



Sprucing Up Dalhousie:

*Understanding Students' Knowledge and
Values about Biodiversity on Dalhousie
University's Studley Campus*

Dalhousie University*

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Table of Contents

Executive Summary	2
1. Introduction	3 – 6
1.1 <i>Project Scope & Definition</i>	3
1.2 <i>Background</i>	3 – 5
1.3 <i>Rationale</i>	5 – 6
2. Methods	6 – 8
2.1 <i>Study Design</i>	6 – 7
2.2 <i>Data Collection & Analysis</i>	7 – 8
3. Results	9 – 11
3.1 <i>Quantitative Analysis</i>	9 – 10
3.2 <i>Qualitative Analysis</i>	10 – 11
4. Discussion	12 – 13
4.1 <i>Summary of Findings & Context in other Literature</i>	11 – 13
4.2 <i>Limitations & Further Research</i>	13 – 14
5. Conclusions and Final Remarks	14
6. Acknowledgements	14
7. References	15 – 18
8. Appendices	19 – 25
<i>Appendix I: Consent Form & Sample Survey</i>	19 – 22
<i>Appendix II: Recruitment Poster & Flyer</i>	22 – 23
<i>Appendix III: Raw Counts</i>	24 – 25

Executive Summary

Previous studies about Dalhousie University's campus biodiversity focused primarily on indoor greenspace and how nature improved students' productivity and wellbeing. However, little was done to explore outdoor greenspaces and the value of biodiversity in one's life. After identifying this knowledge gap, we were curious to see how students perceived biodiversity and if they had an accurate understanding of the amount of species on campus. Seeing this gap and the increasing disconnect between humans and nature, we set out with our research question: "What are students' perceptions on the value of biodiversity on Dalhousie's Studley campus, and how do these perceptions compare to actual campus biodiversity?".

In order to answer our question, we created and advertised a survey aimed at undergraduate students who spend most of their time on the Studley campus. Included in the survey were questions that were specifically designed to determine if participants a) thought biodiversity was important b) thought campus biodiversity should increase and c) what the numerical range of species on campus is. Other questions were aimed at determining the type of change participants wanted to see and why they value biodiversity the way they do.

We used a mixed method analysis with quantitative descriptive statistics and qualitative coding for the frequency of key words and themes. Respondent estimates of biodiversity were compared to the 2019 BioBlitz estimate, and 35% of students selected the correct numeric range. Additionally, 95% of participants indicated that biodiversity was important and 71% agreed that there should be an increase on campus, primarily in native species. Participants' view on the importance of biodiversity were mainly influenced by education and biodiversity's role in ecosystem health.

We recommend that Dalhousie increases the variety of native species on the Studley campus, particularly flowering species. As education and media like social media were identified as the most common influences on perceptions regarding biodiversity importance, we suggest using these pathways to further educate the University population about biodiversity centred initiatives on campus as well as biodiversity in general.

1. Introduction

1.1 Project Scope and Definition

In the past century, technological advancements have led to a more comfortable, modern way of living compared to the first humans who had predominantly outdoor lifestyles and close interactions with nature on a daily basis (Kennedy, 2019). In the present day, however, over half of the global population lives in the built urban environment, and over 90% of North Americans' time is spent indoors (Ritchie & Roser, 2018; United States Environmental Protection Agency, n.d.). Because of this, we have begun to see a detachment between humans and nature (Sanchez et al, 2017). This disconnect has major effects on individuals' and communities' mental health and is often referred to as Nature Deficit Disorder (Warber et al., 2015). The term, coined by Richard Louv in his 2005 book *Last Child of the Woods: Saving Our Children from Nature-Deficit Disorder*, draws on the idea that humans' urbanized lifestyle is decreasing contact with nature in both children and adults (Warber et al., 2015). This decrease in contact, coupled with humans' known need for exposure to nature, suggests there is evidence that one's environment is a meaningful determinant of mental well-being (Araya et al, 2006; Evans et al, 2003).

Within this realm of research, studies suggest that the degree of exposure to greenspaces may have noteworthy impacts on an individual's overall mental and physical health (Mavoa et al, 2019; Rugel et al, 2019; Aerts et al, 2018). More specifically, Van den Bosch & Ode Sang (2017) reviewed previous studies about how the quality of biodiversity in one's environment links to their health. Although the studies under review did not indicate any statistically significant evidence, many of them suggested that more natural areas could have a greater impact on human health (Curtin, 2009; Huby et al, 2006; Luck et al, 2011; Poudyal et al, 2009). As a determinant of health, both the built and natural environments offer opportunities to explore improvements that may benefit people at the individual and community levels. Currently, there is a gap in knowledge pertaining to mental and physical health and the value of biodiverse ecosystems. In an attempt to bridge this gap, the researchers of this study intend to focus on the value systems held by students at Dalhousie University about greenspace and biodiversity. This study seeks to answer the question: What are student's perceptions on the value of biodiversity on Dalhousie's Studley campus, and how do these perceptions compare to actual campus biodiversity estimates?

1.2 Background

SPRUCING UP DALHOUSIE

Biodiversity and greenspaces have often been looked at in the context of improving mental health and increasing well-being through the promotion of social connectivity and a sense of community (Rugel et al., 2019). Social connections are an important determinant of mental health because they provide a sense of purpose and various forms of support, which reduces anxiety and encourages healthy behaviour (Rugel et al., 2019). Natural spaces help foster this sense of community and have direct psychological benefits like improved moods, better focus and reduced stress (Rugel et al., 2019). They have also been associated with increases in physical activity and ecosystem services like reducing urban heat and ameliorating air pollution, therefore improving one's physical health (Rugel et al., 2019). While Rugel et al. (2019) did not find a direct connection between greenspace exposure and mental health, they did find that greenspaces facilitate social cohesion. From what we know about the positive effects of social cohesion and a sense of community, we believe greenspace exposure may improve mental health via this pathway. Other studies like Mavoa et al. (2019) and Dean et al. (2011) have pointed to the importance of biodiversity and human well-being. In their research, they found that biodiverse environments have a greater potential to provide culturally enriching services than their less diverse counterparts (Dean et al., 2011).

