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# The Feasibility of Dalhousie University's Studley Campus's Designation as a "Bee Campus"™ Through Student Support of Pollinator-Friendly Initiatives.

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Bee City Campus™	Dalhousie University	Studley Campus
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## EXECUTIVE SUMMARY

The western honeybee (*Apis mellifera*) plays a significant role in most pollination networks globally (Hung et al. 2018). Bee City Canada™ is an organization that supports the establishment of bee sanctuaries in cities across Canada. To determine the feasibility of Studley Campus in Halifax, Nova Scotia at Dalhousie University being designated as a Bee Campus™ we focused on student support prior to an application sent to Bee City Canada™. The initiatives are creating & maintaining pollinator habitat, educating the community about pollinators, and celebrating pollinators during National Pollinator week. The study design only targeted student support and concerns through a Google Form which consisted of 20 questions with varied styles, and a poster which included a QR code to our survey link. Survey distribution was through Dalhousie Institute student emails to professors, and they were asked to distribute them to their classes. The Bee Campus™ application form requires a single applicant to briefly summarize reasoning to become a Bee City Campus, adopt a Bee City Canada Resolution, and create a Bee City pollinator team of at least two faculty members, 2-5 students, campus staff, and employees from the campus grounds department. Of the student respondents, majority identified as being in their 4<sup>th</sup> year of Undergraduate study. No respondents identified as being in their first year of Undergraduate studies. A high portion of respondents answered yes when asked whether they would like to see more pollinators present on Studley campus. Using Likert-scale questions, we determined the highest levels of support were for the establishment of pollinator gardens (4.90). Coding trees were created for two open response questions in our survey. The most common concern was about being stung, and the safety of those who have anaphylactic allergies. A one-way ANOVA test showed that there was no relationship between the three main initiatives by support versus student interest for volunteering. A limitation is we did not receive first-year student survey responses, and we did not determine professor support or gather the opinions of groundkeepers. With the initial application, there are no fees, although Dalhousie's renewal fee will be \$150 (BeeCity Canada, 2023). Along with increasing green spaces on campus, adding bee boxes made of bamboo, Dalhousie's Studley campus should submit an application to Bee City Canada™ and seek a designation of a Bee Campus™. If the project goes forward, it is crucial that it targets more students in first and second year to ensure that there will be smooth student turnover.

## INTRODUCTION

Pollinators are an integral component of a healthy ecosystem as they contribute to ecosystem services such as increased biodiversity, native species, and overall wellbeing of habitats (El-Sheikh, 2018). Bees are the most important insect pollinators globally, having co-evolved with plants throughout their existence as a distinct clade (Tepedino 1979). The western honeybee (*Apis mellifera*) is the most important pollinator of all the bees, playing a significant role in the majority of pollination networks globally (Hung *et al.* 2018). A super-generalist species with a broad pollen diet, the presence of *A. mellifera* in pollinator networks to assist in plant reproduction is crucial (Tepedino 1979; Hung *et al.* 2018). Additionally, while *A. mellifera* serves as the backbone for many pollinator networks their presence is often supplemented by native pollinator species (Hung *et al.* 2018). Despite the important ecosystem services bees provide they are currently at risk of severe decline due to factors including losses in suitable habitats, biodiversity, and floral abundance (Goulson *et al.* 2008). These losses are more prominent in areas undergoing intensive agriculture and/or urbanization (Goulson *et al.* 2008). In urban areas, sanctuaries in the form of gardens and parks provide habitats for bees and can strengthen their population as well as promote biodiversity of floral species (Goulson *et al.* 2008). The pollination services provided by bees contributes nearly \$361 billion to agricultural processes worldwide, as 80% of the world's major global food crops benefit from the pollination services provided by bees (Lautenbach *et al.* 2012; Klein *et al.* 2006). In addition to this, bees have been shown to increase human well-being and health, while also being of significant value to some cultures around the world (Potts *et al.* 2016).

Many people are unaware of the important ecosystem services pollinators like the bee provide. It is through organizations like Bee City Canada™ that people can become educated on the importance of pollinators. Bee City Canada™ is an organization that supports the establishment of bee sanctuaries in cities across Canada. Additionally, they promote the establishment of pollinator homes on university campuses through their Bee Campus program. While many of these sanctuaries have been established at universities in other provinces, there have been no reports of any established in Nova Scotia. Canadian University's such as Western University, McMaster University, Laurier University and many more, have teamed up with Bee City Canada™ in hopes of becoming a designated Bee Campus™. These schools have made changes to their campuses since joining this organization to make them more pollinator friendly and to raise awareness for pollinators among their student body. All the universities in Canada that have become designated bee campuses have taken part in pollinator-friendly initiatives in order to fulfil the requirements of becoming a designated Bee Campus™ (Bee City Canada, 2020). Many of these schools continue to increase their initiatives which benefit pollinators, thus leading to incremental growth in biodiversity and overall student well-being (Bee City Canada, 2020). McMaster University has taken the next steps and recently installed bee boxes in a variety of locations around their campus (McMaster, 2022). These bee boxes (figure 1) have been shown to raise awareness in the McMaster student and faculty community, by fostering increased recognition of bee's importance to our ecosystem (Bieksa, 2021).



**Figure 1.** McMaster University’s bee boxes which are in a prime location to engage with students and faculty, as well as install curiosity among students. Image taken from McMaster University, 2019.

In hopes of designating Dalhousie University’s Studley Campus as a Bee Campus™, initiatives like that of other Canadian Universities will need to be implemented on Studley campus. Studley campus is the perfect location for a bee campus, as many of Dalhousie’s residences and classes take place on this campus, thus leading to an increased number of student activity at this location. This campus is additionally a great location to increase pollinator populations, as there is lots of sunlight and many spots protected by the wind, which makes the perfect home for pollinators like the bee (Suryanarayanan et al. 2021).

In creating a campus that is pollinator-friendly considering increasing pollinator populations, it is crucial that the campus can support the influx of pollinators. To prepare for this influx there will need to be increased student support and volunteering on Studley campus. Increased student engagement with this initiative will ignite greater levels of awareness of the pollinator services provided by bees among Dalhousie University students.

Research on the level of support from students at Dalhousie University is a key component in implementing this initiative because it will be almost entirely student run. Students will be responsible for maintaining the bee campus as well as any additional initiatives they chose to add. Education on pollinators is a key component in getting the support needed to implement student run initiatives. Findings suggest that having open access educational materials on pollinators allows for people to conveniently access this information at their leisure (Kalaman et al. 2020). In saying this, studies have also shown that education alone is not enough to cause students to support or involve themselves in initiatives or campaigns (Cruz and Grozinger, 2023). Given that education is just the start of this process, student support and willingness to volunteer for initiatives can be determined as well as increased through survey questions and interviews. Surveys tend to be the most effective when they enhance learning, as the survey may list different initiatives and facts the respondent may not have been aware of or known

prior to taking the survey (Skelly and Bradley, 2007). Findings suggest that there may be some relationship between student support for pollinator initiatives and visibility of on-campus pollinator gardens (Skelly and Bradley, 2007). This is important to note when determining ways to increase levels of support and number of volunteers, as well as when trying to incorporate a broad array of student support. It is crucial to make sure there is a diverse student body supporting pollinator initiatives, as this will increase overall student awareness on pollinators. This can be done when distributing surveys by making sure the survey is dispensed among a wide variety of students, through sending the survey to different facilities.

