ENVS 3502: Greening the Campus Project

What are the options for increasing biodiversity on campus through increasing native plant species' populations?

Submitted by:

Jessica MacSween, Hayley Paquette, Scottie Penton, Emily Sangster, and Jared Zwicker

Abstract

The year 2010 is the International Year for Biodiversity. Biodiversity or lack thereof is a pressing environmental issue as the strength and resilience of ecosystems rely strongly on their diversity of species and populations. Urban ecology has become increasingly foreign which creates issues in biodiversity as many introduced species become too abundant as they generally have few or no natural predators, beating out the native species for resources and monopolizing landscapes. This Greening the Campus Project focuses on the alternative options to the current primarily foreign ecology on Dalhousie University Studley Campus as a tool to improve biodiversity on campus and promote native ecology in urban landscapes. The Studley Campus was chosen because the most complete information on foreign and native plant species is available through the Woody Plant Inventory Preliminary Report created by Matt Follett for the Dalhousie Sustainability Office. Research methods used in the project include literary reviews, face-to-face interviews and nature walks. These methods were used to determine the most effective direction for increasing biodiversity through planting more native plant species on campus. Based on quantitative and qualitative results, it was determined that naturalization of the current Red Oak stand behind Sherriff Hall and the Life Sciences Centre (LSC) would be an ideal candidate for naturalization. This was determined due to the following; 1) potential for a natural corridor to be created between the Red Oak stand and the nearby Halifax Urban Greenbelt on Oxford street, 2) campus aesthetics would not be compromised in this area as it is not a focal point of the University, and 3) because naturalization of this particular area would be an improvement economically and environmentally. The final proposal for this site includes low maintenance, low cost initiatives which would not only be environmentally valuable, but also educationally useful for the science faculties which inhabit the adjacent LSC.

Acknowledgements

This project would not have been possible without the generous and enthusiastic participation of many members of the Dalhousie community and their wisdom, resources and expertise in our area of study. We would specifically like to thank Rochelle Owen, Director of Sustainability, Deborah Buszard, Director of the College of Sustainability, and Bill Freedman, Biology Professor at Dalhousie.

Table of Contents   **Page**

List of Figures

1.0 Introduction

Biodiversity refers to the various life forms on this planet and the ecological functions they carry out (Wilcox 1984). The number of different species of plants, animals, and microorganisms are all part of a biologically diverse Earth and the preservation of these organisms is vital. However, in many urban areas there are significant shortages of biodiversity and this can be attributed to an ever increasing pressure from humans (Murphy 1988). The natural wild habitat that once was, is more than ever being replaced with the most general type of habitat that supports little biodiversity (Tallamy 2007). Animals either directly or indirectly depend on plants for their source of food; therefore, the diversity of animals is closely linked to the diversity of plants in an area (Rosenzweig 1995). Animals that are able to live in these urban areas only have very general habitat and resource requirements (Murphy 1988). Those animals that have more diverse resource and habitat requirements are not able to survive in urban environments. Urban areas have also become affected by the introduction of invasive species that out-compete native species for limited resources and spread parasites to which many native species are vulnerable (Murphy 1988). In order to restore some of the lost biodiversity, appropriate conservation strategies need to be developed for urban areas.

Wildlife corridors are among the most valuable urban natural areas, providing extensive biological diversity and reducing the isolation of the largest surviving ecosystem (Murphy 1988). They essentially link habitat patches that were once historically connected (Evans 2007). By linking sites across a fragmented landscape than can maintain higher levels of biodiversity, ideally stocked with native plants that can tolerate the local climate better than non-native plants (Evans 2007). Wildlife corridors are becoming a popular instrument in city planning in order to facilitate wildlife and conserve native plant species (Evans 2007). In light of these facts about the importance of biodiversity and wildlife

corridors, increasing the amount of native plants in urban areas should be considered at Dalhousie University. Dalhousie's Studley campus can be viewed as an innovator of protecting biodiversity by simply making a few steps to increase the amount of native plants on campus. This project will show the benefits of increasing biodiversity on campus with the help of native plants and viable options for placement of future native species on Dalhousie's Studley campus.