A study by Qui et al. (2013) found that most people are able to recognise biodiversity across different habitat types regardless of whether they are “experts” or not. The type of biodiversity identified however does differ, with “experts” tending to notice woodland edges, deadwood and old trees as being signs of diversity while non-experts focused more on the visual cues related to the variety of plant types. This suggests a different value system for biodiversity among the two groups. In contrast to their prediction, however, they found a negative correlation between areas labeled as biodiversity rich and areas people preferred to use which were actually the highly managed, low-diversity areas. It should be noted, however, that Qiu et al. (2013) emphasize that this finding should not be generalized.

In 2019, a study looking at students' perceptions on indoor greenspaces and how they influence well-being and productivity was completed on Dalhousie's Studley campus (Laage et al., 2019). The findings were that the majority of students appear to be in support of an increase in indoor greenspaces on the Studley campus, particularly in study spaces as they believe it helps promote mental wellness (Laage et al., 2019). The results supported their hypothesis that indoor greenspaces have a positive effect on students' well-being and productivity (Laage et al., 2019). This study only focused on the indoor environment and although it is where students spend most of their time, it fails to capture students' perceptions of outdoor environments on

SPRUCING UP DALHOUSIE

campus. Moreover, the study did not ask students how they valued biodiversity on campus or what type of greenery they would like to see in the implementation of new greenspaces. Given the growing body of research suggesting a positive relationship between mental health and biodiversity, as well as the counterintuitive findings of Qiu et al. 's (2013) biodiversity research, we believe it would be beneficial to add to Laage et al. 's (2019) findings. By looking at student perceptions of the value of biodiversity on the Dalhousie Studley campus, we can evaluate how closely these perceptions align with actual campus biodiversity estimates and use student's opinions of preferred plant type in future decision-making regarding Dalhousie greenspaces.

1.3 Rationale

We are conducting this study to gain a better understanding of how students on the Dalhousie Studley campus view and value biodiversity, as well as what they know about biodiversity in general. The topic of biodiversity and greenspaces in relation to mental health and well-being is of particular interest because universities are often associated with increased stress levels and mental strain, especially during midterm and exam seasons (Bojuwoye, 2002). This study will add to the body of knowledge related to health and greenspaces as well as how biodiversity is valued on campus. Previous research on student perceptions of greenspaces did not look at outdoor greenspaces or how students felt about biodiversity. Therefore, this study seeks to add to the findings of the 2019 Dalhousie study to create a more comprehensive understanding of student perceptions of greenspaces on the Studley campus. Given that the researchers in both this study and the 2019 study are most likely pro-environmentalism due to our study program, we are looking to obtain responses from students with diverse backgrounds to see how important this topic is to the general student body.

This study could result in increased awareness of biodiversity as participants will be asked to estimate the amount of biodiversity on campus and to think about nature's value. Practically speaking, the results from this study could be used to inform future policies and decision making around campus greenspace and could align these decisions more closely with what students want. The study could also provide insight into how many students are in support of an increase in biodiversity and greenspaces on campus. In addition, the results could be used to develop biodiversity awareness projects and highlight educational opportunities, which could promote human-nature connections and increase the benefits that come with greenspaces. We, as students, want to better the student lifestyle at Dalhousie through

biodiversity and greenspaces to ultimately reduce stress levels and increase performance, connectivity and appreciation for nature.

2. Methods

2.1 Study Design

To approach the research question, a mixture of quantitative and qualitative methods were used. For the qualitative approach, a browser-based survey in Google Forms was used to obtain students' perception, value and knowledge of biodiversity. We chose this method for its low cost, zero-waste and fast speed of data collection compared to traditional paper surveys or interviews (Palys & Atchison, 2014). A browser-based survey also helped to ensure the confidentiality of the participants' responses, which was important in this study because basic demographic questions as well as opinions and value-based questions were asked.

The necessary sample size of the study was approximated using probabilistic sampling methods with a confidence level of 95% and a margin of error of 5%. The sampling frame for our study was all undergraduate students at the Dalhousie Halifax campuses. The population size is the count of undergraduate students at Dalhousie University and is around 15347, however we did not have access to the precise enrollment number for the Winter 2020 semester (Cray, 2020). With the parameters above, the necessary sample size was calculated to be 375 (Fluid Survey University, n.d.).

The survey questions were developed collaboratively by the research team (Appendix I). The questions included a mixture of multiple-choice, choose all that apply, single response, and long answer questions. This allowed a more efficient

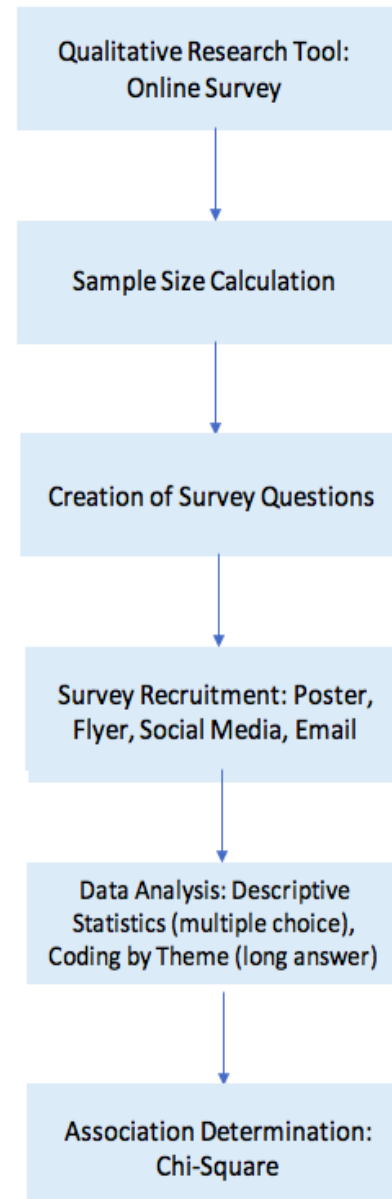


Figure 1. Broad overview of the steps taken to conduct the study.