The purpose of this research study is to determine if there is support amongst students at Dalhousie University to have Studley Campus become a designated Bee Campus™. Additionally, our team will attempt to engage students in initiatives including, creating pollinator gardens, installing bee boxes, and creating accessible education programs (refer to appendix for a full list of initiatives). Through surveying students our team will determine if there is sufficient support among students to establish this sanctuary for bees on Studley campus.

## METHODS

This section will first introduce our study design followed by a detailed description of the research tools used. Justification for each survey question has been given in Table 2 and refers to the questions in Table 1. See Appendix 3 for the full survey as it appeared in the Google Form. The study design consists of one data collection method, communications with two Universities in Ontario (Western & McMaster), and a data analysis plan which are described in detail in the following subsections. To determine the feasibility of Studley Campus in Halifax, Nova Scotia at Dalhousie University being designated as a Bee Campus™, we focused on the three main criteria required prior to an application sent to Bee City Canada™. This includes creating and maintaining a pollinator-friendly campus. The study targeted student support and concerns; we were not able to include faculty or the opinions of groundkeepers. The “Bee Campus” program is an initiative focused on creating, maintaining and/or improving pollinator habitats, educating the community about the importance of pollinators, and celebrating pollinators during National Pollinator Week.

## STUDY DESIGN

The study design only targeted student support and concerns based on the three primary criteria for the designation of a Bee Campus™. The Bee Campus™ designation is a Bee City Canada™ designation granted through ongoing efforts to create and maintain pollinator habitats, educate the community about the importance of pollinators, and celebrate pollinators year-round and additionally during National Pollinator Week. For the year 2023, Pollinator Week in Canada is the week of Monday, June 19<sup>th</sup> and is initiated until Sunday, June 25<sup>th</sup> (Pollinator Partnership Canada, 2023). During this semester, Dalhousie’s Studley campus has a student population of ~20 970, a 95% confidence interval for our study would be **376** student survey respondents.

## RESEARCH TOOLS

We used a survey instead of interviews to gain more outreach from students. We used the online platform Google Forms to create our survey which consisted of 20 questions with varied styles targeted toward student support and concerns (see Table 1). We also created a poster, which was sent along with our surveys during outreach as it included a QR code which was directed to our survey link (see Appendix 3). Online communications were conducted over Microsoft Teams with the engagement coordinator from the McMaster University sustainability office, Abbie Little. We also connected with Jessica Cordes, the engagement coordinator of Western University's sustainability office, over email and she relayed answers to us through email. Western University has been the first University in Canada to receive a Bee Campus™ designation by Bee City Canada™. Connecting with the two engagement sustainability office coordinators instead of sending a survey helped us develop more of a connection between our own campus to Western and McMaster. This was helpful in developing our future recommendations and calls to action.

**Table 1.** Survey Questions which were distributed in a Google Form to students attending Dalhousie University's Studley Campus during the Winter Semester of 2022-2023. The title of the survey was 'Making a Pollinator-Friendly Campus'. A varied array of 20 questions was used, including open-response, single-response, rating, ranking, and Likert-scale. See Appendix 3 for the full survey including the consent form, which was displayed directly above all survey questions, including question 1, the consent single-response question. Questions will be identified individually by their respective number (1. → 20.).

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(\*) Show definitions; (**\*required**) shows which questions were required to be answered by the respondent.

1. Although this survey is anonymous, do you consent to your responses being further used in this research study? (Single-response - (Yes or No)).
2. What year of study are you in at Dalhousie University (open response); (**\*required**).
3. What program are you enrolled in? (Open response); (**\*required**).
4. What is your current student classification? (Single-response - (Undergraduate, Graduate, Professional Studies, Other - (open-response))). (**\*required**).

**To what degree do you agree with the following statements on a scale of 1-5, where 1 equals no support, 2 equals little support, 3 equals neutral (neither support nor do not support), 4 equals somewhat supportive, and 5 equals fully supportive.**

5. Ecosystem services\* provided by pollinators are important *\*Ecosystem services are positive benefits that wildlife or ecosystems provide to people.* (Likert-scale, 1-5, 1 equals no support, 5 equals fully supportive).
6. Increasing the number of native species\* on campus is important. *\*Native species are species which are from a given region or ecosystem, in this scenario we are referring to native species of Nova Scotia.* (Likert-scale, 1-5, 1 equals no support, 5 equals fully supportive).



7. Increasing biodiversity\* on campus is important. *\*Biodiversity describes the variety of life.* (Likert-scale, 1-5, 1 equals no support, 5 equals fully supportive).

8. Would you like to see more pollinators present on Studley Campus? *\*Pollinators are organisms that facilitate sexual reproduction in flowering plants, which can have various effects including increased plant growth, larger yields, and biodiversity protection. Pollinators include flies, beetles, ants, moths, wasps, hummingbirds, butterflies, and bees, which spread pollen from one plant to another as they navigate flowers for food.* (Single-response - (Yes, No, Maybe, Unsure, Other - (open-response))).

**On a scale of 1-5, how much do you support the following initiatives to protect bees and other pollinators on campus? 1 equals no support, 2 equals little support, 3 equals neutral (neither support nor do not support), 4 equals somewhat supportive, and 5 equals fully supportive.**

9. Building bee boxes\*. *\*Bee boxes are hive bodies, or boxes, which provide a dwelling place constructed for bees.* (Ranking, 1-5, 1 equals no support, 5 equals fully supportive).

10. Creating a pollinator garden\*. *A \*pollinator garden is a specific type of garden designed to grow specific nectar and pollen-producing plants. These gardens have the intent of attracting pollinating insects, such as flies, beetles, ants, moths, wasps, hummingbirds, butterflies, and bees, which spread pollen from one plant to another as they navigate flowers for food.* (Ranking, 1-5, 1 equals no support, 5 equals fully supportive).

11. Creating \*community gardens. *\*Community gardens are pieces of land gardened by a group of people individually or collectively.* (Ranking, 1-5, 1 equals no support, 5 equals fully supportive).

12. Establishing Studley as a NO MOW (limited lawn maintenance) campus. *A limited lawn maintenance campus would decrease the amount of lawn care and allow for lawns to grow better which creates habitat and forage for early-season pollinators.* (Ranking 1-5, 1 equals no support, 5 equals fully supportive).

13. Accessible education programs about the importance of pollinators. *Examples of the services education programs offer are free webinars, open-source databases, and habitat-focused activities.* (Ranking, 1-5, 1 equals no support, 5 equals fully supportive).

**As a student, would you be interested in volunteering to maintain and create a pollinator-friendly campus in the following roles:**

14. Creating and maintaining and/or improving pollinator habitat. (Single-response - (Yes, No, Maybe, Unsure, Other - (open-response))).

15. Educating the student community about the importance of pollinators. *These would be formal educational activities such as hosting or attending an event with guest speakers.* (Single-response - (Yes, No, Maybe, Unsure, Other - (open-response))).

