Notebook (n.d.) also suggests putting the water supply at least 20-feet from the hive.

4.1.2. Staff and Volunteers

Two main sub-themes were identified from integrated data sources (including both interviews and document reviews) with respect to staff and volunteers: learning and education, and qualifications.

Some interviewees emphasized the importance of educated staff and volunteers to make a successful on-campus apiary project at Dalhousie University. It is strongly suggested that first time beekeepers take a course on beekeeping, such as the Modern Beekeeping course currently offered at Dalhousie Truro campus. The Dalhousie course include four modules following the stages of the beekeepers experience. One interviewee mentioned that his learning materials were just two books – "Honey Bee Hobbyist: The Care and Keeping of Bees" by Norman Gary and "First Lessons in Beekeeping" by Keith Delaplane. In addition, local beekeeping societies or clubs such as the Halifax Honey Bee Society and bee experts on Dalhousie Truro campus could be considered another source of support and help for education of future staff and volunteers.

Apart from interviewees, many documents in our review list, such as Priesnitz (2009) and Ward (2014), also put bee knowledge at the top of the to-do list for first time beekeepers.

Some interviewees also pointed out three important qualifications regarding staff and volunteers. They need to feel physically comfortable around the bees, they need to be responsible for their job at the apiary, and they must be committed to the learning curve. One of them suggested that "getting several people together, so that you can service several hives" would be a good method for creating more hands-on experience. If the number of staff and volunteers is limited, then the experience will be limited, thereby inhibiting their learning.

4.1.3. Bee Protection

There are two aspects with respect to the criterion of bee protection – disease and pest control, and protecting bees from other animals and vandalism.

Control of disease and pests, to some degree, is determined the quality of bee management operation (The Government of British Columbia, 2014). It is also dependent on the abilities of beekeepers regarding recognizing and responding to disease and pest (New York City Beekeepers Association, 2015). Some actions such as mixing hive equipment and purchasing used equipment should be avoided because of the possibility of transferring contagious diseases, such as American Foulbrood (New York City Beekeepers Association, 2015). The importance of protecting bees from disease was also mentioned during an interview session.

Apart from disease and pests, bees should also be protected from other animals (e.g.. Bears) and also vandalism. In urban areas, colonies may be damaged or stolen; therefore, when selecting an apiary site, these components regarding bee protection should be considered (The Government of British Columbia, 2014).

4.1.4. Urban Hive Management

There are two sub-themes identified under this criterion – record keeping, and queens/bee species.

According to one interviewee, urban settings can be stressful for bees; therefore, urban management techniques are very different from rural ones. In order to guarantee the health of colonies, a regular check for bee performance and hive gentleness should be implemented (New York City Beekeepers Association, 2015). Good record keeping should include, "a catalog of the equipment used, a record of inspections and findings therein, and a history of actions (e.g., adding / removing honey supers), and any relevant observations regarding the hive" (New York City Beekeepers Association, 2015, para. 22).

Local sources are preferred for bees and queens since this could guarantee that the queen and other bees are already adapted to the local climate (New York City Beekeepers Association, 2015). It is key that, "queens are young and vigorous layers" (New York City Beekeepers Association, 2015, para. 17). New York City Beekeepers Association (2015) recommended "a queen of less than two years old" (para. 17) in an urban setting.

4.1.5. Beekeeping Legislation

Caldeira (2007) states that first time beekeepers should learn about local legislations regarding beekeepers before starting an apiary. One interviewee also indicated that beekeepers in Nova Scotia (NS) must register with the Department of Agriculture. Based on the NS Bee Industry Act and Regulations (Province of Nova Scotia, 2011), all beekeepers need to submit a completed registration form to the Department of Agriculture. Then, the Apiculturist would issue a BKCode to each registered beekeeper and the BKCode will appear on the beekeeper's certificate. All beekeepers need to carefully follow the NS beekeeping regulations. For example,

all registered beekeepers need to keep apprised of reportable diseases and follow the rules concerning the buying or selling or movement of bees (Province of Nova Scotia, 2011). The full lists of designated diseases and pests, and reportable diseases can be found in the NS Bee Industry Act and Regulations (Province of Nova Scotia, 2011).