2.0 Background

Although many believe that large monoculture lawns are beautiful, the environmental and economic costs of having them are high. They required a fair amount of maintenance, fuel for power mowers, and water consumption (NANPS 1999). Turf grass, the most common groundcover, requires seeding, mulching, fertilizers, and maintenance costs over many years (USEPA 2008). While native plants only require maintenance for the first few years until they are properly established (Tallamy 2007). The most significant savings from outdoor water consumption is from a reduction of lawn in conjunction with a conversion from exotic plant species to native plant species (NRC 2009). Most native plants use less water because they are adapted to the rainfall in the area (USEPA 2008). According to the U.S EPA (2008), the watering of an acre of turf lawn for 12 weeks in the midwestern United States requires 325, 848 gallons of water. Due to native plants' ability to reduce water consumption, they should be used as a conservation tool in many urban communities.

Additionally, landscapes made up of lawns with exotic plants rather than native plants have many environmental costs. The toxic emissions of carbon dioxide from power mowers, the lost of vital habitat for animals, and the potential settlement of invasive species are all examples of the environmental costs of foreign ecology (USEPA 2008). According to the U.S. EPA (2008), using a gas powered mower for one hour puts about the same amount of carbon dioxide

into the atmosphere as a 350 mile car trip. Native landscapes do not need to be regularly mowed; therefore, there is lower carbon dioxide emissions associated with these landscapes. Not only do they lower carbon dioxide emissions, but they also sequester carbon out of the atmosphere. By storing carbon in soil and plants, the effects of climate change can be diminished somewhat in urban areas (USEPA 2008). All plants have the ability to sequester carbon dioxide; however, native plants have deeper roots than that of non-native plants, allowing them to store more carbon deeper in the soil (USEPA 2008).

A lawn is an ecosystem with little variety in which only a few species of grass exists. This type of landscape is unsuitable for many animals that need food, water, and a place to nest or hide. Furthermore, invasive species of plants and grass can out-compete native species for habitat. Invasive species are considered to be one of the threats to native plants and animals, second to the loss of habitat from urban sprawl and industrial development (Reichard 1997). An invasive species may be an animal, plant, or disease that can kill or displace native organisms (Reichard 1997). When exotic species spread and increase, they are deemed invasive. Non-native plant species out-compete native species, decreasing the amount of available habitat and resources, while disrupting the equilibrium between the plant community and the animal community (Tallamy 2007).

Natural communities are essential for increasing the biodiversity of an area. Native plants help protect the genetic diversity of plant species, as well as attract a variety of native animals, including birds (Barnes 1999). However, many bird species are being lost because not only have their habitats been destroyed, but dangerous obstacles have been built in their place (Tallamy 2007). For example, each year as many as 1 billion birds are killed when they fly into the windows of tall buildings in major cities throughout the US (Klem 1990). Native birds in particular are in trouble due to loss of native plants. Birds and other wildlife have adapted to utilize native plants that provide food, cover, nesting sites or a combination of resources (Tallamy 2007). Native plants provide food at

different times of the year to birds in the form of seeds, fruit or as invertebrate host sites (Tallamy 2007). The growth habits of native plants present recognizable, safe nesting sites and cover that protect birds from harsh weather and predation (Tallamy 2007). Many of the native trees and shrubs with fleshy drupes (fruit with a seed surrounded by a fleshy layer), bright coloured berries and seeds are a source of food (Tallamy 2007). The seeds are then dispersed by the native birds. By planting species that are able to be dispersed readily by birds, regeneration of native ecosystems is also possible elsewhere. For many, the most compelling reason to return to native plants to the landscape is the role such plants have in producing food for native animals, particularly birds. A diverse ecosystem is a healthy ecosystem, not only for the native animals but, for the students and faculty. The increase in native species would facilitate the community to learn about the importance of native plants. By restoring the natural community of flora and fauna, Dalhousie can take direct action and make a difference in improving the ecological integrity on campus.

Brock University in St. Catharines, Ontario has proposed the naturalization of some spaces on campus to ecosystems representing regional identities as part of their campus plan. Part of the inspiration to implement naturalization of campus landscapes came from the fact that Brock University is located within the Niagara Escarpment *UNESCO World Biosphere Reserve*, which presents an outstanding opportunity to raise the profile of the campus and enhance related academic initiatives (Brock University 2002). Dalhousie could certainly prosper from the image gained from addressing and acting on the lack of native ecology on campus. The reputation of Dalhousie University as an environmentally responsible and conscientious institute is very important, especially with the recent creation of the College of Sustainability and its associated new academic program. Naturalization of the campus would not only show

commitment to environmental responsibility, but would also enhance academic programs through creating an experiential learning space and teaching tool.