16. Celebrating pollinators during national pollinator week. *These would be informal celebrations such as sharing educational pollinator facts with a friend.* (Single-response - (Yes, No, Maybe, Unsure, Other - (open-response))).

17. As a student at Dalhousie University, do you have any suggestions for pollinator-themed events that could be hosted on campus during the academic year? *The purpose of these events is to promote knowledge and educate students on pollinators (e.g., flies, beetles, ants, moths, wasps, hummingbirds, butterflies, and bees, which spread pollen from one plant to another as they navigate flowers for food).* (Single-response - (Yes or No)).

18. If you answered yes to the question above, please share your suggestions. (Open response).

19. Would you support a small tuition addendum (approximately \$0.02 per academic year) being added that would directly fund this pollinator-friendly campus initiative? (Single-response - (Yes, No, Maybe, Unsure)).
20. Do you have any comments/concerns about creating more habitats for bees and pollinators on campus? If so, please state below. (Open response).
- 

## STUDENT SURVEY

The survey was distributed in our class of ENVS 3502, and these were mostly third-and fourth-year students. Outreach for survey distribution was through our classmates, as well as 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup>-year Undergraduate classes, and Graduate classes. Outreach was done by Dalhousie Institute student emails to professors with the survey link, and they were asked to distribute them. Professors then distributed the survey link for our ‘Pollinator-Friendly Campus’ student survey and our graphic by posting on their course website along with a website link to our survey (see Appendix 3 & Appendix 5).

Our survey was distributed to classes BIOL 2060, SUST 3107, SUST 3207, BIOL 3061, MGMT 4505, and MARI 4880 during the Winter semester of the academic year 2022-2023. The survey questions used were open-ended, single response, rating, ranking, and Likert-scale. Using Likert-scale questions helped us incorporate a scale to rank the level of support we received from students. Justifications and reasoning for each survey question are included in this report (see Table 2).

**Table 2.** Justification for each survey question in our ‘Pollinator-Friendly Campus’ student survey. Each question is referring to the questions in Table 1, represented by (1. → 20.) will describe the study design and value of the question for our research study. Distributed to students at Studley Campus in the Winter semester of 2022-2023 at Dalhousie University, Halifax, Nova Scotia.

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1. This was required, as we needed to ensure that the collected respondents' information would not be recorded, and acknowledgement was given by the respondent.
2. Important to see what year of study students were supporting this research project were mainly in, students who do not support the study, and what year students were in for who would participate the most in the pollinator-friendly campus initiatives. This was valuable in distinguishing support amongst Undergraduates, Graduates, and Ph.D. students.
3. This question allowed us to see what program students who support the research project were mainly in, what students who do not support the study, what year students were in and who would participate the most in pollinator-friendly campus initiatives. This was helpful in our data analysis as this helped us also distinguish the level of academic background students who have taken our survey have on this topic.
4. This was important in distinguishing the level of study for students taking our survey and their academic background during data analysis.

5. Knowing the level of knowledge students have regarding pollinators prior to this survey directly relates to one of the three main initiatives for the designation of a Bee Campus™.
6. This question asked respondents if they saw a relationship between the variables of pollinators and native species. This allowed us to determine our respondents' level of knowledge on the topic of pollinators in Nova Scotia.
7. We wanted to know if students saw a relationship between pollinators on campus and biodiversity, this question specifically asked respondents about biodiversity.
8. The results of this question were useful it relates directly back to our research question, where we were asking about the preference of the survey respondent, and they were able to state whether they would like this initiative to occur.
9. Questions 9 to 13 follow a ranking style question, and they were linked back to our research question as we could measure the amount of support each survey respondent had towards a given initiative which all affect pollinator populations (5 total). Question 9 is a creating & maintaining initiative.
10. This initiative would be a part of creating & maintaining a pollinator garden on campus.
11. This initiative would be a part of creating & maintaining community gardens on campus.
12. This initiative would be a part of creating & maintaining a NO MOW campus, which would require coordination from groundkeepers and campus-wide support.
13. This initiative would be a part of educating the student community by providing accessible education programs about the importance of pollinators.
14. Questions 14 to 16 follow a single-response style question to determine student willingness to volunteer for the three main initiatives required for being designated as a Bee Campus™. In data analysis, this was important in determining the support for initiatives on campus compared to the willingness to volunteer to take part in the initiatives with a One-way ANOVA. Question 14 represents volunteer interest in creating and maintaining and/or improving pollinator habitat.
15. This question represents volunteer interest in educating the student community about the importance of pollinators, which is the second main initiative.
16. This question represents the last main initiative which is celebrating pollinators during national pollinator week on campus.
17. This question was to see how many students' suggestions for Dalhousie University pollinator-themed events had, which would be hosted year-round at Studley campus if Bee Campus™ designation was given.
18. This is an open-response question targeted toward students who have suggestions to celebrate pollinators around campus. We included this question for students to share their own ideas for this initiative.
19. The addition of this question was to determine the level of support to fund this initiative, as an addition to tuition would be paid by students to run the initiatives around a pollinator-friendly campus.
20. This is important as we wanted to know if our respondents have anything else to say about our survey that was not mentioned above. This open-response question allowed survey respondents to give their own

thoughts.

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## INTERVIEWS

We had a Microsoft Teams conversation with Abbie Little from McMaster University for student experience with a Bee Campus™ designation. Her position is the engagement coordinator for the sustainability office at McMaster's Bee Campus™. We were also able to gather information on Western University's Bee Campus™, which has been the first University in Canada to receive the designation. Jessica Cordes, who is the engagement coordinator for the sustainability office at Western University in London, Ontario, Canada, was able to relay answers to our questions via email.

**Table 3.** 'Bee Campus' questions for Western University and McMaster University. The first two questions were separately asked to the respective Universities based on the beginning year of their Bee Campus™ designation. Communication was with the respective engagement coordinators from each University. These communications occurred during the Winter semester of 2022-2023.

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1. I read that in 2018 there were 50 solitary bee boxes on campus, and in 2021, 25 more were added. Do you plan on adding any more in the upcoming year? Has this affected the local biodiversity on your campus? (McMaster)
  2. Have you been monitoring the bee populations and green spaces on campus since 2019? If so, how much has it changed in the past 4 years? (Western)
  3. Do you know if this has affected students' lives/education (e.g., incorporated into courses, outdoor labs, better mental health, encouraged students to spend more time outside, etc.)?
  4. Have you had any major setbacks with student turnover for the longevity of this initiative?
  5. What are some of the feedbacks gathered following your first year of designation as a Bee Campus?
  6. What is the value of having a no-mow lawn, or low maintenance for this initiative?
  7. Have many students expressed value in a small tuition addendum for the designation and upkeep of a Bee Campus?
- 

## DATA ANALYSIS

One-way ANOVA was performed to determine whether there was a significant difference between respondents' support of an initiative and respondents' willingness to volunteer for each of the three initiatives of the designation of a Bee Campus™. We used Excel formulas to determine levels of support which were separated by student classification, creating & maintaining, educating, and celebrating pollinators.