4.1.6. Vegetation Cover and Floral Resources

The diversity of flowering plants and the amount of grass or herbaceous cover are important environmental variables influencing bees in urban settings since humans may generate negative impacts on floral resources (Lowenstein, Matteson, Xiao, Silva, & Minor, 2014). In a case study regarding an on-campus rooftop apiary in Cambridge, their success story has significantly attributed to the high diversity of floral sources around their apiary site (Wagner, 2012). Bees need enough nectar and pollen for bee satisfaction and survival, and the availability of nectar and pollen depends on the floral sources (The Government of British Columbia, 2014). Beekman & Ratnieks (2000) found "only 10% of the bees foraged within 0.5 k, of the hive whereas 50% went more than 6 km, 25% more than 7.5 km and 10% more than 9.5 km from the hive" (p. 490). When developing an apiary on Dalhousie's Studley campus in Halifax, all these conditions need to be taken into account.

4.2 Social Criteria

This list of social criteria needs to be taken into account in order to mediate a bee apiary that has the public's acceptance and consent.

4.2.1Hive Placement

There are three sub-themes identified from the document review: the fence, hive location, and water, which are elaborated in detail below.

Caldeira (2007) states that a fence plays an important role in backyard beekeeping and needs to be built before you purchase your bees. Having a fence forces the flight path of bees to remain at a consistent height, and therefore creates a barrier that avoids any collisions with humans (Garbuzov & Ratnieks, 2014). Caldeira (2007) suggests that a fence be the height of 6 feet, whereas Ward (2014) states that the height of the fence should be approximately 8 feet.

When it comes to hive placement, bees need to stay far away from any rights of way, roads, and sidewalks (New York City Beekeepers Association, 2015).

According to Caldeira (2007) and Priesnitz (2015), bees collect water primarily throughout the months of spring and summer and if given a reason (ex. a dog's drinking bowl, a neighbour's swimming pool, or a birdbath), bees will collect water in a neighbour's yard. To help eliminate this behaviour, beekeepers should provide bees with water and place it approximately 20 feet away, as bees prefer water that is not too close to their hive (John's Beekeeping Notebook, n.d.).

4.2.2. Staff and Volunteers

There are two sub-themes identified for staff and volunteers from the interviews and document review – education and safety.

Interviewees stressed the importance of having long-term staff in order to monitor the progress of the bees for apiary success. The New York City Beekeepers Association (2015) and the interviewees, agree that education is the most critical step in beekeeping responsibility.

An interviewee mentioned that when he first got started as a beekeeper, he originally used a protective motorcycle helmet and something to wrap around his neck as a substitution for bee gear. Ward (2014) recommended that all beekeepers purchase safety clothing and that they make sure to wear them. Bees are inclined to sting when they feel threatened that either their

young or hive is in danger (Priesnitz, 2015). A quick movement or a threatening movement activates this type of reaction and thus beekeepers must use a slow, meditative approach. Bees can also become defensive if honey robbing occurs from the hive. To prevent this, when honey is exposed, it should be cleaned immediately (The New York City Beekeepers Association, 2015).

4.2.3. Urban Hive Management

There are four sub-themes identified from the interviews and the document review for hive management – laws, neighbor consideration, swarm control, and bee race.

An Interviewee stated that, "beekeepers in Nova Scotia must register with the Department of Agriculture". There is important legislation concerning beekeeping in Nova Scotia and it is highly recommended that the NS Bee Industry Act and Regulations be reviewed. It is required that a beekeeper research local beekeeping regulations and ordinance in order to know about legal restrictions before raising bees. "Nuisance laws" are very common in most cities (Caldeira, 2007).

Many neighbours will fear bees because they are misled to believe that bees are viscous (Priesnitz, 2015). An interviewee shares that the greatest tool throughout the process of beekeeping is making the neighbours feel physically comfortable around the bees. Before introducing bees to your area, Ward (2014) and Priesnitz (2015) advise that beekeepers talk to their neighbours. Ensuring your neighbours about the small risks of beekeeping can make them feel more at ease. In some circumstances, providing neighbours with honey can also create or increase their acceptance to the bees. The New York City Beekeepers Association (2015) recommends that beekeepers post signs that alert neighbours and especially passers-by who may be unaware of nearby hives.

