University of British Columbia

Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

# Native Pollinator Biodiversity: Exploring Biodiversity Policy Creation at UBC

Prepared by: Dayna Rachkowski and Maicen Stuart

Prepared for: SEEDS Sustainability Program

Course Code: RES 505

University of British Columbia

Date: January 26, 2022

**Abstract**

This project is being undertaken in partnership with the University of British Columbia's (UBC) SEEDS sustainability program. UBC is looking to create biodiversity pollinator targets for 2030 (Climate Action Plan 2030) and 2050 (Campus Vision 2050). Currently, UBC does not have any outlined goals or targets for native pollinator species on campus. Scientists are currently seeing native pollinator species decline across British Columbia, therefore it is important to shed light on this issue and understand what UBC could be working towards to maintain native pollinators on campus. This paper uses qualitative methods to determine recommendations for UBC's biodiversity policy. This report employs a policy review of current UBC sustainability and biodiversity policy and programs, semi-structured interviews with various experts [holding experience with pollinator species] that work or study across the UBC campus, as well as a framework analysis of policy and programs installed at other institutions across North America. This project uses these methods to offer four primary recommendations for the university to implement within future policy to help conserve and promote native pollinator presence on campus. While this paper will make reference to both native and non-native pollinators, our emphasis is specifically on increasing conservation of native pollinator biodiversity on UBC campus.

**Positionality Statement**

Dayna:

As an environmental policy focused graduate student in UBC's *Environment, Resource, and Sustainability* program, I have great interest in exploring the interconnectedness of social institutions and systems with the natural environment. My goal in my work is to help explore current systemic limitations, and mitigate them through environmentally focused policy recommendations and reform. My research areas have primarily been in fisheries and contentions around maintaining wild stock while uplifting local fisheries. For the creation of this report, I felt it important to acknowledge my background is not in ecology or biology, which is why we felt it necessary to integrate expert opinions in our work. While I am a Canadian citizen, I am not native to British Columbia, and therefore felt the use of literature in combination with my

own observations were key to building credible and well informed recommendations to UBC. While it is important to note the context of this paper is conservation, many techniques, publications and thoughts on pollinators and agriculture are from western knowledge systems. Future research in this field beyond the scope of my school project should hold a greater emphasis on speaking to Indigenous communities in Vancouver, to better represent their desires and values while simultaneously challenging any colonial biases current research/publications possess, and the colonial nature of existing policy systems.

Maicen:

I am currently a Master's of Science student in the Department of Geography. My research looks at the interconnections between accelerated glacier recession, high-mountain landscape change, and the local community impacts and perceptions of this change on social-ecological systems. I greatly value the importance in having a reciprocal relationship with the environment that one lives in and as such I feel that it's important to acknowledge that although I am originally from the United States and my background is primarily in physics and engineering, I believe in understanding and improving the resiliency of this relationship through making meaningful policy recommendations to UBC. Due to the limited nature of my background and experience, we found it important to rely on the opinions of experts who have greater experience and exposure in this field as well as this region. Although we weren't able to collaborate with local Indigenous communities, it is crucial to acknowledge that this project took place on traditional, ancestral, and unceded xʷməθkʷəy̓əm (Musqueam) territory. Additionally, I would like to acknowledge that if we had more time to provide to this project, we would emphasize such collaboration and inclusion.

**Methods**

Main components of this paper consult literature from biology, agricultural and local environmental management research (Ollerton, 2017). We used diverse interdisciplinary sources and policy programs to discuss native pollinators role in society to build credibility (Marshall & Rossman, 2015) for their importance across all fields of science. This information has been synthesized to give a detailed description of the role of pollinators rooted in policy. Similarly, literature reviews have been used to explore processes

and relationships of pollinators and their need for conservation in studies such as Winfree et al's paper "Native Pollinators in Anthropogenic Habitats" (2011) and Kearns et al "Endangered Mutualisms: The Conservation of Plant-Pollinator Interactions" (1998).

