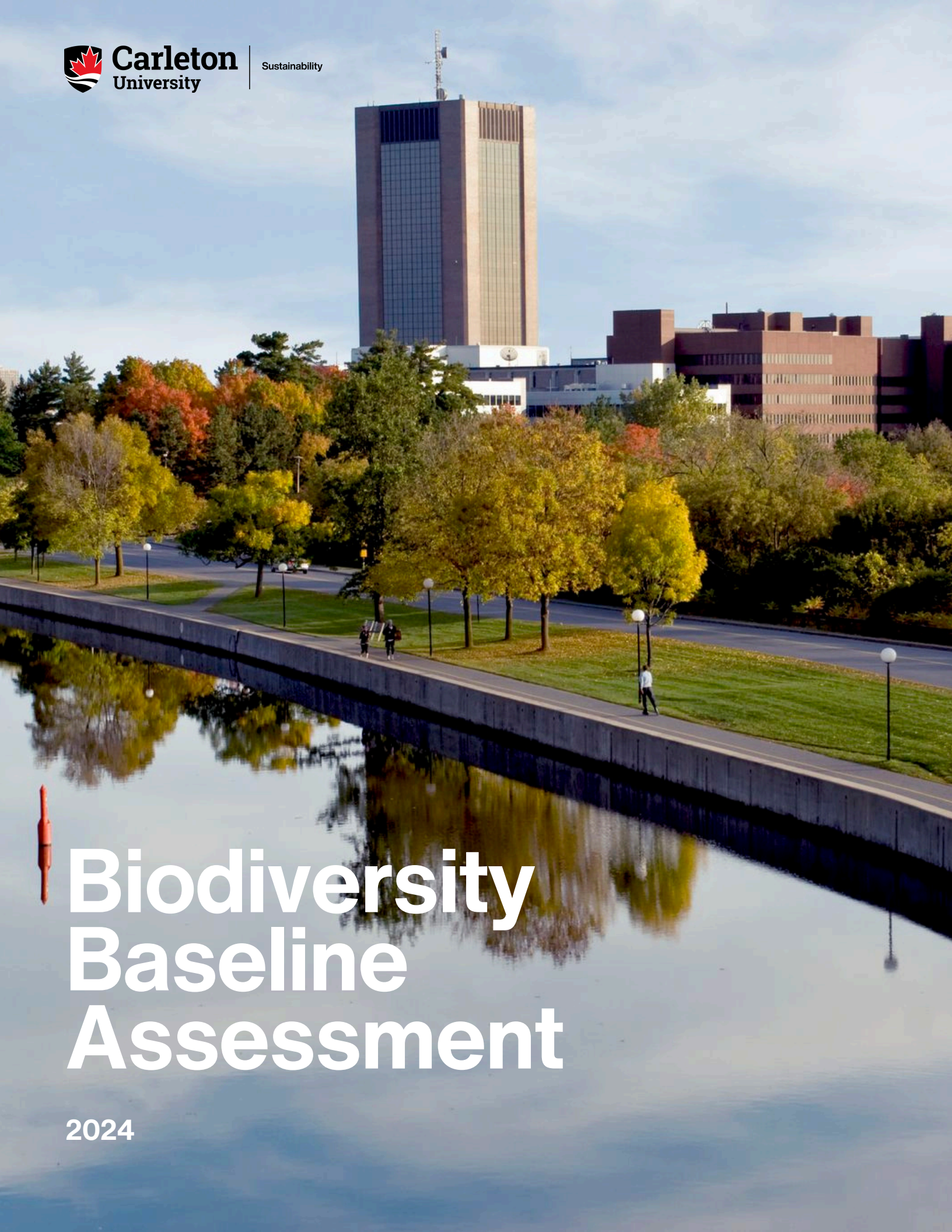
Carleton University | Sustainability



Biodiversity Baseline Assessment

2024

Contents

Abstract

Carleton University is fortunate to be situated in an area abundant with natural beauty and green spaces. Our campus is nestled between the Rideau River and Rideau Canal, offering a vibrant environment filled with diverse flora and fauna. As a pledged Nature Positive University, we are committed to building resilient ecosystems. We recognize the environmental impact of our ongoing operations and are dedicated to fostering an environment that prioritizes sustainability and biodiversity conservation. Conducting a biodiversity baseline assessment will provide a crucial metric for measuring the progress of the university's sustainability goals.

Community participation through the iNaturalist platform has proven to be an effective tool for collecting large quantities of biodiversity data. In this assessment, 540 species were identified, including two that are listed as Species at Risk in Ontario, underscoring the need to set targets for their protection and preservation. However, a more detailed sampling study could enhance these findings by addressing under-sampled areas and improving the accuracy and depth of our observations.

Project Location and Significance

Carleton University is located on the traditional and unceded territory of the Algonquin Anishinabeg Nation, nestled between two distinct water bodies—one natural and one man-made. The Rideau River runs along the southern edge of our campus, while the Rideau Canal, a UNESCO World Heritage Site, borders the north and west edges. Adjacent to the campus are the Dominion Arboretum and the Central Experimental Farm.

Our campus is home to a vibrant community of over 33,000 students, staff, and faculty, as well as a habitat for more than 500 species. Carleton is committed to being a leader among Canadian universities in advancing sustainability. With this in mind, we acknowledge the environmental impact of our operations and are dedicated to creating an environment that prioritizes species conservation.