Although swarming is a natural behaviour for bees, it is very important that staff and volunteers are able to prevent and/or minimize these occurrences. The New York City Beekeepers Association (2015) concludes that the two main reasons why swarming occurs has to do with bees being overcrowded and the lack of good ventilation in the hive. According to an interviewee, bees get overcrowded when there is an increase in population and a large proportion of these bees get ready to find a new home. Handling this situation is important to the safety of the hive and the surrounding public. It is difficult to learn, and it is a challenging obstacle to overcome for inexperienced beekeepers. Swarming is also a result of a poor queen presence, thus beekeepers should ensure that they evaluate their queens regularly. They should be less then two years of age and should be assessed on their performance and hive gentleness (The New York City Beekeepers Association, 2015).

There are certain races of bees that happen to be friendlier than others, and thus make better candidates for beekeeping. The New York City Beekeepers Association (2015) recommends that one bee species to avoid is the Africanized honeybee as they have highly defensive behaviours that make them difficult to manage. The New York City Beekeepers Association (2015) explains the behaviour of this species as, "disrupt[ing] agriculture, beekeeping, tourism, recreation, and public life in general as [the population] has spread" (para. 23).

4.3 Case Studies

These criteria were all cross-referenced with several small-scale apiary case studies in an attempt to determine their credibility during practice. At the Imperial College, in London, England, they required 85 staff and students to maintain three colonies. If we hope to keep one, we need at least 28 staff and students. This was an important figure to find to give an idea of how

many staff and volunteers is “plenty”. Hive management was also explained in this case study, and they mention how management is necessary for controlling hive expansion as well (Imperial College, 2013). This case study was important when sorting the ‘swarming’ sub criteria into the ‘bee protection’ criteria for the final list of criteria because distressed bees are highly linked to high disease rates (Imperial College, 2013).

Another case study used was the progress logs available for the McGill apiary project. This log offers helpful advice on how to check for healthy hives during the winter, how to predict swarm activity, the importance of the Queen’s role in a colony, bee species (Russian bees tend to do worse in the winter because of weak queen influence), and much more (McGill Apiculture Association, n.d.). These bits of information were very helpful for establishing criteria and sub criteria placement. This log journal should continue to be a resource should an apiary be implemented on Dalhousie campus.

5. Discussion

The objective of this project was to determine the social and environmental feasibility of initiating a beekeeping program on Dalhousie University’s Studley campus. Environmental feasibility meant whether or not Dalhousie’s environmental surrounding are suitable for a campus bee apiary and social feasibility included whether or not local HRM by-laws, funding, and regulations lend themselves to an apiary on Dalhousie University’s Studley campus. In order to broaden the research question of this project, the sub questions were also extensively explored, which included looking at social and environmental components in success stories of other campus apiaries, as well as anticipating challenges that could be encountered in implementing an

apiary on a university campus. The hope was to acquire a better understanding of the main research question and to provide support for future research.

5.1 Final Assessment

In consideration of the results above, we have concluded that not only would implementing an apiary on Dalhousie Campus be socially and environmentally feasible, and also immensely beneficial to the surrounding ecological landscape at Dalhousie, it would serve as an invaluable learning tool for students, staff and faculty alike. While the existence of other university campus apiary's gave indication that a project such as this would be possible, our research proved the extent to which implementation of an apiary on Dalhousie's Studley campus would positively impact the biodiversity of the entire Halifax Urban core and offer undeniable resources to our community (see Appendix A-1 for carrying capacity zone of the potential apiary).

It is important to note, that the feasibility of this project heavily relies on strict compliance with the detailed social and environmental criteria list that we have compiled through our research. In addition to conducting research to determine the viability of this project on Dalhousie's campus, we were able to use GIS as a tool to identify a site-specific location that would be an excellent candidate for Dalhousie's first ever, pilot campus apiary.