Our positionality statement acknowledges that as primary researchers, we are not native to British Columbia and our main field of research is not ecological pollinator research. This project was conducted in a singular masters semester, and due to the scope and timelines of the project we conducted 4 hours of observation around campus. Pollinator subjects cannot be observed at this time of year to perform a biological ethnography (Kirskey, 2010), and a limitation of our report was voluntary participation from buildings and ground keepers at UBC. Our vignette (pg. 12) helps to display and assert themes found in our qualitative interviews. Observational research in our vignette aids to provide a visual context (Barter, 1999) to those who read our report, and acknowledges evidence of existing infrastructure we found/failed to find around UBC campus to sustain native pollinators. This helps provide a multi-method approach to enhance findings in other sections of our report (Barter, 1999). Fieldnotes from our observations and qualitative interviews can be found in appendix (Barter, 1999).

To help ground our policy review and recommendations, we conducted 3 semi-structured (Tracy, 2019) interviews to help build our knowledge from experts. These experts have spent time working in the field with pollinators and researching them in labs and academic settings. Participants of our interviews have worked and studied across Canada and North America, and are therefore familiar with pollinators role in a larger biodiversity context. They also have worked specifically towards pollinator management, biological exploration and conservation. Participants have worked with --- and implemented pollinator programs and agricultural practices targeted at increasing native pollinators presence, and conserving existing populations (Potts et al, 2010). Appendix C features our interview question guide for all conducted interviews.

Data from our qualitative interviews was coded using a deductive approach. Coding of our transcripts is visible in appendix D. We emphasized 4 general themes when reading our transcripts (Saldana,

2014): biodiversity, UBC locations, concerns/constraints, and programs/policy. These themes go beyond coding words, allowing us to capture entire stories and lived experiences shred in semi structured interviews by experts in the field. Under QDA coding methods, thematic coding better *asserts* policy recommendations (Saldana, 2014). Recurrent themes from these interviews were then further explored within the transcripts to define more specific areas used to support recommendations to UBC (Saldana, 2014).

Using identified themes and from existing programs, we conducted a policy review framework analysis (Dixon-Woods, 2014) of existing pollinator policy and current programs at UBC. Our framework analysis explores concepts, language, and frameworks that exist in other institutions across North America. This allowed us to triangulate (Saldana, 2014) data from similarly scaled institutions into our recommendations for UBC biodiversity policy. Expert analysis for policy recommendations is used at both the institutional and government levels of policy creation (Byrne & Fitpatrick, 2009) (Watzold & Schwerdtner, 2005), identifying key limitations and success or pre-existing policy.

### Limitations

Due to a short timeline to conduct interviews for our report, the sample size for semi structured interviews is limited in participation (Young & Casey, 2018). Therefore, we opted to integrate additional methods such as literature reviews, framework analysis, concept maps, and observational work/vignettes into our report to contribute to the reliability of our work and the associated recommendations. We also encountered a limitation in finding data surrounding the current health of native pollinator species (and in comparison to honey bees), in both the Vancouver area and specifically at UBC campus. Participants mention within this report that baseline data of population health as well as consistent monitoring has been limited, and academic literature has been found to support this statement. (Potts et al, 2010). However due the the scope of this report, we can only state that using UBC's library search engine to the best of our abilities – we could not find any relevant data but that this does not mean none exists.

## INTRODUCTION

### Role of Native Pollinators

Pollinators play a key role in global biodiversity, acting as what research participants describe as a 'keystone species'. This is due to their large contributions to plant reproduction, making them integral to both plant and species functions and food systems. The process of pollination refers to a species ability to transfer pollen from one plant to another to allow for reproduction, a term formally known as zoophily (Ollerton, 2017). It is currently estimated that pollinators are relied on by 87.5% of *angiosperms* (flowering plants) for their pollination and reproduction (Ollerton, 2017). This activity holds both ecological and agricultural significance, making this one of the most important interactions that occurs in terrestrial ecosystems (Ollerton, 2017). Humans currently depend on pollination for our food sources. By better understanding the role of pollinators and food systems, we have globally increased yields in over 75% of crop types by aligning our agricultural practices to match pollinators foraging behaviours (Daily & Sharp, 2015). Currently, 75% of global crops are reliant (either fully or partially) on pollinators, with 35% of our annual global food production being fully dependent on pollinators for food production (CBD, 2021).