University of Waterloo has had many different projects and proposals concerning topics similar to our group's subject of replacing foreign species and turf lawns with indigenous plant species through their *Watgreen* class projects. One particular *Watgreen* project by S. Hassan (2000) outlined criteria for conversion of turf areas to alternate forms of ground cover as social, ecological and economic. Our group's project will address the ecological and economic criteria as quantitative research and the social criteria as qualitative research to be discussed as part of the implementation process to conclude our research proposal.

3.0 Methods

An extensive literature review was conducted looking at the benefits of native species, specifically focussing on shrub and wild flower species. The subjects of water consumption, maintenance and biodiversity were the focus of the literature review.

Different methods of increasing the number of native species were explored. There are active and passive methods. Both of these techniques were thoroughly researched.

A solar access map of campus was constructed, using Google Sketch up; to show what areas of Studley Campus get the most light to aid in the selection decisions of which native plants to recommend. A series of maps were created using a Google Maps image and were edited in Photo Shop. These maps show the lack of connectivity on campus, the potential to connect a corridor to the Halifax Urban Greenway, the potential to connect the natural area to Ocean Pond and finally a map to show different areas with potential for naturalization around the Henry Hicks Academic building.

Interviews were conducted with experts in the area of native plants and also about the soil of the university. The people interviewed include Rochelle Owen, Professor Deborah Buszard, and Professor Bill Freedmen.

A comparison of the urban greenway was conducted by taking photographs of the greenway and taking pictures of the area being considered for naturalization. Also if wildlife was spotted in the greenway or the area behind Sheriff Hall they were documented.

4.0 Results: Different options for native species introduction on Studley Campus

Passive Naturalization Method

The passive method of naturalization is best described as just leaving the area alone. If an area is not mowed or manicured, species that are able to survive without the inputs of fertilizer and water will take over (GPP Architecture 2007). The area undergoes succession. This method relies on native plants being nearby to provide native seeds to the area (LandOwner Resource Centre 2005). It does not work so well when there are not a lot of native plants around. If the surrounding plants are not native there is a possibility of invasive species over taking the area. This method may also require some work if the initial composition of plants is primarily grass. Grass lawns are generally more compacted so to get things started some aeration of the soil is usually necessary.

Active Naturalization Methods:

Planting

To begin planting, grass and other non native plants must be removed so that there no plants to compete with the native ones. This can be expensive as the older plants get, the more expensive they are. This method has the advantage of producing instant results and people will notice the difference right away. This also provides a lot of control in the plant composition of

the area. This is good if the desired look is more manicured like a traditional garden. To create

something like the Harriet Irving Botanical Gardens at Acadia University planting would be one

essential to use planting to produce the desired plant composition and patterns.

Seeding

The method of seeding is cheaper than buying plants but the results take longer. This can

also provide control over the plant composition but some plant seeds might not germinate. There

is also the exposure of the soil which can lead to some erosion. Seeding could be used in the

same way as planting to produce a desired pattern and species composition, however the results

would be slower to be seen.

Soil Grafting

Soil grafting is a simple way to naturalize a small area. It involves taking soil from an

area rich in native species and spreading it in the area to be naturalized (Rodewald et al. 2004).

The soil will already have a diverse reserve of seeds and will sprout a variety of plants. A

disadvantage of this method is that the seed composition of the soil is unknown. This means that

it might not be very aesthetically pleasing for people accustomed to traditional gardens.

The main costs of this method are the transportation of the soil and possible damage to the area

the soil is taken from. A way to mitigate the damage of taking soil is to take soil from the area

alongside a road (Chown et al. 2006). The sides of the road are mown infrequently and would

contain native species. The area is also not habitat for a lot of animals as there is a lot of

disturbance next to roads.