The location chosen using GIS mapping systems and criteria developed is the roof the psychology department of the Life Science Building (See Appendix A-2 for map of site location). This site was chosen because it is isolated and relatively quiet, both of which are important for the health of bee colonies. Further research on management techniques will be needed to determine the best means to supply this location with certain lacking elements and

other important factors, such as vegetation and wind cover and possibly adequate water sources (Caldeira, 2007; Hegic & Bubalo, 2007; Needham, 2013; The Government of British Columbia, 2014). There were patterns found in the data obtained that included the importance of making sure that bees' natural environments were as closely mimicked as possible, to avoid causing stress to bees. A possible solution would be a vegetation fence surrounding the hive and a water bowl that is regularly maintained. Local legislation will also need to be looked further into, as well as the possibilities of hiring full time staff to look after the bees. The importance of knowledgeable and dedicated staff and volunteers was also highlighted in several points of research.

In addition to the social and environmental benefits that would undoubtedly arise from implementation for such a project, we came across unforeseen academic and economic benefits as well. In the academic realm, implementation of an apiary would make Dalhousie equipped to offer courses in Urban Beekeeping and Management, mimicking those offered on the Agricultural Campus in Truro (Dalhousie Faculty of Agriculture, 2015). The University and College of Sustainability would be recognized for innovative environmental management techniques as well as attracting students who are interested in bee hive management. Economic benefits could also arise if the keepers of the hive decided to sell the honey for a profit. The profit could perhaps be put towards more funding to increase the size and capacity of bee keeping in urban areas in Halifax.

A preliminary budget breakdown of the potential cost of sourcing and maintaining an apiary on campus was assessed. The budget below outlines the cost estimate for a single hive, all required equipment and other miscellaneous expenses (Table 2). Equipment pricing is based on

pricing from Propolis-etc (2014), and current bee market value is determined from Nova Scotia Bees (2014).

Table 2: Costs associated with implementation process.

Required Resources	**Product Description**	**Costs**
A Five Frame Honey Bee Nucleus (Nuc)	One colony of honey bees which includes a 'laying' queen, 3 inner frames and 2 outer frames containing honey, pollen and adhering bees	$140- $150 per Nuc (x5)
Safety Equipment	Hats and veils ($40.00 each) and smoker ($45.50 each)	$95.50
Hive Equipment	Frames and bodies, winter wrap and wooden top feeder ($123.50)	$123.50
Miscellaneous Expenses	Annual paid staff to perform regular maintenance on hive ($400), epi-pen for emergency purposes ($100), vegetation to generate 'natural' green wall ($60.00).	$560.00
	Total	$929.00

5.2 Limitations

Some sources of error in our research were not fully assessed because there were minimal past campus apiary reports to compare to, in terms of case and site-specific limitations to implementing an apiary in a University setting, and within a dense population. However, through an intensive document review we were able to develop a set a criteria for our purpose and location. Therefore, it is possible that our research may have extremely positive implications for other campuses to implement an apiary of their own. With an educational institution implementing this technology, there are possibilities for huge successes in the realm of looking forward to sound ecological and urban resource management.

6. Conclusion

Bees are of the utmost importance to our environment. They are integral to the systems we rely on to provide food, energy, and livelihoods. Without this important pollinator, the biodiversity of our province and surrounding area would plummet. Social acceptance is extremely important for implementation of a project like this because bees can easily be considered as pests if people are not accepting, creating a hostile environment for the public and the bees. Environmental elements must also be in alignment with bee needs if the apiary is going to thrive and survive the harsh Nova Scotian winters.

6.1 Recommendations

As our study shows, we believe Dalhousie could help counter the unfortunate diminution of bee populations by creating a rooftop apiary on our Studley campus. After using the outline of criteria established through our research, the ideal location for this project is on the rooftop of the Life Sciences Centre. We would like to reiterate that although this was our result, any rooftop or area on campus that could be acceptable should be used. It would be a great benefit to the reputation of our University and the College of Sustainability itself to establish a program like this. Our interviewees were all supportive of the idea and interested in its implementation, proving that there is support available. We believe this bodes well for the success of the apiary and the feasibility of long-term staff representation. There is unlimited information about beekeeping, and resources are highly acceptable. With an area that is compliant with the criteria list provided by this report, there is no reason why bees need to be suffering population decline.