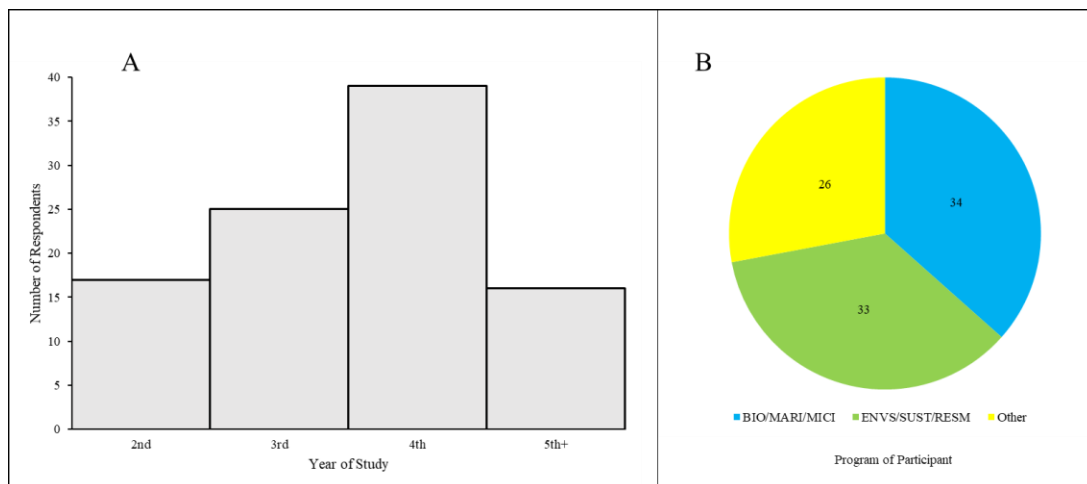
Using our Likert-scale questions we determined the level of support for the initiatives related to creating a pollinator-friendly campus. A coding tree was created for student statement responses for the last question in our survey, which was open-ended regarding concerns about a potential designation of Studley campus (Table 1, question 20.; Appendix 1). As well, a coding tree was created for the open-response question on student ideas for pollinator-themed events on Studley campus (Table 1, question 18.; Appendix 2). We used Excel formulas to determine the degree of support separated by student classification and focused on support versus volunteering for the three degrees of a Bee Campus™ designation, creating & maintaining, educating, and celebrating. Using our Likert-scale questions we determined the level of support for initiatives related to the designation of accessible education programs, the importance of the NO MOW campus, creating community gardens, creating pollinator gardens, bee boxes, biodiversity importance, and pollinators' importance.

## LIMITATIONS

We were only able to target students with our survey outreach. We would not determine professor support through our study or gather the opinions of groundkeepers. Targeting more 1<sup>st</sup> and 2<sup>nd</sup>- year Undergraduate students would help with concerns regarding student turnover.

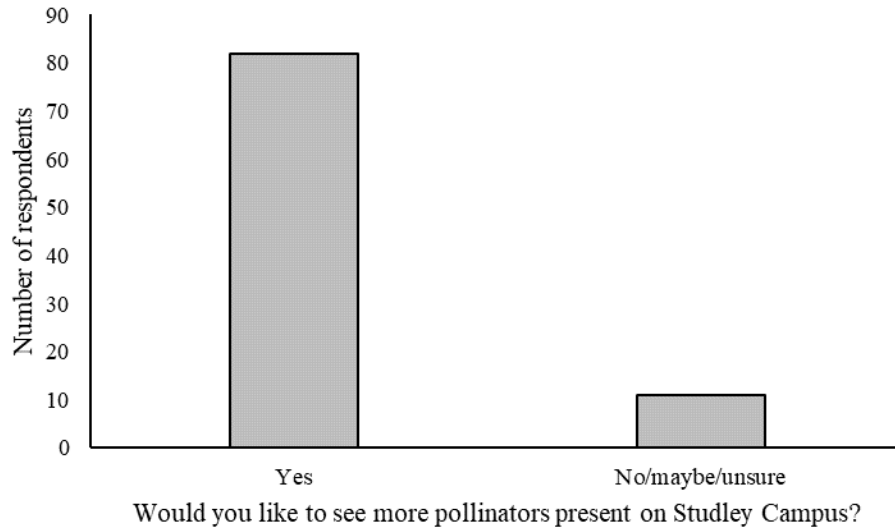
## RESULTS

A survey was made available to all students at Dalhousie University, regardless of year or program, to quantify student support for the establishment of Studley campus as a Bee Campus™. Out of a population of ~20 970 students, there were 93 students who responded to the survey and consented to have their results analyzed and discussed. Of the respondents, the majority (~42%) identified as being in their 4th year of study (Fig 2. A). Subsequently smaller percentages of students identified as being in their 3rd, 2nd, and 5th+ year respectively (Fig 2. A). Notably, no students who participated in the survey identified as being in their first year of undergraduate studies, although there were several who identified as being in the first year of graduate studies but for the purpose of this study they were classified as being in their 5th+ year. Most students (~72%), identified as being fitting into either of the broad categories of BIO/MARI/MICI and ENVS/SUST/RESM programs (Fig 2. B). These programs were grouped together based on similarity and relatively even distribution amongst participants. Other programs were represented by only a scant few members, with some programs being represented by only a single participant; for the purpose of clarity in information sharing, these programs were all grouped together into a single category (Fig 2. B).



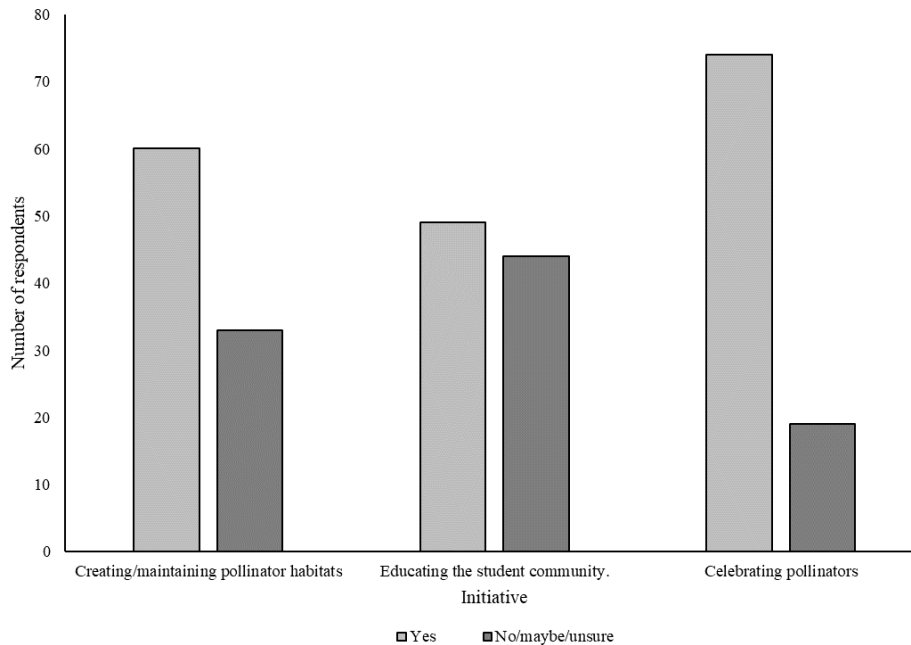
**Figure 2.** Breakdown of student respondent demographics by A) year of study and B) program.