SPRUCING UP DALHOUSIE

response coding process while allowing respondents to express their own opinions. Moreover, the survey responses were confidential, and the only personal data the respondents were asked was their year of study, major, age range, and Dalhousie email for the prize draw. Other information gathered included students' perception of biodiversity, their knowledge of biodiversity on the Studley campus, and what kinds of changes to biodiversity they would like to see on campus. Knowledge of biodiversity was included because it is important to know what students understand biodiversity to be and how their knowledge of biodiversity can affect their perceptions and values of it. It is also crucial to understand the changes students would like to see regarding biodiversity on campus so if any changes are to be made, Dalhousie Faculty and Staff will be able to make informed decisions. This question in the survey focused on plant diversity as it is feasible for Dalhousie to change simply by planting new vegetation. Based on the results of this study, recommendations were made to Dalhousie University regarding types of plant biodiversity changes students would like to see on the Studley campus.

2.2 Data Collection & Analysis

A poster (Appendix II), which included the link and QR code to the survey, was designed and placed in the common areas of the major buildings on Studley campus. These buildings included the following: Killam Library, Life Science Centre (LSC), Student Union Building (SUB), Marion McCain Arts and Social Sciences Building, Kenneth C. Rowe Management Building, Chase Building, Henry Hicks Building, Mona Campbell Building, Goldberg Computer Science Building, Sir James Dunn Building, Chemistry Building, Weldon Law Building, and Dalhousie Arts Centre. A flyer with a short description of the research (Appendix II), link and QR code to the survey was designed and handed to students in the common areas in the Student Union Building and the Killam Library. Descriptions of the study and the survey link were also posted on Facebook groups for further recruitment. Additionally, emails with the survey link were sent to the students enrolled in the Department of Earth and Environmental Science.

With 106 responses, we closed our survey and cleaned our data to remove any invalid responses. Three responses from graduate students were taken out of the dataset as these respondents were not part of our sampling frame. With this new number of responses, we calculated the actual confidence level, which is 90% with a margin of error of 8.053% (Fluid Survey University, n.d.). The responses from the multiple-choice questions were analyzed by frequency of each answer and descriptive statistics were calculated. The results of the long answer questions were coded by the frequency of keywords and 13 overarching themes. The

demographic information was used in the case of extreme responses to see if there was a link between respondent's value of biodiversity and study major, year of study, or age.

The responses from the survey question to estimate the number species on Studley campus was compared to the actual species diversity data obtained from the 2019 Dalhousie BioBlitz. The BioBlitz estimate of species diversity on Studley campus was acquired from the Department of Earth and Environmental Science's entries on the iNaturalist application during the BioBlitz event. The majority of entries were verified by faculty and experts. Therefore, it allows the study to compare the difference between what respondents think the species diversity is and the actual species diversity on campus. The mode of responses from this survey question was calculated and compared to the estimated species diversity on the Studley campus. A chi square test was run to determine if there was an association between respondents' estimate of species diversity on Studley campus and if they believed there should be an increase in campus biodiversity with the null hypothesis that there is no association.

3. Results

3.1 Quantitative Analysis

To get a better understanding of how students view biodiversity both in general and on campus, we asked participants two questions: *Did they think biodiversity was important?* and *Should there be an increase in biodiversity the Studley campus?*. 95% of our participants agreed that biodiversity was important, 3% responded "Unsure" and only said "No" (Figure 2a). The majority of those who chose unsure also indicated that they had never heard of the term "biodiversity". 71% of respondents indicated that there should be an increase in biodiversity on campus while only 1% said no, there should not be an increase (Figure 2b). Again, those who answered "No" indicated that they had never heard the term biodiversity prior to their participation in the survey. The proportion of participants who answered unsure was 28%, which was 25% higher than the previous question. At first it appeared that those who answered "Unsure" or "No"

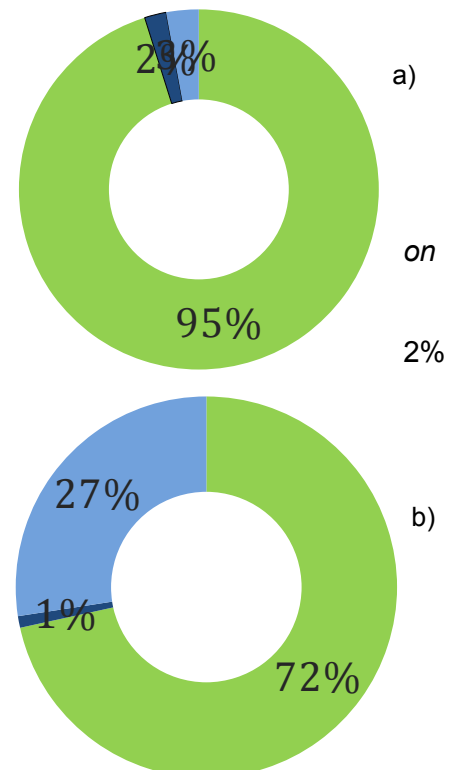


Figure 2. Proportion of responses to a) *Do you think biodiversity is important?* and b) *Do you think the amount of biodiversity should be increased on Studley campus?*, where green = "yes", black = "no", grey = "unsure".

SPRUCING UP DALHOUSIE

had also selected a higher biodiversity estimate when asked “*How many species do you think there are on the Dalhousie Studley campus?*”. To test if respondents' biodiversity estimates were associated with their answer to the increase question, we ran a chi square test. We failed to reject our null hypothesis that the answers to these two questions were independent indicating that there is no statistically significant association between the two.