References

Beekman, M, & Ratnieks, F. L. W. (2000). Long-range foraging by the honey-bee, Apismellifera L. *Functional Ecology, 14*(4), 490-496.

Britten, N. (1995). Qualitative Research: Qualitative interviews in medical research. BMJ, 311, 251. doi: http://dx.doi.org/10.1136/bmj.311.6999.251.

Caldeira, J. (2007). *John's beekeeping notebook: Backyard beekeeping. Notes on beekeeping bees in urban and suburban neighbourhoods.* Retrieved from http://outdoorplace.org/beekeeping/citybees.htm

Creswell, J. W. (2014). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (4th Edition). Thousand Oaks: SAGE Publications, Inc.

Dalhousie Faculty of Agriculture (2015). *The Modern Beekeeper: New course starting March 2015*. Retrieved from http://www.dal.ca/faculty/agriculture/extended-learning/programs-courses/learn2farm/the-modern-beekeeper.html

Dalhousie University. (n.d.). *College of Sustainability: News and events*. Retrieved on February 21st, 2015 from http://www.dal.ca/faculty/sustainability/news-and-events.html

Delaplane, K., & Mayer, D. (2000). *Crop Pollination by Bees*. New York: CAB International.

Garbuzov, M., & Ratnieks, F. L. W. (2014). Lattice fence and hedge barriers around an apiary increase honey bee flight height and decrease stings to people nearby. *Journal of Apicultural Research*, 53(1), 67-74.

Gemelli, A., Mancini, A., Diamantini, C., & Longhi, S. (2013). *GIS to support cost-effective decisions on renewable resources: Applications for low temperature geothermal energy*. New York: Springer.

Hegić, G., & Bubalo, D. (2007). Hygienic water supply for the bees. *Journal of Central European Agriculture, 7*(4), 743-751.

Imperial College. (2013). *The apiary project.* Retrieved from https://workspace.imperial.ac.uk/sustainability/Public/Beekeeping%20report%20summer%202013.pdf

John's Beekeeping Notebook (n.d.). Notes on Keeping bees in Urban and Suburban Neighbourhoods. *Backyard Beekeeping*. Retrieved from http://outdoorplace.org/beekeeping/citybees.htm

Lietaer, C. (n.d.). *Impact of beekeeping on forest conservation, preservation of forest ecosystems and poverty reduction*. Retrieved from: http://community.eldis.org/.59d3bb5d/Lietaer%20%20Impact%20of%20beekeeping%20on%20forest%20conservation%20preservation%20of%20forest%20ecosystems%20and%20poverty%20reduction.pdf

Loaded Ladle. (n.d.). *Contact*. Retrieved on February 21st, 2015 from http://loadedladle.com/contact/

Lowenstein, D., Matteson, K., Xiao, I., Silva, A., & Minor, E. (2014). Humans, bees, and pollination services in the city: the case of Chicago, IL (USA). *Biodiversity & Conservation*, *23*(11), 2857-2874. doi:10.1007/s10531-014-0752-0

McGill Apiculture Association. (n.d.). *The apiaries.* Retrieved from http://www.maa-mac.com/apiaries.html

Moore, L. J., & Kosut, M. (2013). *Buzz: Urban Beekeeping and the Power of the Bee*. New York: NYU Press.

Needham, A. W. (2013). *Beginning beekeeping: everything you need to know to become a beekeeper.* Retrieved from http://www.beginningbeekeeping.com/index.html

New York City Beekeepers Association. (2015). *NYCBA's best practices for beekeeping.* Retrieved from http://www.bees.nyc/nycbas-best-practices-for-beekeeping/

Nova Scotia Bees. (2014). *Beekeeping: Getting started*. Retrieved on February 20th, 2015 from http://novascotiabees.com/beekeeping-getting-started/

Nova Scotia Public Interest Group (NSPIG). (2012). *Contact us*. Retrieved on February 21st, 2015 from http://www.nspirg.org/contact-us/index.htm