While most pollinator species are insects, there are also mammal and bird pollinator species (Ollerton, 2017). The diversity of pollinator species is dependent on the geographic regions, but the *functional* (tasks they perform for an ecosystem) and *response* (how they withstand change in their environment) diversity is what makes each species necessary and unique. Bees are seen as the most important taxa of pollinators, as they have the most frequent visitation rate to flower compared to all other pollinator species (Winfree et al, 2011). Their visitation rate is so high because bees are *florivores*, meaning they feed on floral outputs such as pollen and nectar in their adult and larval stages of life (Winfree et al, 2011). Flies are the second most common visitor to flowers for pollination purposes, and are acclimated to high latitude regions (Winfree et al, 2011). Butterflies, moths, birds and bats follow flies as the next important taxonomic groups of pollinators. Finally, beetles are recognized as pollinators, serving as an 'accidental' pollinator due to their scavenger-like behaviour when collecting food (Winfree et al, 2011).

Globally, there is data that wild/native pollinators are in decline (Potts et al, 2010). Threats to native pollinators include climate change, agro intensification, habitat fragmentation, disease, invasive species

predators, and heavy pesticides and neonicotinoids use (Potts et al, 2010). This has been documented as a growing list of threatened pollinator species, declines in overall number of pollinators, and a loss of floral species in areas where pollinator richness is found to be declining (Potts et al, 2010). What has made tracking this decline so difficult is a lack of baseline monitoring for most wild pollinator species. Having no previous data has made understanding the severity and scale of wild pollinator decline increasingly hard to communicate to both the public and policymakers (Potts et al, 2010).

British Columbia specifically is home to approximately 482 pollinator species (Guzman et al, 2022). Specific monitoring programs show a difference in overall biodiversity levels across BC, which is dependent on the presence of agriculture, land topography and urban land use/development. More specific literature on regional pollinator differences and annual populations/health is harder to come by. There are currently not many published or accessible monitoring programs done throughout metro Vancouver, or the UBC campus.

## DISCUSSION

### Biodiversity

In our discussion with interview participants, all agreed that the standard scientific definition of biodiversity is sufficient to use when defining the term in policy. That definition of biodiversity is a Participant B stated "*understanding the interactions and processes of different groups and species"*. In relation to pollinators specifically, all participants acknowledged native species of pollinators to be critical to the maintenance of healthy ecosystem function, and that the variety of species promotes both response and functional diversity. When creating policy for pollinators, it is important to recognize that bees are critical, but flies, moths, butterflies and birds also perform pollination functions and need to be included and protected in biodiversity policy. This was also important in that participant A referred to honey bees as "monoculture farming in the world of pollinators". While honey bees (non-native pollinators) are efficient at pollination, they are limited to hybrid bred variations of the *apis mellifera* species. This reduces their

resiliency compared to that of native species, as hybrid apis mellifera are versions of a singular species. This reduces their genetic difference (species diversity) while also lowering the response diversity.

Biodiversity of native pollinators was also stressed by participant A and B as a keystone species. They both commented that the conservation of native pollinators in the broader context of all ecological systems was critical, and that may also play an important role in social issues too, such as building opportunities for meaningful Indigenous collaboration and reconciliation.