Most respondents (~88%) responded yes when prompted as to whether they would like to see more pollinators present on Studley campus (Fig 3.). A substantially smaller proportion (~12%) displayed a total or partial disagreement to the concept or were otherwise unsure (Fig 3.)



**Figure 3.** Student support for an increase in the number of pollinators present on Studley campus.

When prompted by questions regarding the specific components of becoming a bee campus (namely the support for initiatives related to the creation/maintenance of pollinator habitats, education of the student community, and celebrating pollinators during pollinator week), student support was generally high (~73-78%) for all initiatives (Fig 4.). Furthermore, there did not appear to be any significant difference in support based on initiatives, although it should be noted no formal statistical analysis was performed for these variables (Fig 4.).



**Figure 4.** Student support for specific initiatives (creating/maintaining pollinator habitats, educating the student community, celebrating pollinators) related to the Bee Campus™ program.

One-way ANOVA was performed to determine whether there was a significant difference between respondents' willingness to support an initiative and respondents' willingness to volunteer for initiatives. While the willingness of respondents to volunteer (~52-79%) varied more broadly than willingness to support (~73-78%), the results from the one-way ANOVA indicated that there was no significant difference between the two factors ( $p = 0.24 > p = 0.05$ ; Fig 5.)

	<b>Support</b>	<b>Volunteer</b>
<b>Creating</b>	78.90%	63.80%
<b>Educating</b>	73.10%	52.10%
<b>Celebrating</b>	77.70%	79.80%

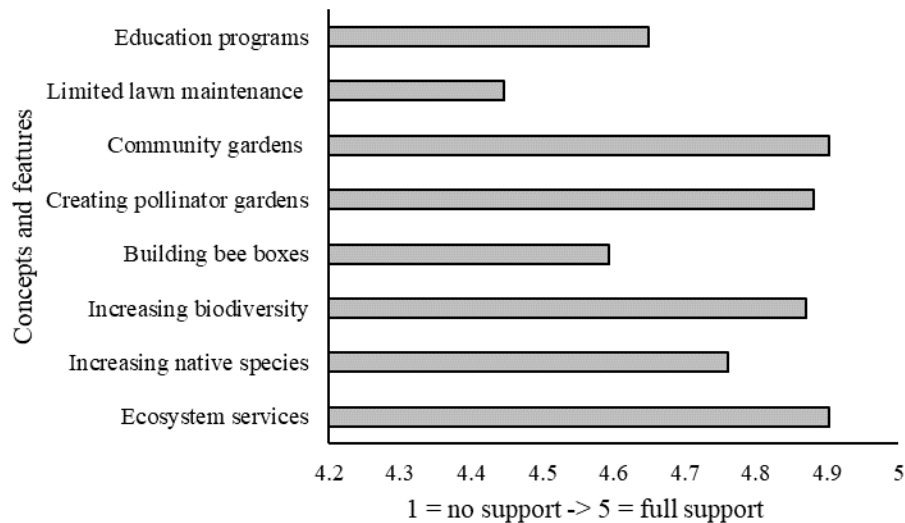
**One-Way ANOVA**

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0.01926667	1	0.01926667	1.90065931	0.24008562	7.70864742
Within Groups	0.04054733	4	0.01013683			
Total	0.059814	5				

**Figure 5.** One-way ANOVA results for the comparison of students' willingness to support vs willingness to volunteer for specific initiatives (creating/maintaining pollinator habitats, educating the student community, celebrating pollinators) related to the Bee Campus™ program.



Attempting to further engage students on specific initiatives and their relative support for them, respondents were asked to indicate their level of support using a five-point Likert scale (1 = no support -> 5 = full support) for various concepts and features that could be incorporated into Studley were it to become a Bee campus™. Average support was generally high (~4.4-4.9) for all features/concepts that were offered in the survey (Fig 6.). The highest levels of support were for the establishment of pollinator gardens (4.90) and community gardens (4.88) respectively (Fig 6.). The lowest support was for the no mow/limited maintenance lawn servicing program (4.44; Fig 6.).



**Figure 6.** Student support for various concepts and features that could be implemented as a part of a prospective Bee campus™ program run on Studley campus.

## DISCUSSION

The purpose of the research was to determine if there was support amongst students at Dalhousie University to designate Studley Campus as a “Bee Campus”. The results demonstrate that there will be a significant amount of support from students and that the majority of students will support initiatives which include volunteering to create and maintain pollinator habitats, educating others on their importance, and celebrating pollinators during national pollinator week. The difference in students who support the initiatives, and who would volunteer was found not to be significant, indicating that the designation of Studley campus as a “Bee Campus” is a possibility. The initiative with the most support for volunteering was celebrating pollinators. The survey respondents gave suggestions on how they would like to get more involved including activities such as a design competition for paintings on the bee boxes, planting parties, pollinator themed BioBlitz’s using iNaturalist, and native plant giveaways (see Appendix 2). Similar results were demonstrated in a study by Penn et al. in 2020 where they examined students’ thoughts regarding pollinator conservation. An in-person intercept survey was done at Louisiana State University (LSU), Ohio State University (OSU), and the University of Kentucky (UK) and it concluded that 95.8% of their sample size (736) showed support for Bee Campus USA certification (Penn et al. 2020). These findings support our hypothesis as there is significant support among students at other schools as well.

## ADDRESSING CONCERNS

Students at Dalhousie University were asked if they had any concerns about creating more habitats for bees and pollinators on campus. The most common answer was that people are concerned about being stung, and the safety of those who have anaphylactic allergies. This concern was posed to Abbie Little, the engagement coordinator from the sustainability office at McMaster University, Hamilton, Ontario, and Jessica Cordes the engagement coordinator from the sustainability office at Western University, London, Ontario. Jessica Cordes stated that the fear of stings only comes up occasionally, and that it is more prominent in the fall when there is an abundance of wasps, which is not a result of the Bee Campus™ program, they have always been there. Open food and drink greatly increase their interactions with students, so they should be avoided in pollinator friendly areas. She also alluded on the fact that educating the campus on the diversity of pollinators (hummingbirds, moths, etc.) helped reduce a lot of student concerns as well.

Abbie Little expanded more on this subject, and explained how the live video feed they build on monitor the bee boxes made students and staff less afraid of bees, and it did an excellent job at expanding others knowledge about their behaviour. In addition, Abbie explained that native pollinators are much less aggressive than wasps and will not sting you unless they are feeling threatening or going to die. She also explained that there is wildlife every time you step outside, and those who are allergic will likely carry an EpiPen on them. Signage is also extremely important so at risk individuals are able to avoid areas where they would be stung. Overall, providing a home for the

bees will keep them out of areas on campus that are more densely populated, and with the proper signage it is anticipated that bee stings will not be a major concern.