In addition to the question depicting whether or not participants wanted a change in campus biodiversity, we also wanted to know what type of change students wanted to see if there were to be a change in campus biodiversity. We gave respondents 13 options of different plant types that they would like to see. Respondents could choose as many answers they wished, making the number of responses for this question 393 rather than 103. The answers with the most responses were “more native flowering species” with 101 responses, “more native trees” with 96 responses, and “more native shrubs and bushes” with 79 responses (Figure 3). Collectively, an increase in non-native species of any kind received 69 responses, making up 17.5% of the total responses. Similarly, 11.4% of the responses indicated the desire for fewer species (Figure 3).

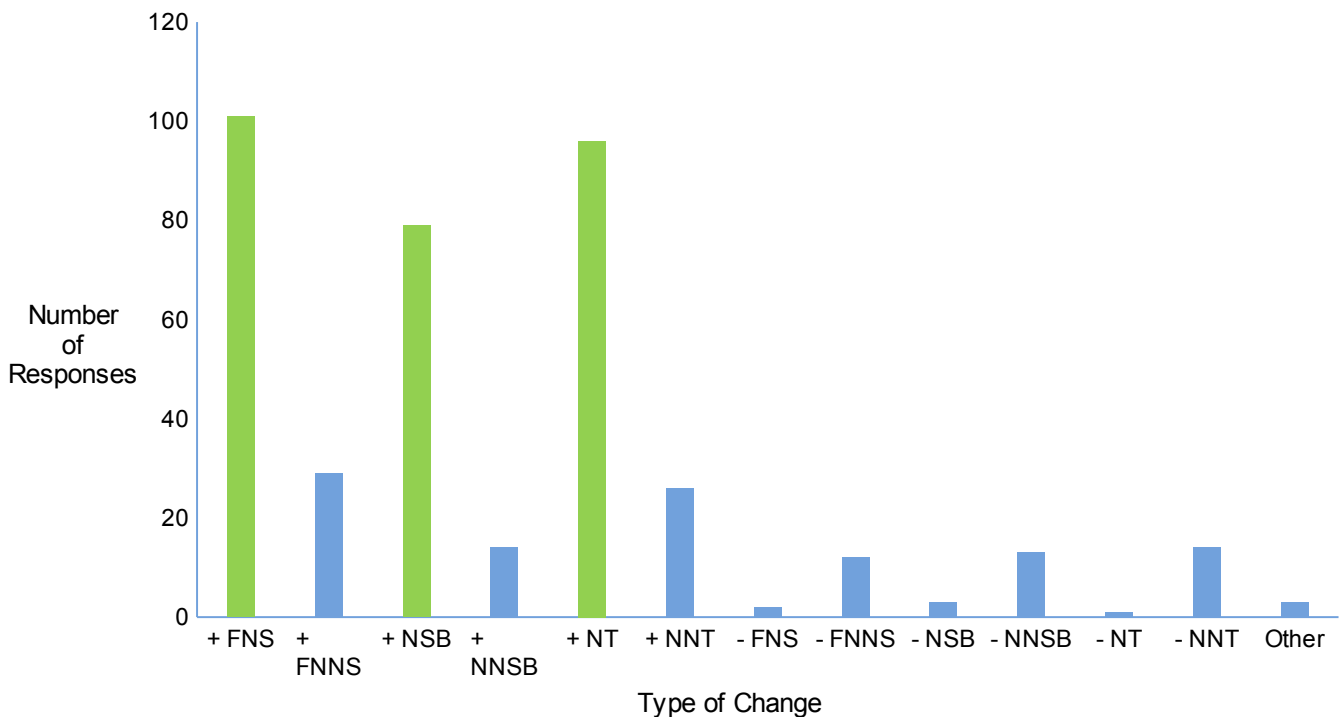


Figure 3. Change in biodiversity requested by participants where + indicates an increase, - indicates a decrease, native flowering species (FNS), native shrubs and bushes (NSB), native trees (NT), non-native flowering species (FNNS), non-native shrubs and bushes (NNSB) and non-native trees (NNT). The most frequent responses are highlighted in green.

In order to gage the number of species participants thought there were on campus, we asked participants to select the range of numbers that indicated their species count estimate. The most frequent response was the 101 – 500 range, accounting for 35% of all responses (Figure 4). The next highest range (501-1000) was close behind, accounting for 31% of all responses. 14% of respondents estimated that there were more than 1501 species on campus and 5% estimated that there were less than 100 species on campus (Figure 4). The 2019 BioBlitz estimated that there were about 532 species on the Studley campus. By comparing the BioBlitz estimate and the mode of our data, it appears that the majority of participants have an accurate estimate of campus biodiversity, however, since the data is categorical, we could not statistically verify this hypothesis.