**Land Use**

The UBC campus is over 400 hectares on the west side of Vancouver city. Campus space is what Participant B describes as a 'suburban urban' land use. Meaning we have a significant amount of infrastructure development on UBC property that can hinder success of native species hibernation. Typically, native pollinators need undisturbed soft ground for nesting and winter. Depending on the species, this means leaf litter should be left as cover, and soil should not be highly trafficked, compacted or turned regularly. Creating and conserving spaces of undisturbed soil habitat patches throughout campus was deemed important by both participant A and B as a way to promote nesting and breeding sites. While no participants claimed this was not being done (as it is easy to have small patch of undisturbed soil on a campus this large) there is no intentions set to make this a priority. The intention to create and maintain these spaces are why all participants flagged this as a priority. Participants all identified UBC farm, spirit park, totem, and the botanical gardens as spaces we should be optimizing for native pollinators. In addition, land use disturbances can be mitigated by making use of vertical space. Using trees across campus were suggested options to install bee hotels, which provide additional artificial spaces for bees to nest, rest and breed primarily in the spring.

Management of our land at UBC was brought up in relation to the farm by all participants. While UBC itself is an organic farm, other pesticides can be sprayed throughout the campus for lawn maintenance. Chemicals such as neonicotinoids are main concerns for pollinator health, as they can impact the neurological functions of native bee species. Participant A explained that pesticides are much more

threatening to native species, since we cannot ensure the safe removal of wild populations during spray periods. This is made possible for non-native hives, as bee keepers can fumigate them beforehand, or relocate the bee boxes during spray periods to limit their exposure.

Pollinator gardens were suggested by all participants as a key tool in land use and management to promote species inclusion. If plants on campus are focused towards non-native pollinators (more decorative plant species rather than regionally found species dependent on native pollinators), this will only increase contention. Bumble bees are known to travel much further to collect pollen than honey bees. Using behavioral knowledge like will help to appropriately install pollinator gardens in locations that follow natural patterns and behavior of native species. Participant B outlined that native species need these to be planted in widespread regions across campus, ad they need small patches of food. These can include hedgerows, agroforestry, and smaller gardens.

**Education**

Furthermore, there is a large gap in education that creates an overemphasis on honey-bee conservation rather than wild pollinator populations. Our discussion highlighted that a lack of education on the difference between native versus non-native means wild pollinator species lose out on funding, research opportunities, and are generally not the face of the global movement to "save the bees." There was also the issue presented of the time it takes to create credible findings in pollinator research. Participant B said explained a time they received premature approval for the implementation of hedgerows to protect pollinator species biodiversity – before the study fully proved hedgerows to be useful. Participant A also expressed how literature has been published as early as 2000 stating a need to emphasize native bees over honey bees, yet the most cited work and focus in labs is still around understanding anthropocentric and biological functions of honey bees.

Furthermore, a lack of education around the difference between pollinators species is what participant A labeled as a form of public *greenwashing*. Failure to disseminate key differences of native and non-native pollinators through advertisements and science communication leads many citizens to

believe apiculture is a prime way to save the bees and promote biodiversity. This speaks to greater issues of science and communication through pollinator policy and conservation discussions.

All participants expressed that there is a unique opportunity for research of native pollinators at UBC, specifically with access to a campus farm. The farm allows in house space to study and manipulate agriculture processes to see how they better serve native pollinators. Having a farm, endowment lands, and suburban urban landscape also makes for unique opportunity to cross examine and compare data of native populations across the campus. A potential transformation to a native bee population campus (getting rid of apiculture) was expressed by all participants as an opportunity for students, scholars, and farm volunteers to conduct field work and monitoring programs on native species – which is currently not prevalent. Participant A and B also noted the reputation UBC has for being a very green/innovative university. Being one of the first schools in Canada to prioritize wild pollinator data collection and conservation under policy would be a significant opportunity to promote our cutting edge research and enhance campus business/CSR.