Globally, habitat loss and fragmentation, driven by urban development, are the most significant threats to biodiversity (Markovchick-Nicholls et al., 2009). Urbanization has led to biotic homogenization, forcing native species to adapt to increasingly uniform environments, which reduces the diversity of wildlife that can coexist (Olden et al., 2004). These threats to biodiversity jeopardize ecosystem functioning and the essential services ecosystems provide. The species within an ecosystem are vital for maintaining its functionality; thus, increasing species richness across trophic groups is key to ensuring a high-functioning ecosystem (Vricella, 2017). Measuring biodiversity and tracking conservation progress are critical to addressing ongoing challenges and developing effective responses (Pauchard et al., 2018).

Introduction

Carleton's 'Strive for Sustainability' Comprehensive Sustainability Plan 2020-2025 outlines the university's commitment to sustainability. The plan's holistic approach extends beyond operational focus to ensure that sustainability ideals are integrated across all departments, fostering collaborative efforts. Goal 4.2 of the plan is specifically aimed at "enhancing conservation and biodiversity outcomes through the management of our campus." To achieve this, Carleton seeks to maximize the use of green space and maintain university grounds in an environmentally sensitive manner, as outlined in the Carleton Outdoor Space Master Plan (2020). Key projects include enhancing the tree canopy, converting unused land to planting areas, avoiding monocultures, select plants that promote biodiversity and increase animal and insect habitats, and incorporating naturalised infrastructure.

This biodiversity baseline study provides a comprehensive understanding of the flora and fauna on our campus. The assessment establishes a baseline report of biodiversity, serving as a tool for identifying important conservation areas and monitoring the impact of campus operations on biodiversity. As a pledged Nature Positive University, Carleton is committed to building resilient ecosystems to help restore and preserve urban wildlife. A biodiversity baseline is crucial for measuring, setting, and reporting on target goals.

Community participation through the iNaturalist platform has significantly enriched this biodiversity assessment, enabling the collection of diverse species data across the Carleton campus.

Methodology

The data for this assessment was sourced from the Carleton University Biodiversity Inventory project on iNaturalist. This online platform allows community members to share biodiversity observations for educational, outreach, and research purposes. The observations were filtered into two categories: research-grade observations and needs-ID observations. Research-grade observations are those where at least two out of three identifiers agree on a taxon, while needs-ID observations are verifiable but await further confirmation. These observations were then compared to the Species at Risk in Ontario List, as outlined under the Endangered Species Act (2007), to identify any endangered or vulnerable species on campus.

The data was analyzed in Microsoft Excel and visualized using ArcGIS maps. Kernel density heat maps were employed to analyze areas of high and low observation density, offering insights into data distribution across campus and highlighting under-sampled areas.

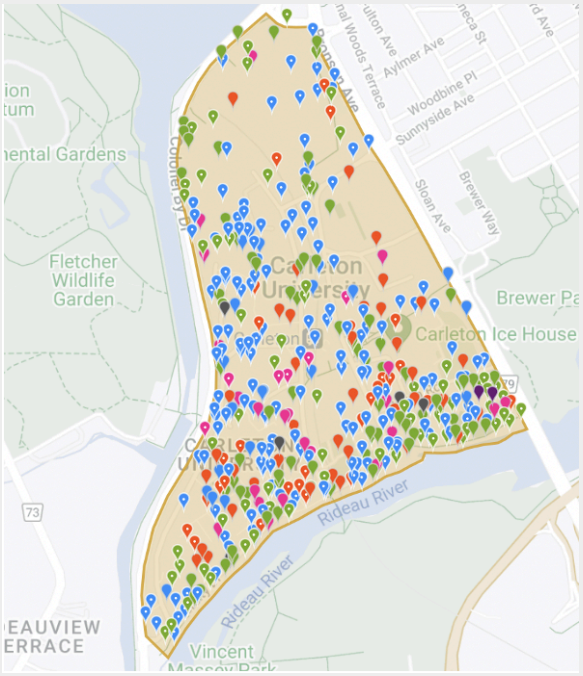


Figure 1: Map of all iNaturalist observations on campus.