Studley Campus

The following Figure 1. shows the Studley Campus in the context of the Halifax Peninsula. The area in red is the Studley Campus, while the area in green represents the urban forest network. The grey areas represent the relatively sparse urban forest network. The figure shows how Studley Campus stands out as a significant urban area with little forest cover imposing a bottleneck between the south and north end habitats on the Halifax Peninsula.
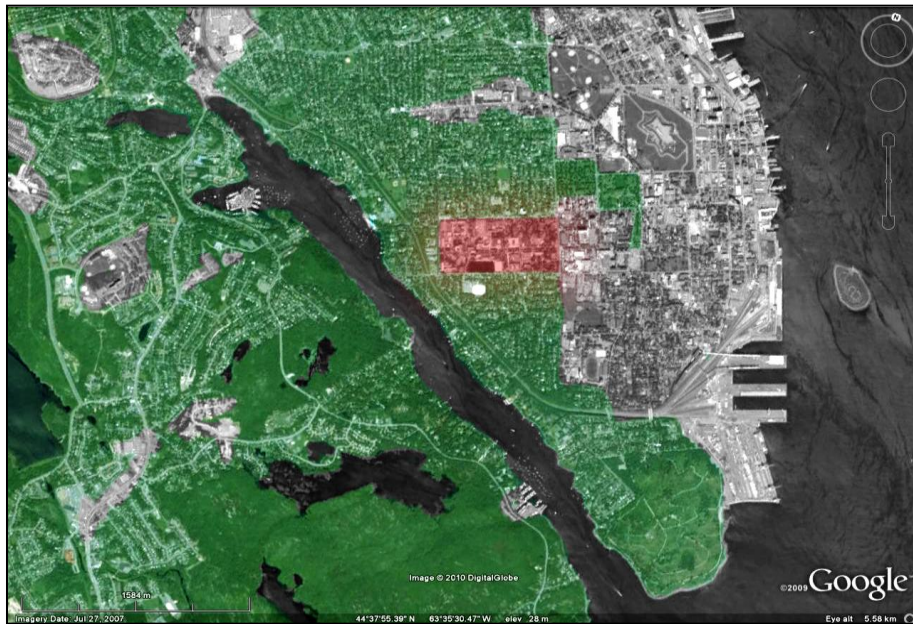

Figure 1. Studley Campus in the context of the Halifax Peninsula.

<u>Shirreff Hall</u>

The grounds behind Shirreff Hall (highlighted in blue) represent an ideal area for naturalization due to the Red Oak stand found behind the building, which is outlined in red. This area has many opportunities to connect with other urban forest habitat, which is demonstrated by the green arrows below.

Figure 2. Shirreff Hall, showing connection to surrounding urban forest areas.

Ocean Pond

The Ocean Pond (red circle) is an area that is lacking in connection to the urban forest

areas or any other source of input. There are a few connections, noted in blue, however these are

just a few patches of isolated forest.

Figure 3. Ocean Pond (red circle) in relation to other urban forest areas.

<u>Henry Hicks Academic Building</u>

The Henry Hicks area has some potential for increasing naturalized areas on campus. The green areas are where native plants may be considered. The yellow, blue, and red areas are areas were naturalization in unlikely to occur. This is because of aesthetic (yellow), recreational (blue), and security (red) considerations.
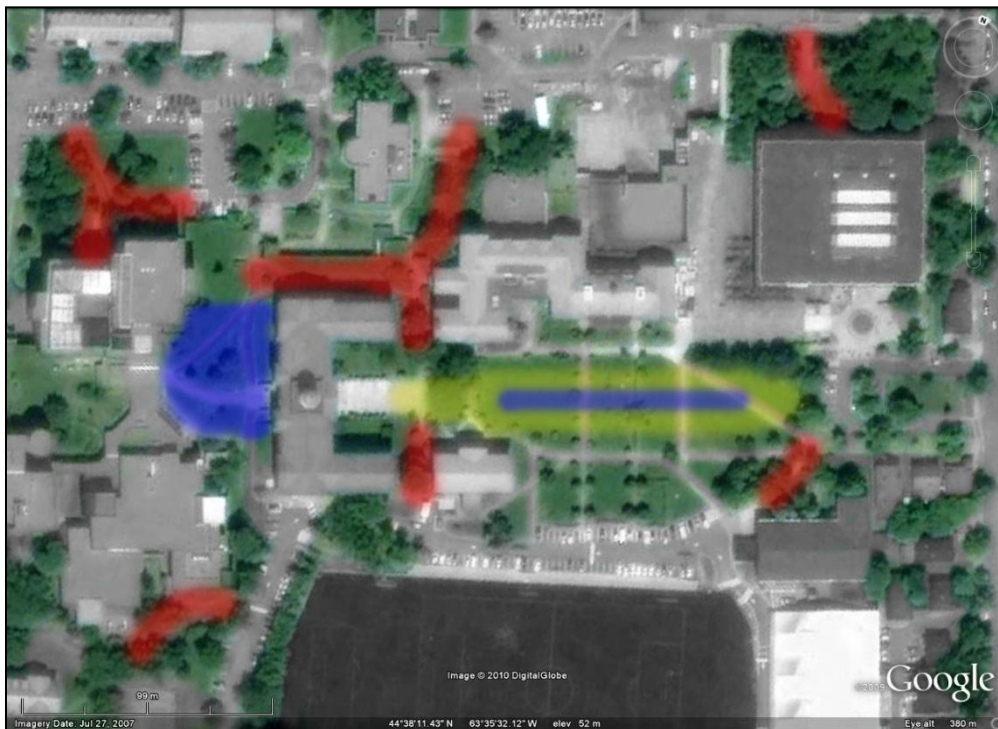

Figure 4. Henry Hicks area in relation to aesthetic (yellow), recreation (blue), and security (red) considerations.