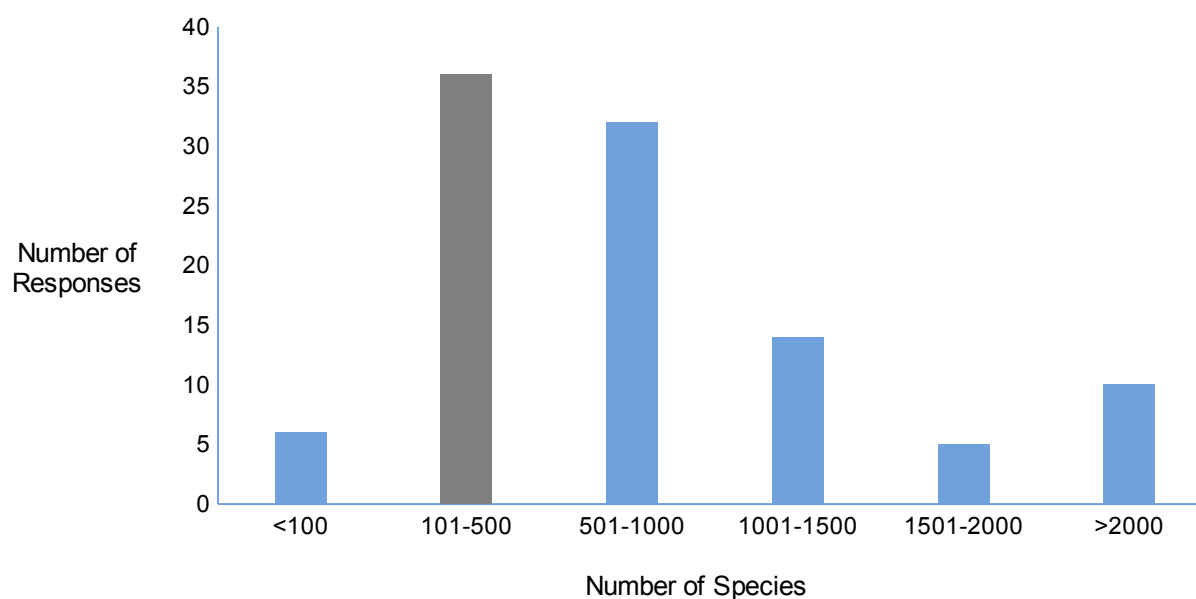


Figure 4. Participant biodiversity estimates compared to the 2019 BioBlitz estimate.

3.2

Qualitative Analysis

Participants were also asked to indicate what factors influenced their perception regarding the importance of biodiversity. The most frequent theme of this long answer question was related to education (i.e. classes, professors). The importance of biodiversity for ecosystem health was the next most common answer. The third most common was unsure or unable to answer. Many of the participants who answered “Unsure”, also responded “Unsure” when asked if they think biodiversity was important, with some even indicating that they felt they did not know enough about biodiversity to comment. Media-based influences like social media, the news and nature documentaries were also popular among respondents. Beauty was identified

SPRUCING UP DALHOUSIE

as an influencing factor with one response comparing biodiversity to a museum or gallery. Other factors that were identified were sustainability, climate change, personal experiences, the impact it has on mental and physical health, living with nature and its intrinsic value.

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4. Discussion*4.1 Summary of Findings & Context in Other Literature*

As seen in our results, the students in our sample generally have an accurate idea of the number of species on the Studley campus, although this could not be verified by statistics. Most of them do value biodiversity and indicated that they would like to see an increase in biodiversity on campus, with a preference towards more native species. More specifically, the majority of respondents would want an increase in native flowering species over other options. However, the majority of respondents selected multiple types of plants to be increased as they had the option to select all that apply. This suggests that respondents would want an overall increase. Participants also indicated that the two most common influences on their perception regarding the importance of biodiversity were education and the health of an environment. Media, such as social media and nature documentaries were also sources of information regarding the importance of biodiversity. These responses showed that most participants view biodiversity as a necessary component of environmental health, from helping to mitigate climate change and creating more resilient ecosystems to maintaining its anthropocentric value. To answer our research question, it appears that our participants value biodiversity positively and would like to see an increase in it on campus. Our study draws on themes and ideas that are a part of a growing body of research that focuses on the effects of natural spaces and biodiversity on mental well-being as well as its benefits to stress relief and ecology.

.1

ience

Both our results and the study done by Laage et al. in 2019 found that the majority of Dalhousie students would like an increase in the amount of greenspace on Dalhousie Studley campus. Furthermore, both studies identified a connection between natural space, beauty, and mental and physical well-being. The study from Laage et al. (2019) showed that students want more indoor greenspace due to factors like natural aesthetics and better mood. The study also

identified an association between greenspace and students' productivity and overall well-being (Laage et al., 2019). Like the previous study, respondents in this research study also made a connection between biodiversity and nature, ecosystem health, mental and physical health benefits and aesthetics. While Laage et al.'s study (2019) found that students would prefer more indoor trees, this research found that students would like more native flowering species, followed by more native trees and shrubs, for the outdoor campus environment.

Other research assessed fine particulate matter concentration on Dalhousie Studley campus and indicated that an increase in urban greenspace is one way to improve air quality on campus (Beard et al., 2017). Our research can therefore assist this quantitative analysis on air quality, which identified students' desire to have more plants on the Studley campus. Findings from our study and the study conducted by Beard et al. (2017) can be collectively used to inform decision-makers at Dalhousie University, especially regarding changes in the type of outdoor plant species students would prefer on the Studley campus. As discussed previously, natural greenspace has physical and mental benefits including reducing stress and improving concentration while working (Rugel et al., 2019). Moreover, Laage et al. (2019) also found that increased greenspace will improve students' productivity and overall well-being. Therefore, the increase in vegetation cover and diversity on Dalhousie Studley campus could also help to improve students' health and academic performance.

The research findings also highlighted the importance of education in affecting students' knowledge and perception about biodiversity. The Aichi Biodiversity Targets, which came out of the Convention on Biological Diversity, aim to ensure that biodiversity is valued, conserved and restored in order to sustain a healthy planet and deliver benefits to all people (Convention on Biological Diversity, 2018). The Targets, which lead advancement in sustainability and biodiversity conservation, suggest that by 2020, people should be more aware of biodiversity, its value, and the means to conserve it (Convention on Biological Diversity, 2018). According to the survey responses, the majority of the participants gained knowledge about biodiversity through courses or media, particularly social media. A few respondents, however, stated that they have not heard the term "biodiversity" so they were unsure about the value of biodiversity. Dalhousie University can use pathways like social media to further educate students on biodiversity and its value, as well as how the University is maximizing the benefits of a biodiverse ecosystem.