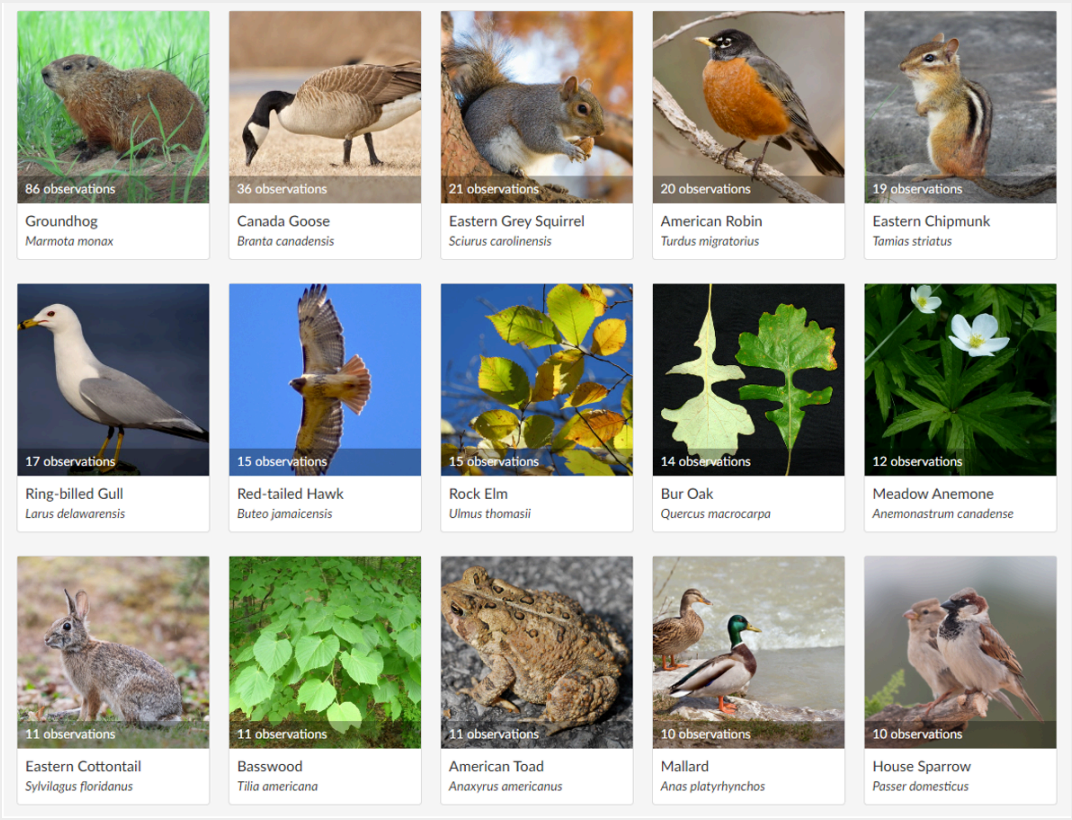


Figure 2: Overview of most common observations on campus.

Results

Throughout 2023 and 2024, iNaturalist observations identified twelve taxa groups on campus. Plants were the most frequently observed group, accounting for 43% of all observations, followed by insects (18%), birds (17%), and mammals (11%). Plants also showed the highest diversity, representing 42% of identified species, followed by insects with 28%. Although mammals were abundant, fungi surpassed them in species richness, comprising 10% of the total species identified, compared to mammals' 3%. Observations were primarily concentrated along the southern borders of campus, adjacent to the Rideau River, which is rich in vegetation.

Observation Characteristics (Total, Research Grade and Needs ID)

Total species identified	540
Total number of observations	1,506
Total observers	244
Total identifiers	600
Total research-grade species identified	316
Total research-grade observations	910
Total needs-id species identified	246
Total needs-id observations	467

Highest Abundances

Most abundant species	Groundhog (Marmota Monax)
Most abundant plant	Rock Elm (Ulmus Thomasii)
Most abundant bird	Canada Goose (Branta Canadensis)
Most abundant insect	Eastern Forktail (Ischnura verticalis)

Endangered Species

The species observed across all taxa groups in the iNaturalist observations were then compared with the Species at Risk in Ontario List obtained under the Endangered Species Act (2007). Two species within the observations were found on the Species at Risk in Ontario List.

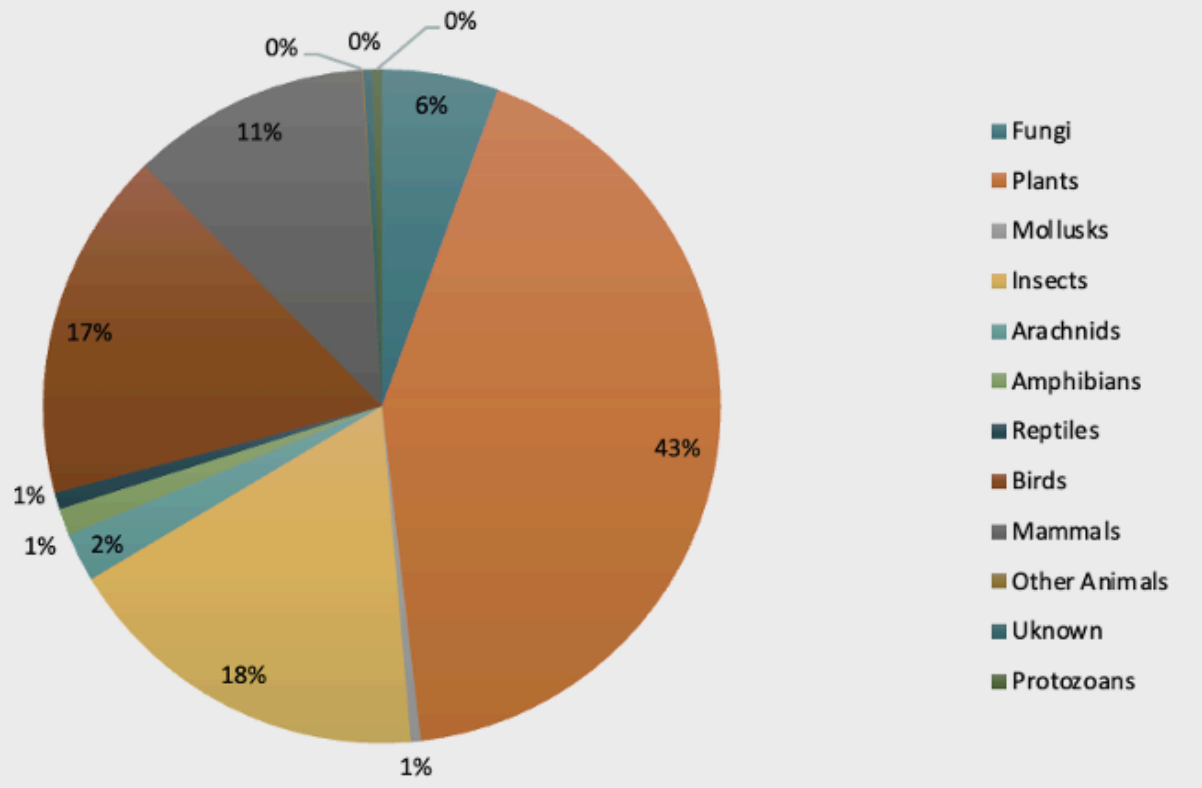
The results were the following:

Taxa Group	Specie at Risk
Plants	Celandine-Poppy (endangered)
Birds	Barn Swallow (special concern for species)

We can observe that in our campus biodiversity, the plant species celandine-poppy, and the bird species barn swallow are species at risk and further actions need to be taken to protect and conserve them.

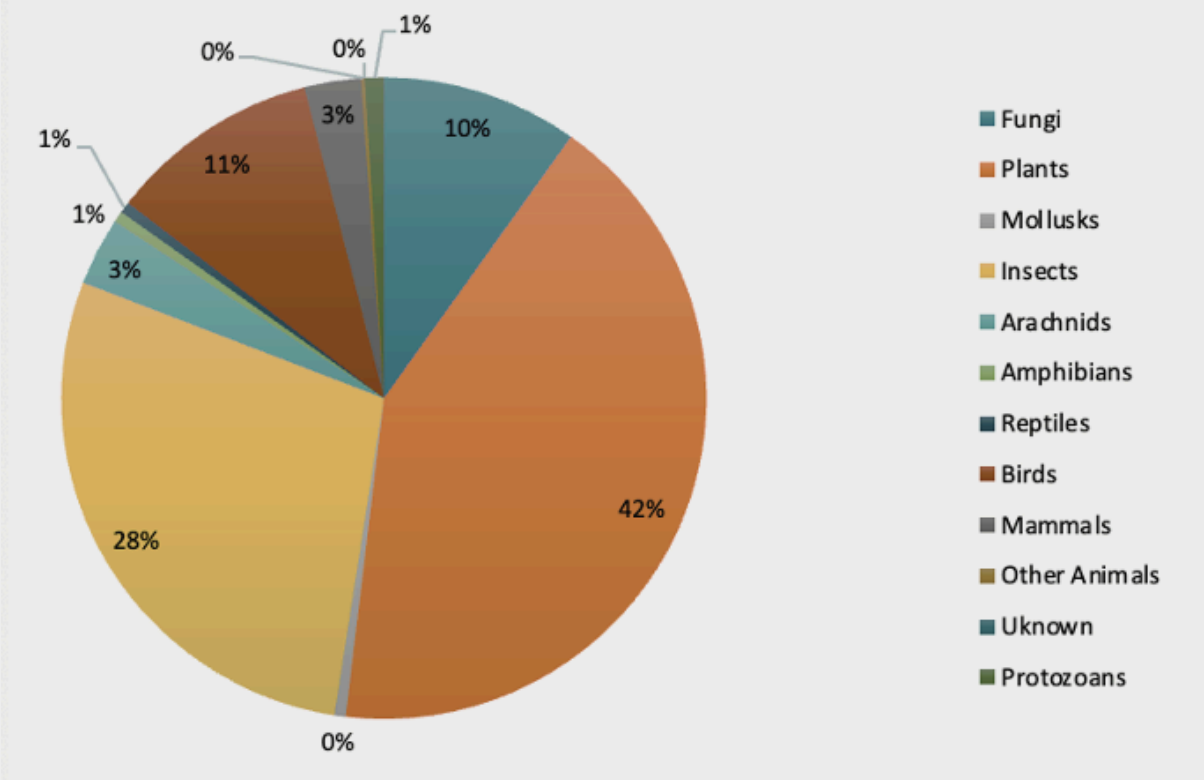
Taxa Group Abundance

Percentage of the total number of observations that fall within each taxa group.



Species Richness Per Taxa

Percentage of the total number of species identified that fall within each taxa group.