5.0 Discussion

In order to increase the amount of natural areas on Dalhousie's Studley Campus, a variety of methods were explored. Active methods such as using seeding and soil grafting are a good way to establish native plants species in an area. Considering the limited budget at Dalhousie University for increasing native species soil grafting would be the most viable option, as it is inexpensive and low maintenance, while still providing effective results.

It was found that Dalhousie's campus is mostly made up of non-native species, which are largely disconnected from one another (Figure 1). The plant species documented on Dalhousie's Campus consist of 57% introduced species, while only 22% are native plant species (Follett 2010). This disconnect in the ecosystem hampers the growth and flow of native biodiversity within Halifax peninsula. In order to improve biodiversity on campus, the integration of native plants is encouraged.

Throughout our study, we conducted interviews with Rochelle Owen, Professor Deborah Buszard, and Professor Bill Freedmen. These interviews allowed us to gain focus for our project and encouraged the pursuit of increasing biodiversity on campus. The main point that was discovered from interviews with Rochelle Owen and Deborah Buszard was the rejuvenation of the Ocean Pond. This area is of concern because it is thought to comprise the aesthetic appeal of Dalhousie's campus. The area is isolated from any urban forest areas which influences the amount of biodiversity, making it nearly devoid of animal activity (personal communication with Deborah Buszard, March 15th 2010). It has been noted that the increasing presence of the Norway maple in the Ocean Pond is of great concern particularly because it is an invasive species (personal communication with Rochelle Owen, March 16th 2010). The plant species on Dalhousie's Campus are 12% invasive and the primary invasive species is Norway maple

(Follett 2010). The Norway maple evolved in northern Europe and was brought over by early European colonists (Tallamy 2007). It is considered as an invasive species because it has the ability to self-propagate and out-compete the native plant for limited resources (Follett 2010). The plants and animals of North American have never evolved with this tree, and have yet to adapt to its presence (Tallamy 2010). The Red maple is a native plant to this region and is often confused for the Norway maple (personal communication with Bill Freedman, February 11th 2010). This is just one of the types of plant species it has been displacing, it also casts heavy shade that leads to a decreased presence of native shrubs and herbaceous plants (Follett 2010).

Ocean Pond is located on the Studley Campus between the Chase Building, Life Science Center (LSC) and the Chemistry Building (Ocean Pond 2005). This area provides habitat to native species, of which some are moving to other parts on campus and increasing the amount of native species present (Ocean Pond 2005). However, this area is relatively isolate from other naturalized area and as a result biodiversity remains relatively low (Ocean Pond 2005). Without connecting this area to another wildlife corridor, future plans to increase diversity may prove difficult. Ocean Pond has developed somewhat of a bad reputation due to its disorganized appearance. However, this area can possibly be improved by the increased naturalization of the surrounding area and establishing wildlife corridors could potentially add more visible 'life' to the pond.

6.0 Conclusions and Recommendations

When contemplating where to naturalize on campus many factors were brought to our attention. Areas for recreation are off limits because turf grass is required. It is very durable and an appropriate native alternative is unavailable. There are also areas of campus that are very

representative and their prestige must be maintained. Replacing the current exotic species with natives would not decrease economic inputs to grounds maintenance, most likely these cost would actually increase (personal communication with Deborah Buszard, March 15th 2010). It would also not increase the biodiversity of the area as the same number of species would be present. As we consider increased biodiversity to be the goal these areas do not have the highest potential due to the previously outlined constraints.