## LIMITATIONS

Following the closure of the survey, several limitations of the study were noted. The primary limitation was that the majority of responses came from fourth year students. This raised concerns with regards to student turnover. The majority of fourth year students will not be staying on Dalhousie's Studley campus in the upcoming years when this program has the potential to be implemented. If the project goes forward, it is crucial that it targets more students in first and second year to ensure that there will be a smooth student turnover. Abbie Little and Jessica Cordes stated that staff and faculty play an extremely important role with the longevity and sustenance of the program. They are generally on campus for longer periods and can take the lead on offering programs like informative workshops, webinars, and volunteer-run pollinator gardens.

The survey did not incorporate the opinions of staff because the sample size would have been much larger, so there is some uncertainty surrounding how much support there would be from faculty. However, Emily McLean, a student at Dalhousie University spoke at a public consultation in the fall of 2022 to designate Halifax as a "Bee City" and she emphasized how much support there was from Dalhousie Faculty including Debra Grantham, a senior instructor at Dalhousie University who stated, "I would like to offer my support in your worthwhile endeavor to designate Halifax as a 'Bee City' and protect pollinators across the municipality. Bees provide many useful functions and are especially critical for pollinating fruit crops such as apples." There were many quotes from other instructors as well, and in future studies faculty should be included in the research. In addition, we did not include the opinions of groundkeepers. This is an extremely important aspect because they will likely be affected the most by the change in lawn management and will be involved in the labor needed to build bee boxes and pollinator gardens.

## RECOMMENDATIONS FOR THE FUTURE OF DALHOUSIE UNIVERSITY

If Dalhousie students or faculty would like to implement this initiative in the future, this research has provided several recommendations. [The application form](#) asks the individual applying to briefly summarize why your College/University should become a Bee City Campus, to adopt the Bee City Canada Resolution, create a Bee City pollinator team of at least two faculty members, 2-5 students, campus staff, and employees from the campus grounds department. In addition, they would need to create a habitat action plan, explain how Dalhousie would promote education about pollinators and celebrate pollinators during national pollinator week (BeeCity Canada, 2023).

To create a habitat action plan, Dalhousie must outline initiatives which aim to improve, maintain, or create new habitats for pollinators. At McMaster University, a student led academic project in collaboration with Facility Services resulted in the production of a 400 square foot pollinator garden to increase pollinator populations. They also placed bee homes on campus and planted native plant species. They monitored which activity around plant

species to see if bees respond best to a certain set of vegetation, location of home, and design of home. McMaster is a pesticide free campus, ensuring that no native plant species of bees will be affected by chemicals. To promote education about pollinators, McMaster promoted the planting of native vegetation allowing individuals to watch stories about where, how, and why they were planting native vegetation. The Implementing Sustainable Change (SUSTAIN 3S05) course at McMaster also requires students to create and maintain pollinator habitats and participate in the Crouse Project Showcase, which informs and educates students, staff, and the community on the initiatives involved in the project. Dalhousie could follow a similar route by incorporating Bee Campus™ initiatives into courses such as Community-Engaged Research and Practice for Sustainability (SUST 3038) (Bee City Canada, 2019). To celebrate pollinators during National Pollinator Week, Dalhousie could create a “DalhousBEE Day” to host pollinator themed events, plant native plants around campus, and outline what successful initiatives other Bee Campuses have done to outline their successes as well.

There are no fees associated with the initial application, although because Dalhousie has a population of ~20,000, the renewal fee will be \$150 (BeeCity Canada, 2023). To fund the initiative the survey asked if students would support a \$0.02 tuition addendum in to support the initiative, and the majority of students answered yes. Although, upon speaking with Jessica Cordes and Abbie Little, they stated that there is a need for funding to create the gardens, and bee boxes. The tuition addendum would only support the renewal of the “Bee Campus” on an annual basis. At Western, the payment for the Bee Campus™ comes from the Sustainability offices budget. At McMaster, the facility services office expressed interest in supporting the initiative and they provide funding every year for the maintenance of it because they have to remove and replace the bamboo rods in the boxes every year. There is also the initial labor of creating the boxes, where they donated time and their skills to build them. In addition, grounding nesting bee gardens have a large cost. Abbie Little recommended that the best way to go is internally. Attempting to get students to pay requires referendums, which usually fail because of the lack of awareness about the initiatives. Students already must pay a large sum for tuition and will likely not be in favour of paying more to create more gardens on campus. In future studies, this should be considered, and students should be asked how much they would be willing to pay to develop gardens and build bee boxes if there is no funding available from the Sustainability Office, or Grounds Department.

## CONCLUSION

Following our study to determine if there is support amongst students at Dalhousie University to designate Studley Campus as a “Bee Campus”, we cannot claim a 95% confidence interval with a representative 376 students from the student body. We received 93 respondents expressing support and concerns regarding initiatives to create and maintain a pollinator-friendly campus. For our study analysis, we focused on volunteer support for Bee Campus™ designation, as well as the primary initiatives that are, creating & maintaining, education, and celebrating pollinators such as native bee populations in Nova Scotia during National Pollinator Week. This is the week of Monday, June 19<sup>th</sup> and is initiated until Sunday, June 25<sup>th</sup>, this year of 2023 (Pollinator Partnership Canada, 2023).

Using our Likert-scale questions in our student survey we determined the level of support for the initiatives related to designation for, accessible education programs, importance of NO MOW campus, creating community gardens, creating pollinator gardens, bee boxes, biodiversity importance, native species importance, and pollinators importance. Our analysis found that the least supported initiative was for the NO MOW campus. The most supported statement is that pollinators provide important ecosystem services, to create pollinator gardens, and community gardens on Studley Campus. Our One-Way ANOVA test was conducted to determine if there is a relationship between the three main initiatives, creating & maintaining, educating, and celebrating pollinators conducted by support versus student interest for volunteering to promote or take-part in these initiatives. Our p-value (0.24008562) is greater than 0.05, and we cannot conclude that there is a significant difference between support for initiatives and support for volunteering by students.

Notably, no survey respondents from students identified as being in their first year of Undergraduate studies. The most common concern we found is that students are worried about bee stings, and others who are allergic to pollen, and other pollinators which will be attracted to a pollinator-friendly campus. Where designated areas for NO MOW or erected bee boxes are, signage is extremely important so at-risk individuals are able to avoid areas where they would be stung. From our interviews with McMaster and Western University, live video feed and education on the variety of pollinators helped ease students and staff while reducing concern about bees.

We promote curriculum incorporation for the longevity of a Bee Campus™ on Studley to mitigate issues with student turnover. For the designation of Bee Campus™, campus-wide support is required, as the volunteer team requires a committee of at least two faculty members, 2-5 students, campus staff, including employees from the campus grounds department. Therefore, gaining support from faculty members and professors is required, as well as grounds maintenance staff who are working at Studley. With incorporation into curriculum and professor support, there will be a solid volunteer team for creating & maintaining, educating, and celebrating pollinators. Receiving funding from Dalhousie’s sustainability office while not relying on tuition addendums from students was recommended by the engagement coordinator from Western University. With funding through Dalhousie’s office of sustainability, Studley will be able to increase green spaces on campus. Another collaboration can be the Dal Beekeeping society to promote and educate students and staff on a pollinator-friendly campus. We conclude that we

need more first year support, which is a limitation as we did not receive first-year student survey responses. Along with increasing green spaces on campus, adding bee boxes made of bamboo, Dalhousie's Studley campus should submit an application to Bee City Canada™ and seek a designation of a Bee Campus™.