4.2 Limitations & Further Research

This study was faced with a few varying limitations. First, the voluntary nature of the survey reduced the overall number of respondents and the representativeness of the results. Some respondents opted out of answering particular questions in the survey, indicating respondent bias. Ideally, our study would include different times to collect responses, such as during both the fall and winter semester and even perhaps the spring semester. Having it only in the winter semester may have limited or influenced participants' responses since trees are bare and less time is spent outdoors. As a point of reference, we used Dalhousie's BioBlitz data that provides information on campus diversity, however there were some limitations with this estimate, undermining its accuracy. Observations during the event were mostly made by students and not all were verified by experts. Some observations could not be narrowed down to the species level which could mean the number of species had been overestimated or underestimated. Certain areas of campus were surveyed more than others. Similarly, surveys during certain times of day also had more volunteers potentially making them more thorough. As a result of this limitation, researchers could not statistically verify if students had an accurate estimate of campus biodiversity.

The most significant limitation encountered during this study was the coronavirus pandemic (or COVID-19). Consequently, on March 15th classes were suspended and campuses were closed. This drastically affected the number of survey respondents and prevented researchers from statistically generalizing the results to the larger Dalhousie population. With the research project being added to the Past ENVS project database, there is potential for the project to be expanded upon in the future. If so, researchers could alter the survey response period to be longer and at varying times throughout the school year to understand the impacts of workloads or seasons on responses. Restructuring the biodiversity estimate question so that responses can be statistically compared to the BioBlitz estimate would help better determine if students have an accurate idea of campus biodiversity. Moreover, researchers would expand the target demographics beyond undergraduate students to gather a more representative sample of the greater Dalhousie population.

5. Conclusions & Final Remarks

In an attempt to bridge the knowledge gap pertaining to mental and physical health and the value biodiverse ecosystems, researchers set out to answer the following research question: What are student's perceptions on the value of biodiversity on Dalhousie's Studley campus, and

SPRUCING UP DALHOUSIE

how do these perceptions compare to actual campus biodiversity estimates? Expanding upon the research of Laage et al (2019), the attention was shifted from indoor greenspaces to outdoor greenspaces with a narrowing focus on how Dalhousie students value biodiversity. Data was gathered through a brief online survey, with a majority of respondents indicating they would like to see an increase in biodiversity on the Studley campus. Survey responses also demonstrated that students consider their environment to be an important determinant of health. These findings are supported by Rugel et al (2019) who suggest that biodiverse spaces act as a facilitator for social connections and a sense of purpose, which both provide support for mental and physical well-being. The findings of this research project also highlight the role of education in shaping attitudes toward biodiversity, with courses and social media as the predominant sources of knowledge. With the overarching goal of increased awareness of biodiversity among students and policymakers at Dalhousie, this body of research could be expanded by looking at the particular role of social media in shaping perceptions of value systems, particularly ways in which Dalhousie can use its social media platforms to heighten awareness of biodiversity among students and faculty. Whether changes come from our study or ones that come after, based on our results we recommend the University looks deeper into campus biodiversity and awareness to promote positive change on campus.

6. Acknowledgements

We would like to thank Dr. Heather Cray for helping and supporting us as we navigated the changes caused by COVID-19 as well as her guidance in designing and implementing our study. We would also like to thank our teaching mentor Anastasia Papadopoulos for her expertise in answering all of our questions, especially her advice regarding our statistical tests. Our study would not have been possible without the feedback from both Dr. Cray and Anastasia. We would also like to thank all those who took the time to complete our survey especially given the campus closures and other COVID-19 measures.

7. References

- Aerts, R., Honnay, O., Van Nieuwenhuysse, A. (2018). Biodiversity and human health: Mechanisms and evidence of the positive health effects of biodiversity in nature and green spaces. *British Medical Bulletin*, 127 (1), 5-22. Retrieved from <https://doi-org.ezproxy.library.dal.ca/10.1093/bmb/ldy021>
- Araya, R., Dunstan, R., Playle, R., Thomas, H., Palmer, S. & Lewis, G. (2006). Perceptions of social capital and the built environment and mental health. *Social Science and Medicine*, 62 (12), 3072-3083. Retrieved from <https://doi.org/10.1016/j.socscimed.2005.11.037>
- Beard, S., Hoffmann, N., Hunter, J., Jarrar, H., & Quartermain, D. (2017). *Assessing Fine Particulate Matter Concentrations Across Dalhousie University's Studley Campus*. Dalhousie University. Retrieved from https://dalspace.library.dal.ca/bitstream/handle/10222/76653/ENVS35022017GT_C05AssessingFineParticulateMatter.pdf?sequence=1&isAllowed=y.
- Bojuwoye, O. (2002). Stressful experiences of first year students of selected universities in South Africa. *Counselling Psychology Quarterly*, 15(3), 277–290. <https://doi.org/10.1080/09515070210143480>
- Convention on Biological Diversity. (2018). *Aichi Biodiversity Targets*. Retrieved from <https://www.cbd.int/sp/targets/>.
- Convention on Biological Diversity. (2018). *Key Elements of the Strategic Plan 2011-2020, including Aichi Biodiversity Targets*. Retrieved from <https://www.cbd.int/sp/elements/>.
- Cray, H. (2020). "Sampling methods & approaches." Lecture, Dalhousie University, Halifax, Nova Scotia, January 27, 2020.
- Cray, H. (2020). "Research Ethics." Lecture, Dalhousie University, Halifax, Nova Scotia, February 3, 2020.