Priesnitz, W. (2009). The buzz about backyard bees. *Natural Life Magazine.* Retrieved from http://www.life.ca/naturallife/subscribe/

Propolis-etc. (2014). *Beekeeping supplies*. Retrieved on February 24, 2015 from http://www.propolis-etc.ca/

Province of Nova Scotia. (2011). *Bee industry regulations made under Section 17 of the Bee Industry Act S.N.S. 2005, c.3. O.I.C. 2007-357 (June 22, 2007), N.S. Reg. 319/2007 as amended by O.I.C. 2012-213 (June 26, 2012), N.S. Reg. 133/2012.* Retrieved from https://www.novascotia.ca/just/regulations/regs/beeindustry.htm

Roberts, G., & Graham, L. (2007). *A document review and synthesis of information on Fetal Alcohol Spectrum Disorders (FASD) in Atlantic Canada. Halifax, NS, Canada: Public Health Agency of Canada, Atlantic Region*. Retrieved from http://www.ebrary.com

Selwyn, N., & Robson, K. (1998). Using email as a research tool. *Social Research Update* (21). Guildford, England: Department of Sociology, University of Surrey.

Sheffield, C. S., Kevan, P. G., Smith, R. F., Rigby, S. M., & Rogers, R. E. L. (2003). Bee species of Nova Scotia, Canada, with new records and notes on bionomics and floral relations. *Journal of the Kansas Entomological Society, 76*(2), 357-384.

The Government of British Columbia. (2014). *Ministry of Agriculture: Apiculture factsheet #101.* Retrieved from http://www.agf.gov.bc.ca/apiculture/factsheets/101_hist.htm

Wagner, M. (2012). *AASHE student diary series: Abuzz with rooftop bees.* Retrieved from Association for the Advancement of Sustainability in Higher Education (AASHE) website: http://www.aashe.org/blog/aashe-student-diary-series-abuzz-rooftop-bees

Ward, L. (2014). *How to start an urban beehive: here's how to make your first urban beehive a success.* Retrieved from Urban Farm Online website: http://www.urbanfarmonline.com/urban-livestock/bee-keeping/start-beehive.aspx