Research Grade and Needs Id iNaturalist Observations

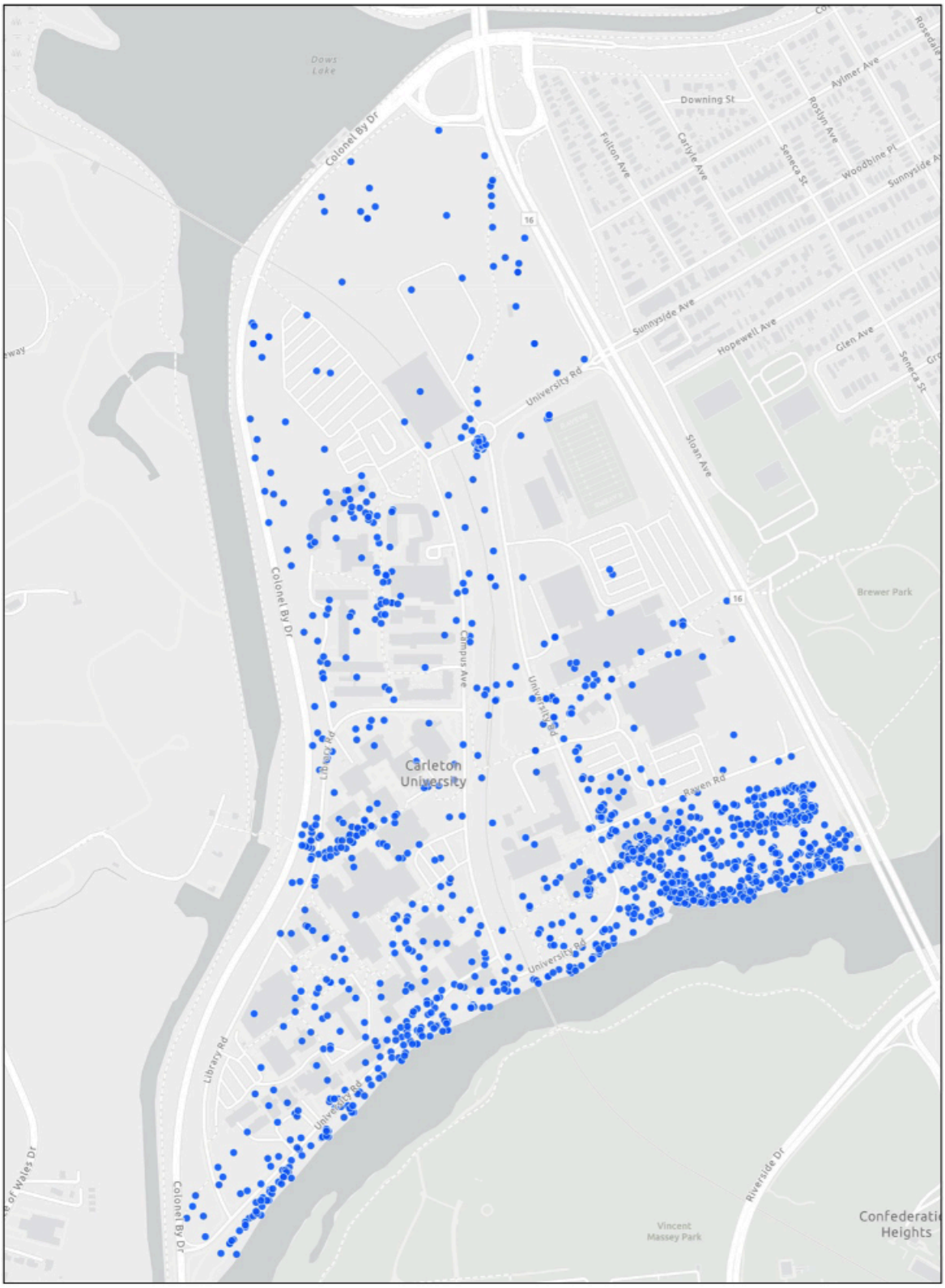


Figure 3: Map of all research-grade and needs-id iNaturalist observations on campus.