SPRUCING UP DALHOUSIE

- Curtin, S. (2009) Wildlife tourism: the intangible, psychological benefits of human–wildlife encounters. *Current Issues in Tourism*. 12:5-6, 451-474, DOI: 10.1080/13683500903042857
- Dean, J., Dooren, K. van, & Weinstein, P. (2011). Does biodiversity improve mental health in urban settings? *Medical Hypotheses*, 76(6), 877–880. Retrieved from: <https://doi.org/doi:10.1016/j.mehy.2011.02.040>
- Evans, G.W. (2003). The built environment and mental health. *Journal of Urban Health*, 80 (4), 536-555. Retrieved from <https://link.springer.com/content/pdf/10.1093%2Furban%2Fjt063.pdf>
- Fluid Survey University. (n.d.). *Survey Sample Size Calculator*. Retrieved February 10, 2019, from <https://fluidsurveys.com/university/survey-sample-size-calculator/>
- Huby, M., Cinderby, S., Crowe, A. M., Gillings, S., McClean, C. J., Moran, D., Owen, A., & White, P. C. L. (2006). The association of natural, social and economic factors with bird species richness in rural England. *Journal of Agricultural Economics*, 57(2), 295–312. <https://doi.org/10.1111/j.1477-9552.2006.00053.x>
- Kennedy, L. (2019). The Prehistoric Ages: How Humans Lived Before Written Records. *History*. Retrieved from <https://www.history.com/news/prehistoric-ages-timeline>
- Laage, E., Thorpe, E., Wallace, S., & Wu, Y. (2019). *The effects of interior green spaces on student well-being and productivity on Dalhousie University's Studley Campus* (pp. 1–29). Dalhousie University. Retrieved from: <https://dalspace.library.dal.ca/bitstream/handle/10222/76569/EffectofGreenSpaceonStudentwell-being.pdf?sequence=1&isAllowed=y>
- Louv, R. (2005). *Child of the Woods: Saving Our Children from Nature-Deficit Disorder*. Algonquin Books of Chapel Hill.
- Luck, G. W., Davidson, P., Boxall, D., & Smallbone, L. (2011). Relations between urban bird and plant communities and human well-being and connection to nature. *Conservation Biology*, 25(4), 816–826. <https://doi.org/10.1111/j.1523-1739.2011.01685.x>

- Mavoia, S., Davern, M., Breed, M., & Hahs, A. (2019). Higher levels of greenness and biodiversity associate with greater subjective well-being in adults living in Melbourne, Australia. *Health & Place*, 57, 321–329. Retrieved from: <https://doi.org/doi:10.1016/j.healthplace.2019.05.006>
- Palys, T., Atchison, C. (2014). *Research decisions: quantitative, qualitative, and mixed methods approaches*. Toronto: Nelson Education.
- Poudyal, N. C., Hodges, D. G., Bowker, J. M., & Cordell, H. K. (2009). Evaluating natural resource amenities in a human life expectancy production function. *Forest Policy and Economics*, 11(4), 253–259. <https://doi.org/10.1016/j.forpol.2009.04.007>
- Qiu, L., Lindberg, S., & Nielsen, A. B. (2013). Is biodiversity attractive? – One-site perception of recreational and biodiversity values in urban green space. *Landscape and Urban Planning*, 119, 136–146. Retrieved from: <http://dx.doi.org/10.1016/j.landurbplan.2013.07.007>
- Raanaas, R. K., Evensen, K. H., Rich, D., Sjøstrøm, G., and Patil, G. (2011, March). Benefits of indoor plants on attention capacity in an office setting. *Journal of Environmental Psychology* 31(1), pp. 99-105. Retrieved from: <https://doi.org/10.1016/j.jenvp.2010.11.005>
- Ritchie, H., Roser, M. (2018). Urbanization. *Our World in Data*. Retrieved from <https://ourworldindata.org/urbanization>
- Rugel, E., Carpinao, R. M., Hendeson, S. B., & Brauer, M. (2019). Exposure to natural space, sense of community belonging, and adverse mental health outcomes across an urban region. *Environmental Research*, 171, 365–377. Retrieved from: <https://doi.org/10.1016/j.envres.2019.01.034>
- Sanchez, E., Sullivan, M., Dupart, L. (2017). In Symmetry With Nature. *Center for Humans and Nature*. May 29, 2017. Retrieved from <https://www.humansandnature.org/what-happens-when-we-see-ourselves-as-separate-from-or-as-a-part-of-nature-in-symmetry-with-nature>

SPRUCING UP DALHOUSIE

United States Environmental Protection Agency. (n.d.). What are the trends in indoor air quality and their effects on human health? *USEPA*. <https://www.epa.gov/report-environment/indoor-air-quality>

Van den Bosch, M., & Ode Sang, Å. (2017). Urban natural environments as nature-based solutions for improved public health – A systematic review of reviews. *Environmental Research*, 158, 373–384.
<https://doi.org/10.1016/j.envres.2017.05.040>

Warber, S. L., DeHudy, A. A., Bialko, M. F., Marselle, M. R., & Irvine, K. N. (2015). *Addressing (Nature-Deficit Disorder): A Mixed Methods Pilot Study of Young Adults Attending a Wilderness Camp*. 2015, 1–13.
<http://dx.doi.org/10.1155/2015/651827>

Appendix I: Consent Form & Sample Survey**CONSENT FORM**

Sprucing Up Dalhousie

You are invited to take part in a research study being conducted by four undergraduate students at Dalhousie University as a part of the ENV5/SUST 3502 Campus as a Living Lab course. The purpose of this research is to assess undergraduate student's perceptions and values of biodiversity on Dalhousie's Studley campus. All registered undergraduate students attending campus in Halifax, Nova Scotia are eligible to participate. Data will be collected through an online, confidential survey.

If you choose to participate in this research you will be asked to answer a 11-question survey, with opinion-based questions and some minor background information (i.e. age, program of study, year of study). All responses to the survey will be confidential. The only identifying information is your email address, which will only be used to determine the winners of the prizes. Please note that giving your email is completely voluntary. All responses will be saved on a secure Dalhousie server that is password protected. Only the four researchers will have access to the survey results. The data collected from this study will be held until April 30, 2020, after which the data will be destroyed.

Your participation in this research is entirely your choice. You do not have to answer any questions that you do not feel comfortable with 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. Surveys that are not submitted will not be included in the analyses. If you do complete your survey and you change your mind later, please contact Nina Garret and your responses will be removed from the study.

The general findings of this research will be described and shared in a group presentation and a final report that will be submitted to the Department of Earth and Environmental Science database of "Past ENV5 3502 Projects". The database will keep the anonymized survey information indefinitely as it may be used in future research.