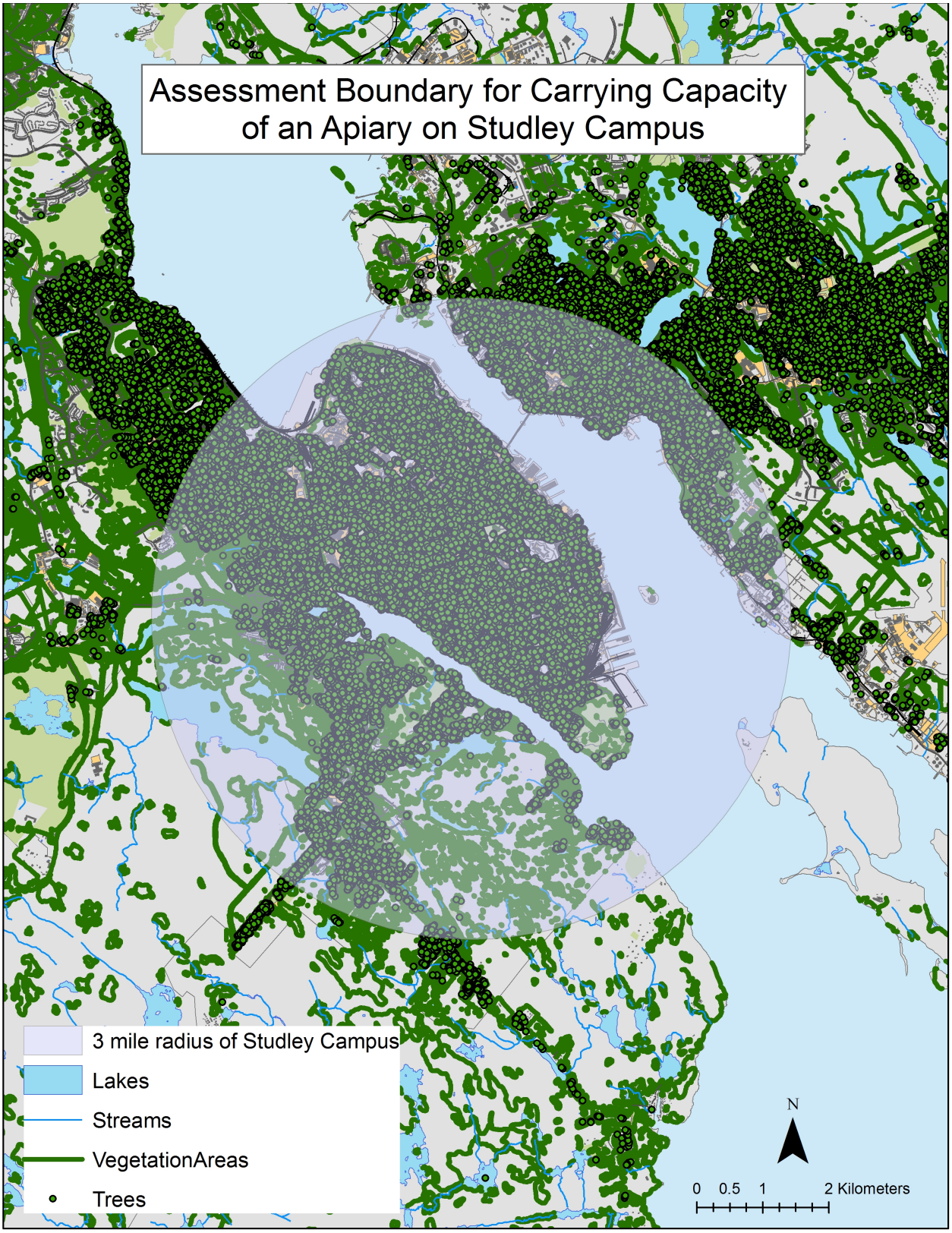
Wilmer, P. (2011). *Pollination and Floral Ecology*. Retrieved from http://press.princeton.edu/titles/9485.htm

Appendix A

Appendix A-1: Map of the radius for the carrying capacity of a potential apiary located on Studley Campus.

Appendix A-2: Map of the rooftops on Studley campus that are ample distance from traffic noise (100m), and should be cross-referenced with the other criteria for feasibility of an apiary.

Appendix A-1


Assessment Boundary for Carrying Capacity of an Apiary on Studley Campus
3 mile radius of Studley Campus
Lakes
Streams
VegetationAreas
Trees
N
0 0.5 1 2 Kilometers

Appendix A-2


Street Noise Assessment and Appropriate Rooftop Apiary Sites
Chase Building
King's Gym
Henry Hicks
University Club
Life Sciences Centre
buildings 100m from street noise
quiet
too loud
VegetationAreas
Trees
N
0
0.05
0.1
0.2 Kilometers

Appendix B

Interview Questions: Face-to-face, semi-structured

1. What steps did you take when first introducing an apiary to campus?

2. Do you have any key pieces of advice for first time beekeepers?

3. What was the greatest tool or resource throughout your process?

Appendix C

Interview Questions: Email-based, structured questions

1. What are the barriers you (or your team, etc.) has faced in implementing an apiary? This includes monetary, physical, and staffing troubles.

2. How long did it take you (or your team, etc.) to install your apiary? This includes gathering tools, construction, and moving the bees in.

Appendix D

List of Interviewees

1. Jason Sproule: Responsible for registering beekeepers in Nova Scotia.
Apiculturalist / Minor Use Pesticide Coordinator
Nova Scotia Department of Agriculture
Truro, NS, B2N 5G6
Email: Jason.Sproule@novascotia.ca
Phone: (902) 890-1565

2. Emanuel Jannasch
Professor for Dalhousie's Faculty of Architecture and Planning.
Hobby beekeeper.
Phone: 225-4717
Email: jannasch@dal.ca

3. Chris Cutler
Professor for Dalhousie's Department of Environmental Sciences,
Agricultural Campus.
Email: chris.cutler@dal.ca
Phone: 902.896.2471

4. Levi Megenbir – hobby beekeeper in Halifax.