Research Grade and Needs Id iNaturalist Observations

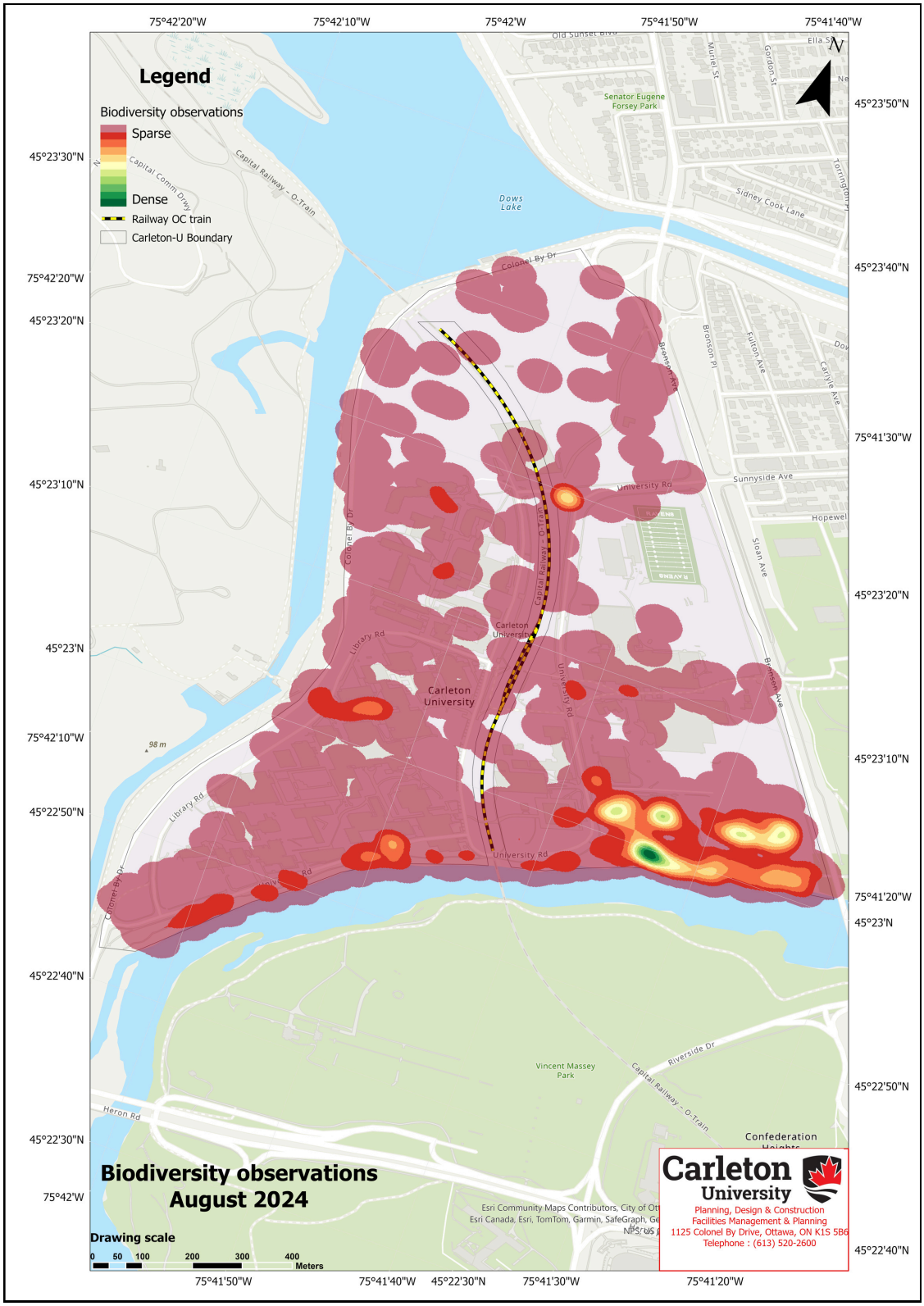


Figure 4: Density map of samples across Carleton University Campus. Hot Spots are depicted with darker shades while less dense observations with lighter ones.

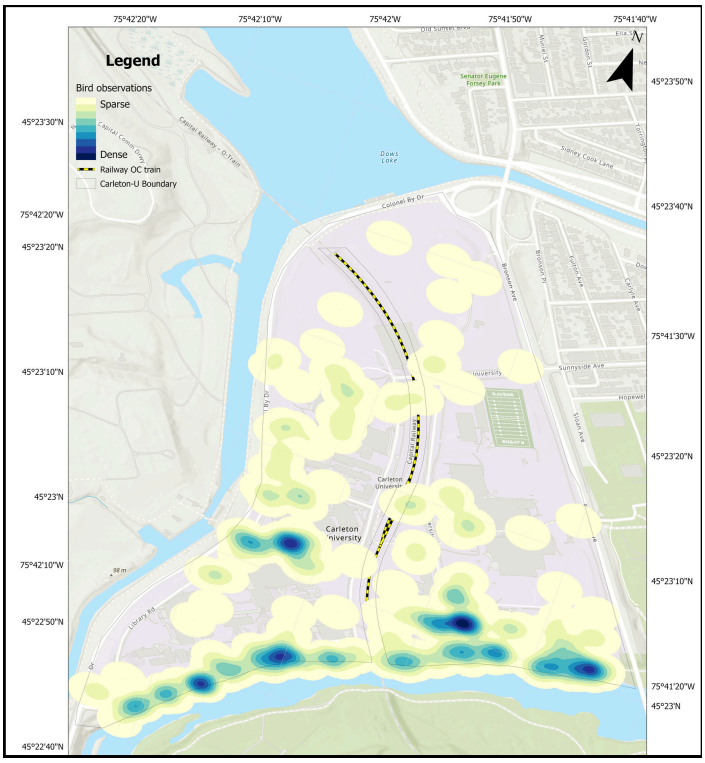


Figure 5: Density map of bird research-grade & needs-id observations from iNaturalist.

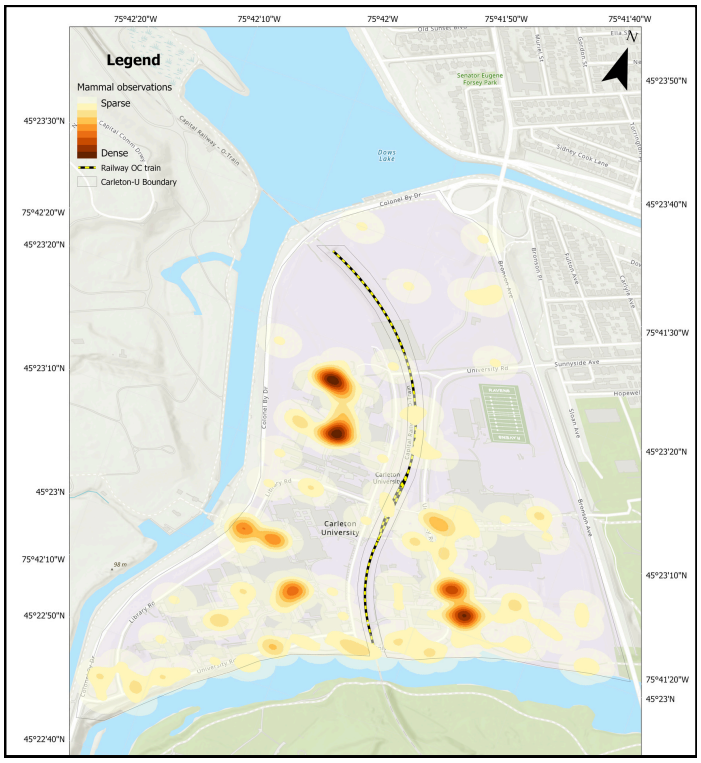


Figure 6: Density map of mammal research grade & needs-id observations from iNaturalist.