The risks associated with this study are no greater than those you encounter in your everyday life. To thank you for your time, participants may voluntarily provide their email

SPRUCING UP DALHOUSIE

address so they can be entered into a draw to win one of two prize packs containing a \$10.00 Pete's Togo gift card and a Dalhousie Student Union Food box valued at \$20.00. Participants who do not complete the study may still enter the draw.

You may discuss any questions you have about this study with Nina Garrett (nn622001@dal.ca) or Dr. Heather Cray (hcray@dal.ca). Please ask as many questions as you like before or after participating.

Pressing "Continue to next section" is considered your agreement to participate in the study and your understanding of the aforementioned consent information.

SURVEY
Sprucing Up Dalhousie

1. What year of study are you currently in?
 - 1
 - 2
 - 3
 - 4
 - 5
 - 5+

2. What is your major?

3. How old are you?
 - <17
 - 17-20
 - 21-24
 - 25-28
 - 29-32
 - 36+

4. On which Dalhousie Halifax campus do you spend the most time?
 - Studley
 - Carlton
 - Sexton

5. Have you heard of the term "biodiversity"?
 - Yes
 - No

6. How do you define the term "biodiversity"?

7. How many species do you think there are on the Dalhousie Studley campus?

SPRUCING UP DALHOUSIE

- <100
 - 101-500
 - 501-1000
 - 1001-1500
 - 1501-2000
 - >2000
8. Do you think the amount of biodiversity should be increased on Studley campus?
- Yes
 - No
 - Unsure
9. If there were to be changes to the plant species in managed parts of campus, what would you like to see? Choose all that apply.
- More flowering native species
 - More flowering non-native species
 - More native shrubs/bushes
 - More non-native shrubs/bushes
 - More native tree species
 - More non-native tree species
 - Fewer flowering native species
 - Fewer flowering non-native species
 - Fewer native shrubs/bushes
 - Fewer non-native shrubs/bushes
 - Fewer native tree species
 - Fewer non-native tree species
 - Other (specify):
10. Do you think biodiversity is important?
- Yes
 - No
 - Unsure
11. What influences your perception regarding the importance of biodiversity?

Appendix II: Recruitment Poster & Flyer

Should Studley Branch Out?

Complete our 5-minute survey about Studley Campus' biodiversity for a chance to win a prize pack!



The survey is part of our ENVS/SUST 3502 Campus as a Living Laboratory research project and will help us determine **what kind of change students want to see** in our greenspaces at Dalhousie.



To participate in the survey, go to the link below or scan the QR code.



Participate for a chance to **win one of two prize packs of a \$10 Pete's-to-go Gift Card and a DSU Farmer's Market Food Box!**

<https://forms.gle/a7zZPqH7aaALn6dG9>
<https://forms.gle/a7zZPqH7aaALn6dG9>
<https://forms.gle/a7zZPqH7aaALn6dG9>
<https://forms.gle/a7zZPqH7aaALn6dG9>
<https://forms.gle/a7zZPqH7aaALn6dG9>
<https://forms.gle/a7zZPqH7aaALn6dG9>
<https://forms.gle/a7zZPqH7aaALn6dG9>
<https://forms.gle/a7zZPqH7aaALn6dG9>
<https://forms.gle/a7zZPqH7aaALn6dG9>
<https://forms.gle/a7zZPqH7aaALn6dG9>
<https://forms.gle/a7zZPqH7aaALn6dG9>
<https://forms.gle/a7zZPqH7aaALn6dG9>

Figure A. Survey recruitment poster.



**WANT A CHANCE TO WIN
A 10\$ PETE'S TOGO GIFT
CARD AND A DSU
FARMER'S MARKET FOOD
BOX??**

**Complete our short 5
minute biodiversity
survey for a chance to
win!**

- The survey is part of our ENVS/SUST 3502 Campus as a Living Laboratory research project.
- We want to understand how students value biodiversity on the Studley Campus!
- The survey is online and is totally confidential.
- To complete the survey and enter for your chance to win, go to the link below or scan the QR code.

<https://forms.gle/a7zZPqH7aaALn6dG9>



Figure B. Recruitment hand out.

Appendix III: Raw Counts

Table 1. The number of responses related to each coding category.

Theme/Category	Number of Response
<i>Education</i>	25
<i>Healthy Environment/Balance/Nature</i>	17
<i>Unsure/Unable to/did not answer</i>	15
<i>Media</i>	11
<i>Climate Change</i>	10
<i>Beauty</i>	10
<i>Sustainability/Resilience</i>	8
<i>Personal Experience</i>	7
<i>Mental/Physical Health</i>	7
<i>Living together/Cohesion</i>	5
<i>Intrinsic Value</i>	4

Table 2. Raw counts from question 7: *How many species do you think there are on the Dalhousie Studley campus?*

Number of Species	Number of Responses
<100	6
101-500	36
501-1000	32
1001-1500	14
1501-2000	5
>2000	10
<i>Total</i>	<i>103</i>

Table 3. Raw counts from question 8: *Do you think the amount of biodiversity should be increased on Studley campus?.* *Note: One participant did not answer the question, resulting in only 102 responses for this question.

Answer	Number of Responses
Yes	73
No	1
Unsure	28
<i>Total</i>	<i>102*</i>

Table 4. Raw counts from question 10: *Do you think biodiversity is important?.*

Answer	Number of Responses
Yes	98
No	2
Unsure	3
<i>Total</i>	<i>103</i>

Table 5. Raw counts from question 9: *If there were to be changes to the plant species in managed parts of campus, what would you like to see? Choose all that apply.* *Note: As it was a choose all that apply question the total number of responses was 393

Type of Change	Number of Responses
+ FNS	101
+ FNNS	29
+ NSB	79
+ NNSB	14
+ NT	96
+ NNT	26
- FNS	2
- FNNS	12
- NSB	3
- NNSB	13
- NT	1
- NNT	14
Other	3
Total	393*