**Disease**

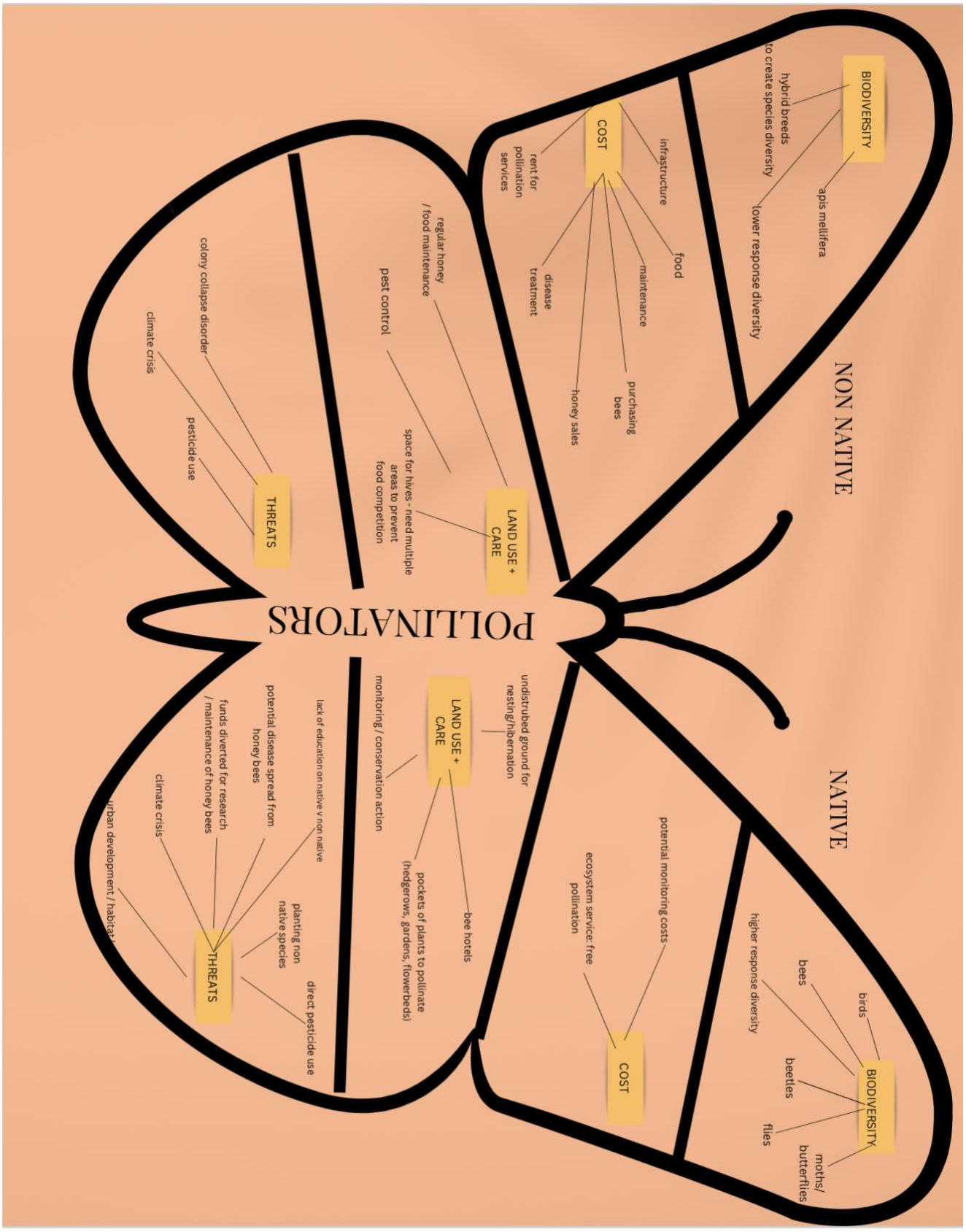
Discussion also brought up concern for spread of disease. Apiculture (non-native bees) are often treated and terminated for the presence of mites, parasites and colony collapse disorder. These can be widespread, and a large presence of honey bees (non-native) may provide opportunities for contamination and disease spread of wild native populations. Overall, the presence of disease and unknown disease is much more prevalent in non-native pollinator species, which raises questions for concern on promoting opportunities for interactions and spread on campus.

**Cost and Sufficiency**

Native species and apiculture have different associated costs. Participant A outlines that apiculture requires the honey-bees to be fed, inspected and treated for disease control, research, handlers to manage hives, honey production and overwintering. Since the bees are not native, there is a cost to purchase every frame or hive UBC installs. They do generate revenue in the form of honey sales and the opportunity to be

rented for other pollination services, but this means you need infrastructure to extract, process and grade it, and transport if being used for off property pollination services.