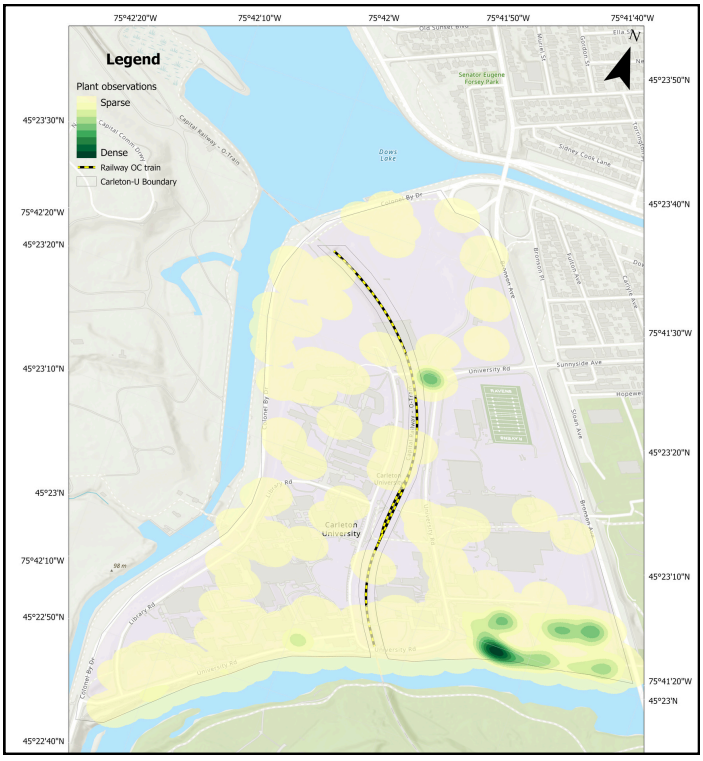


Figure 7: Density map of plant research-grade & needs-id observations from iNaturalist.

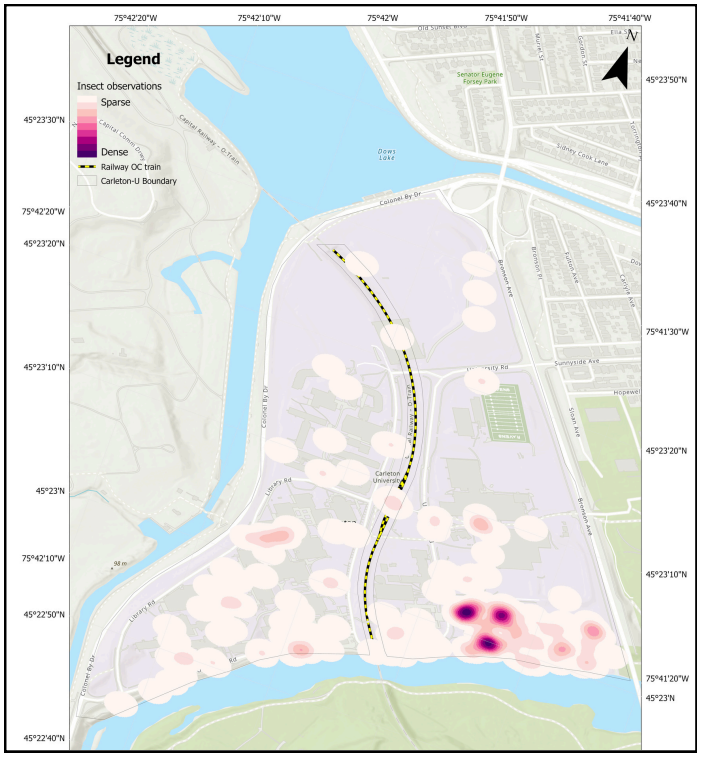


Figure 8: Density map of insect research-grade & needs-id observations from iNaturalist.

Discussion and Future Steps

Sampling and Data Analysis

The extensive data collected via iNaturalist has provided a solid foundation for studying the biodiversity of Carleton's campus and has contributed to the creation of this baseline report. Conducting the project throughout the year ensured that the observations were not limited to a single season, offering a more comprehensive overview of biodiversity across different times of the year. A total of 540 species were identified, with the most abundant being plants, insects, birds, and mammals. However, when analyzing species evenness, groundhogs (Marmota monax), Canada geese (Branta canadensis), and Eastern Gray Squirrels (Sciurus carolinensis) were the most prevalent.

Notably, two species were identified as vulnerable when compared to the Species at Risk in Ontario List: the Barn Swallow (Hirundo rustica) from the bird taxa group and the Celandine-Poppy (Stylophorum diphyllum) from the plant taxa group. These findings underscore the importance of setting conservation targets to protect these species.

While iNaturalist data provides a valuable baseline for biodiversity assessment, there are limitations to consider. The large number of observers allows for the collection of extensive data, but this can also introduce bias, as observation frequencies may be influenced by observer preference. This bias can impact the accuracy of distribution maps, reflecting observer interest rather than true species richness and evenness. Additionally, observations are dependent on user density, and widespread taxa data may reflect observer density more than actual species distribution. To address these limitations, further research should focus on under-sampled areas to increase data availability.

Errors in species identification or location data are also possible, which could affect the validity of observations. While iNaturalist offers a robust baseline of information, a more detailed and controlled sampling study could enhance the overall biodiversity assessment.