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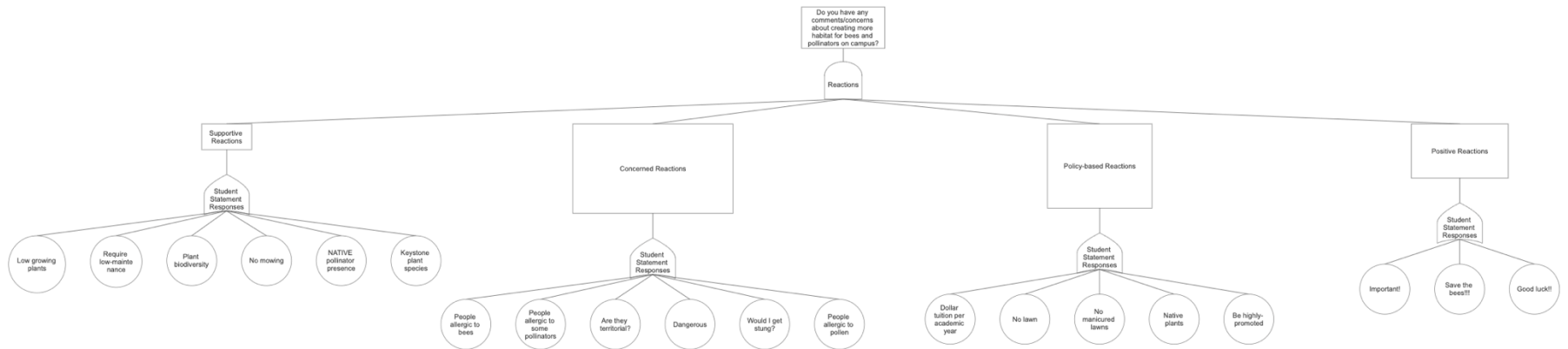
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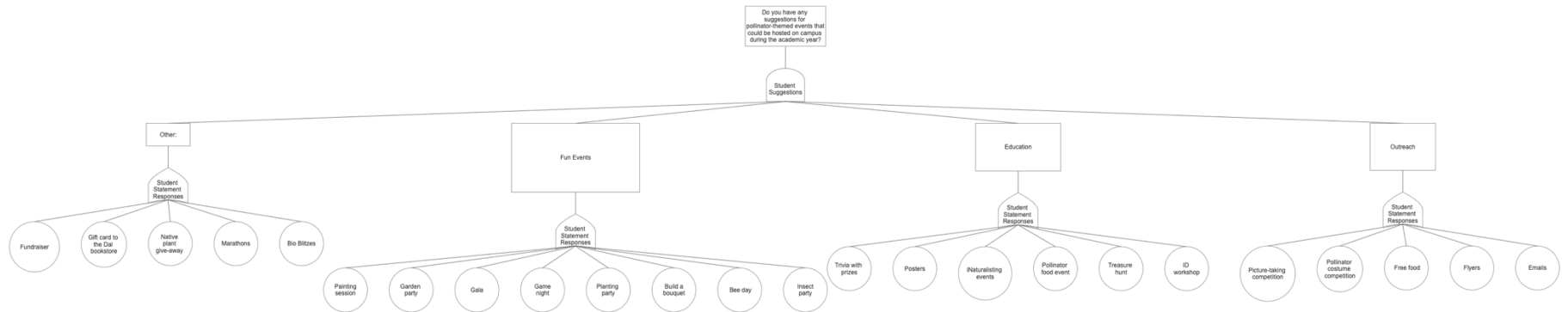
**APPENDIX 1**

Appendix 1. Shows student statement responses from our last survey question, which was open-ended and asked students to share any comments/concerns about making a pollinator-friendly campus on Studley at Dalhousie University. Sizes of reaction boxes represent frequency of responses in that category. Bigger reaction boxes equal a higher frequency of answers with that theme.



**APPENDIX 2**

Appendix 2. Shows student statement responses from question 18, which was open-ended and asked students to share any ideas on pollinator-themed events that could be hosted on Studley at Dalhousie University during the academic year. Sizes of reaction boxes represent frequency of responses in that category. Bigger reaction boxes equal a higher frequency of answers with that theme.



APPENDIX 3

## Making a Pollinator-Friendly Campus

### Making Dalhousie University, Studley Campus a Pollinator-Friendly Campus

You are invited to take part in a research study being conducted by, Sarah Macdonald, Rebecca Mendes, Maclean Rivers, and Charlotte Morrow, undergraduate members in the Biology and Earth and Environmental Science departments at Dalhousie University. The purpose of this research is to measure support for making Dalhousie University, Studley Campus a pollinator-friendly campus, and students in any study year are eligible to participate.

If you choose to participate in this survey you will be asked to answer 18 questions in an anonymous online survey in regard to making Dalhousie University's Studley Campus a pollinator-friendly campus. The survey should take approximately 5 minutes.

Your participation in this research is entirely your choice. You do not have to answer questions that you do not want to answer by going to the next question, and you are welcome to stop the survey at any time if you no longer want to participate. All you need to do is close your browser. We will not include any incomplete surveys in our analyses. If you do complete your survey and you change your mind later, we will not be able to remove the information you provided as we will not know which response is yours.

Your responses to the survey will be anonymous. This means that there are no questions in the survey that ask for identifying details such as your name or email address. All responses will be saved on a secure Dalhousie server. Only the research team (Sarah Macdonald, Rebecca Mendes, Maclean Rivers and Charlotte Morrow) will have access to the survey results.

Although this survey is anonymous, do you consent to your responses being used further in this research study?

- Yes
- No

If you agree to complete this survey, please continue.

If you agree to complete this survey, please continue.

Description (optional)

As a part of our research project, we would like to ask students about their thoughts on making Studley Campus more pollinator friendly.

Description (optional)

What year of study are you in at Dalhousie University? \*

Short answer text

What program are you enrolled in? \*

Short answer text

What is your current student classification? \*

- Undergraduate
- Graduate
- Professional Studies
- Other...

The purpose of this study is to determine the percentage of undergraduate students at Dalhousie University that would be in support of establishing Studley campus as a "Bee Campus". The "Bee Campus" program is an initiative focused on creating, maintaining and/or improving pollinator habitats, educating the community about the importance of pollinators, and celebrating pollinators

## Student Support in Creating a Bee Campus™

The purpose of this study is to determine the percentage of undergraduate students at Dalhousie University that would be in support of establishing Studley campus as a "Bee Campus". The "Bee Campus" program is an initiative focused on creating, maintaining and/or improving pollinator habitats, educating the community about the importance of pollinators, and celebrating pollinators during National Pollinator Week. Pollinators are organisms that facilitate sexual reproduction in flowering plants, which can have various effects including increased plant growth, larger yields, and protecting biodiversity. Bees are some of the most well-known pollinators and provide pollination services for various plant species.

Description (optional)

To what degree do you agree with the following statements on a scale of 1-5, where 1 equals no support, 2 equals little support, 3 equals neutral (neither support or do not support), 4 equals somewhat supportive, and 5 equals fully supportive.