The area we settled on is the Red Oak stand behind Shirreff Hall and the Life Sciences Centre. Red Oaks are the most represented native species on campus (Follett 2010) and this area would be the optimal location to start the naturalization process. It is also thought to be an ideal area for naturalization because it is located on a slope and therefore maintenance of this area would be reduced. This area is also located in the more dense areas of forest cover on the Studley campus, where there is little disturbance by people. This area is not representative, nor is it used for recreation. This area is under-utilized from a productivity standpoint and naturalizing it would increase its value because it would increase campus biodiversity. It is also located very close to the Halifax Urban Greenway on Oxford Street which is a strip of natural wild ecology that reaches all the way to Point Pleasant Park. By increasing the amount of native plants behind Shirreff Hall, an effective corridor can be established that would allow species to migrate along the belt. By favouring native plants over aliens in the urban landscape, we can do so much to sustain biodiversity. Animals are dependent on plants for their food, causing the diversity of animals in a particular area to be linked to diversity of plants (Rosenzweig 1995). Plant diversity also creates different niches for animal species in order for them to obtain their energy without interfering with one another (Tallamy 2007).

With the naturalization of this area we envision three potential stages; 1) Naturalization of Red Oak stand, linking to Greenway; 2) extend corridor around north west side of Life Sciences Centre to Ocean Pond to create a energy input to revitalize this site; and eventually 3) further extend corridor from Ocean Pond to front of Henry Hicks Academic building to bring native species and the importance of biodiversity to the forefront of the minds of students, faculty, staff and community of Dalhousie and Halifax Regional Municipality.

Building upon the projected successes of naturalization at both the Shirreff Hall and Ocean Pond sites, the front and rear grounds of the Henry Hicks Academic building provide an ideal place to bring naturalization and its benefits into higher traffic public spaces. Special considerations and careful planning must be undertaken to ensure a healthy balance of aesthetics and ecosystem integrity are met that meet physical needs of those people who use the space, the aesthetic and maintenance needs of the University, and the character needed to maintain a sustainable healthy native urban ecosystem. The courtyard on the eastern side of Henry Hicks is largely used by students for general recreation and it is one of Dalhousie's most treasured views. It is because of this that replacing non-native grass with native plants would not be appropriate in this area. However, in order to facilitate an increase in native species on campus, without compromising Dalhousie's courtyard, native shrubs that are not too tall and do not conflict with aesthetic quality could be used to line the perimeter of the courtyard. An ideal choice would be rhondora (*Rhododendron canadense*) because it reaches a height of no more than four feet, blooms early in the spring with attractive rose-purple flowers, and is tolerant of a wide range of soil types (Leopold 2005).

With the implementation of our proposal to naturalize the Red Oak stand further as multi –phased plan for increasing native ecology on Studley and campus to improve biodiversity there

are still a few considerations to be reviewed. We suggest further study into soil quality and an analysis of contaminants. Also, increasing native species on campus is not possible without more education and involvement on campus about the benefits of native species. In order for change to occur at Dalhousie, there is a need to re-evaluate how we use native plants in the landscape and educate students, faculty and staff about the importance of a project such as this.

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Appendix A: Interview questions for Rochelle Owen.

1.   Natural Inventory – what is the most complete area? Can we get this information?

2.   Have you spoken with/advised any past projects addressing increasing native ecology on campus? If so:

       a.   What problems did they run into?

       b.   What was the project?

       c.   Research question?

3.   What is your opinion on "naturalization" of campuses?

4.   Do you have any information on the current financial cost of grounds maintenance? If not who would be the best person to pursue for this information?

Appendix B: Interview questions for Deborah Buszard

Fertilizers

1)   What are the consequences of use on campus?

2)   Is it a significant problem the school is already aware of?

3)   Are there alternatives to use?

4)   Are we using them on campus?

5)   Are there any testing methods you suggest?

6)   What costs go into fertilizing?

Soil characteristics on campus

1)   Is fertilizer necessary for anything to grown on campus?

2)   Would fertilizers be necessary for the growth of native shrubs on campus?

Seeding vs. Transplanting

1)   In planting native shrubs, are there advantages of growing from seed vs. transplanting?

2)   Will locate climate or geography play a large role in this choice?

3)   Does each method have differing fertilizer requirements?

Appendix C: Interview questions for Bill Freedman.

1) What types of native shrubs are good for this area?

2) What kind of soil is most predominant on Dalhousie`s Campus?

3) What types of native species are attracted to most native shrubs?

4) Is it less work with native shrubs (plants) vs. grass or non-native shrubs (plants)?

5) What are the main economic costs associated with native plants and where is the best place to get them in Nova Scotia?

6) Are native plants cost-effective in the long-run?

7) What techniques did you use to install native plants in your garden?

8) Is there any issues with native plants being transplanted to areas where there was once fertilizers or pesticides used?

9) Out of the list created which shrubs are most appropriate for Dalhousie`s Campus?