As an ongoing project, iNaturalist observations and data should be downloaded and analyzed at least annually. This will provide Carleton with a comprehensive understanding of environmental changes and the impact of campus operations on biodiversity. Beta biodiversity measures could be used to analyze data over time, offering insights into species abundance trends and the effectiveness of sustainability initiatives. Future efforts could be further enriched by organizing events such as BioBlitzes.

Measuring and Increasing Biodiversity

Expanding biodiversity assessments to include adjacent areas, such as Vincent Massey Park, Fletcher Wildlife Garden, and the Dominion Arboretum, could enhance our understanding of the environmental implications of campus operations and their impact on nearby ecosystems. A beta analysis of biodiversity in these areas, combined with our campus data, could offer a more comprehensive perspective.

Although this baseline assessment is a valuable starting point, further research is needed to measure progress toward sustainability targets. By incorporating sustainability into undergraduate courses and promoting volunteer opportunities, Carleton can leverage student research and initiative to enhance biodiversity data. Increasing research programs and making them more accessible to the campus community will also support data collection and sustainability efforts.

Further actions to improve biodiversity on campus include:

- Enhancing vegetative restoration and biodiversity through naturalized planting areas.
- Diversifying the age class and species of campus vegetation.
- Continuing to protect and preserve ecosystem fragments, especially along the Rideau River.
- Implementing and retrofitting bird-friendly glazing on new and existing buildings.
- Strengthening partnerships and communication between the Sustainability Office, Carleton University Student Association (CUSA), and Carleton Student Government to achieve sustainability goals.
- Conducting an Environmental, Social, and Governance (ESG) Survey to assess the impact of Carleton's supply chain on global biodiversity, aiding in sustainable decision-making.
- Learning from and with Indigenous peoples to deepen our understanding of the land and create effective responses to environmental changes while preserving biodiversity.

Measuring and Increasing Biodiversity

Goal 5 of the Sustainability Plan emphasises community engagement and aims to "raise awareness of the university's sustainability journey and milestones." This biodiversity baseline assessment should help raise awareness and engage the broader community. Communication about campus biodiversity should align with Goal 3.1, which seeks to "ensure sustainability research knowledge is communicated to the broader community." To achieve this, Carleton should consider developing a repository for campus biodiversity data to increase accessibility, communication, and engagement in biodiversity efforts.

Our sustainability plan commits to integrating environmental improvement across teaching, research, and operations. Biodiversity metrics could offer additional opportunities for enhancing student learning. Expanding campus green spaces could serve as "Living and Research Labs," providing experiential opportunities for students and enriching biodiversity data collection. Efficient communication and open access to research, reports, and sustainability plans will strengthen engagement across disciplines, supporting the achievement of sustainability goals.

Conclusion

Throughout this biodiversity assessment, iNaturalist has been an invaluable resource for gathering data across campus, providing insights that would have been difficult to obtain otherwise. However, it is important to acknowledge the limitations of iNaturalist, such as potential biases in observer selections and possible errors in data. To address these issues and improve the accuracy of the biodiversity data, a more detailed and controlled sampling study should be conducted, especially in under-sampled areas. Performing a biodiversity assessment is crucial for understanding the impact of urbanization and campus operations on biodiversity.

References

Chapple, M., & Kupiec, G. (2020). Campus Biodiversity Assessment Using iNaturalist [Review of Campus Biodiversity Assessment Using iNaturalist]. In The Sustainability Tracking, Assessment & Rating System (pp. 1–11). George Washington University. https://drive.google.com/file/d/1XEsPAK-z1av0Ujz4DWWmdC6Bd9_HdYvv/view

Pauchard, A., Meyerson, L. A., Bacher, S., Blackburn, T. M., Brundu, G., Cadotte, M. W., Courchamp, F., Essl, F., Genovesi, P., Haider, S., Holmes, N. D., Hulme, P. E., Jeschke, J. M., Lockwood, J. L., Novoa, A., Nuñez, M. A., Peltzer, D. A., Pyšek, P., Richardson, D. M., ... Zenni, R. D. (2018). Biodiversity assessments: Origin matters. PLoS Biology, 16(11), e2006686–e2006686. https://doi.org/10.1371/journal.pbio.2006686

Markovchick-Nicholls, L., Regan, H.M., Deutshman, D.H., Widyanata, A., Martin, B., Noreke, L., & Ann Hunt, T (2008). Relationships between Human Disturbance and Wildlife Land Use in Urban Habitat Fragments. Conservation Biology, 22(1), 99–109. https://doi.org/10.1111/j.1523-1739.2007.00846.x

Olden, J. D., LeRoy Poff, N., Douglas, M. R., Douglas, M. E., & Fausch, K. D. (2004). Ecological and evolutionary consequences of biotic homogenization. Trends in Ecology & Evolution (Amsterdam), 19(1), 18–24. https://doi.org/10.1016/j.tree.2003.09.010

Vricella, C. (2017). Effect of Urbanization on Biodiversity: Ecological and Sociological Perspectives. SUNY Oneonta Academic Research (SOAR): A Journal of Undergraduate Social Science, 1

O. Reg. 230/08: Species at Risk in Ontario List under Endangered Species Act, (2008, S.O. 2007, c.6). Retrieved from the City of Ottawa website: Species at risk in Ontario | ontario.ca