Description (optional)

Ecosystem services\* provided by pollinators are important.

*\*Ecosystem services are positive benefits that wildlife or ecosystems provide to people.*

1      2      3      4      5

No support                        Fully supportive

Increasing the number of native species\* on campus is important.

*\*Native species are species which are from a given region or ecosystem, in this scenario we are referring to native species of Nova Scotia.*

1      2      3      4      5

No support                        Fully supportive

Increasing biodiversity\* on campus is important.

*\*Biodiversity describes the variety of life.*

1      2      3      4      5

No support                        Fully supportive

...

Would you like to see more pollinators\* present on Studley Campus?

*\*Pollinators are organisms that facilitate sexual reproduction in flowering plants, which can have various effects including increased plant growth, larger yields, and biodiversity protection. Pollinators include flies, beetles, ants, moths, wasps, hummingbirds, butterflies and bees, which spread pollen from one plant to another as they navigate flowers for food.*

Yes

No

Maybe

Unsure

Other...

On a scale of 1-5, how much do you support the following initiatives to protect bees and other pollinators on campus? 1 equals no support, 2 equals little support, 3 equals neutral (neither support or do not support), 4 equals somewhat supportive, and 5 equals fully supportive.

Description (optional)

Building bee boxes\*.

*\*Bee boxes are hive bodies, or boxes, which provide a dwelling-place constructed for bees.*

## Student Support in Creating a Bee Campus™

Building bee boxes\*.

*\*Bee boxes are hive bodies, or boxes, which provide a dwelling-place constructed for bees.*

1      2      3      4      5

No support                        Fully supportive

Creating pollinator gardens\*.

*A \*pollinator garden is a specific type of garden designed to grow specific nectar and pollen-producing plants. These gardens have the intent of attracting pollinating insects, such as flies, beetles, ants, moths, wasps, hummingbirds, butterflies and bees, which spread pollen from one plant to another as they navigate flowers for food.*

1      2      3      4      5

No support                        Fully supportive

:::

Creating \*Community Gardens.

*\*Community gardens are pieces of land gardened by a group of people individually or collectively.*

1      2      3      4      5

No support                        Fully supportive

Establishing Studley as a NO MOW (limited lawn maintenance) campus.

Establishing Studley as a NO MOW (limited lawn maintenance) campus.

*A limited lawn maintenance campus would decrease the amount of lawn care and allow for lawns to grow better which creates habitat and forage for early-season pollinators.*

1      2      3      4      5

No support                        Fully supportive

Accessible education programs about the importance of pollinators.

*Examples of the services education programs offer are free webinars, open-source databases, and habitat-focused activities.*

1      2      3      4      5

No support                        Fully supportive

:::

As a student, would you be interested in volunteering to maintain and create a pollinator-friendly campus in the following roles:

Description (optional)

Creating and maintaining and/or improving pollinator habitat.

Yes

No

Maybe

...

## Student Support in Creating a Bee Campus™

- Maybe
- Unsure
- Other...

- Maybe
- Unsure
- Other...

Educating the student community about the importance of pollinators.  
*These would be formal educational activities such as hosting or attending an event with guest speakers.*

- Yes
- No
- Maybe
- Unsure
- Other...

As a student at Dalhousie University, do you have any suggestions for pollinator-themed events that could be hosted on campus during the academic year?

*The purpose of these events is to promote knowledge and educate students on pollinators (e.g., flies, beetles, ants, moths, wasps, hummingbirds, butterflies and bees, which spread pollen from one plant to another as they navigate flowers for food).*

- Yes
- No

If you answered yes to the question above, please share your suggestions:

Short answer text \_\_\_\_\_

Celebrating Pollinators during national pollinator week.

*These would be informal celebrations such as sharing educational pollinator facts with a friend.*

- Yes
- No
- Maybe
- Unsure
- Other...

...

Would you support a small tuition addendum (approximately \$0.02 per academic year) being added that would directly fund this Pollinator-friendly campus initiative?

- Yes
- No
- Maybe
- Unsure

## Student Support in Creating a Bee Campus™

*The purpose of these events is to promote knowledge and educate students on pollinators (e.g., flies, beetles, ants, moths, wasps, hummingbirds, butterflies and bees, which spread pollen from one plant to another as they navigate flowers for food).*

- Yes
- No

If you answered yes to the question above, please share your suggestions:

Short answer text \_\_\_\_\_

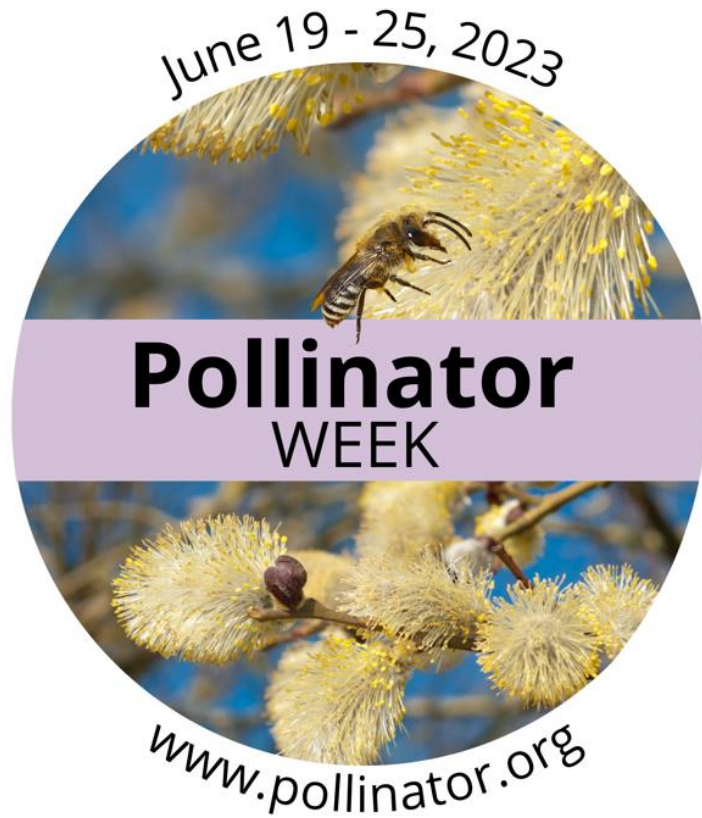
Would you support a small tuition addendum (approximately \$0.02 per academic year) being added that would directly fund this Pollinator-friendly campus initiative?

- Yes
- No
- Maybe
- Unsure

Do you have any comments/concerns about creating more habitats for bees and pollinators on campus? If so, please state below:

Short answer text \_\_\_\_\_

APPENDIX 4





APPENDIX 5



# Should Dalhousie University's Studley Campus become a "Bee Campus"?

**Bee City is a North American organization responsible for the designation of Bee Campuses across Canada and the US. As a Bee Campus Dalhousie would commit to:**

- 1. Creating, maintaining and/or improving pollinator habitat.**
- 2. Educating the community about the importance of pollinators.**
- 3. Celebrating pollinators during National Pollinator Week.**

**SHARE YOUR OPINIONS:**