Participant A outlines that native species do not require human handling, overwintering or pre-made food sources. Their cost is embedded into proper campus maintenance/gardens and space creation, and may need direct funding for more expansion research and monitoring programs. It was noted however that many monitoring programs could be performed by existing on campus labs or as a form of educational field work by students, creating opportunities for this to be done voluntarily, or through lab funding as opposed to campus budgets.


POLLINATORS
NON NATIVE
BIODIVERSITY
hybrid breeds to create species diversity
apis mellifera
lower response diversity
COST
infrastructure
food
maintenance
purchasing bees
honey sales
disease treatment
rent for pollination services
LAND USE + CARE
regular honey / food maintenance
pest control
space for hives - need multiple areas to prevent food competition
THREATS
colony collapse disorder
climate crisis
pesticide use
NATIVE
BIODIVERSITY
birds
bees
beetles
flies
moths/ butterflies
higher response diversity
COST
potential monitoring costs
ecosystem service: free pollination
LAND USE + CARE
undisturbed ground for nesting/hibernation
bee hotels
pockets of plants to pollinate (hedgerows, gardens, flowerbeds)
monitoring / conservation action
THREATS
lack of education on native v non native
potential disease spread from honey bees
funds diverted for research / maintenance of honey bees
climate crisis
planting non native species
direct pesticide use
urban development / habitat

## OBSERVATION

### When The Pollinators Rest: Exploring UBC's Efforts to Raise Awareness of Pollinator Presence

We are bundling up after class, and Maicen and I tell our classmates we are going to take a pollinator walk. With this they all start laughing saying "you're not going to see any bees in this weather!". We knew this, and as the wind hit my face with some small droplets of rain, I was certain, there would be no pollinators in sight. I knew this was hibernation season, but we couldn't help but wonder, what does UBC have installed around campus to celebrate and protect the pollinators come spring? We left our class building in AERL and headed towards what we figured would be a pollinator friendly space, the UBC Rose Gardens. It isn't in its glory right now, but there we went, taking pictures of the remaining spindly roses and pansies that still miraculously stand (though quite limp and tattered). We knew our friends were right, we weren't expecting a pollinator parade through the gardens or in the main square. This as we have learned -- is when most species hibernate underground. But while we looked around, there wasn't a living thing in sight that was not a person! No squirrels rustling, no birds overhead, not a pollinator to boot. But our fear was quickly validated beyond the bee-less winter grey garden. There wasn't a presence of pollinators – at all. Beyond the sign to show you the entrance stairs, there wasn't an educational sign in sight.

Making some notes and trudging forwards in the weather, we decided to explore more of campus. The more our feet grew tired, the more absences for signage we saw. Walking all the way down Marine Drive, there were no bee hotels in trees, we passed several small project gardens – all with no plant species listed, no mention of native pollinators presence. Finally, in turning back to the main square, the overwhelming presence of infrastructure your entire eyeline. While the main square looks devoid of fuzzy pollinator friends, our research connected dots of issues in our management. We saw leaves being raked across the square – to tidy up the place. To us, we saw piles of leaves now unusable for pollinators hibernation spaces. How undisturbed could that be? It was then we decided in this bleak, cold Wednesday, that when the pollinators decide to hibernate through the winter -- their presence on campus is completely untraceable.

# LITERATURE REVIEW

## Current Policy and Research at UBC

In order to meet, and even exceed the recommended Paris Agreement emissions reduction target of 45% by 2030 (United Nations, 2015), the University of British Columbia has begun to implement climate policy such as the Climate Action Plan (CAP) 2030. The ultimate goal of the CAP 2030 is to reduce overall building and energy supply emissions to become a net-zero emissions campus, including external sources such as commuting, business air travel, food, waste and materials, and embodied carbon (*Climate Action Plan 2030*, 2021). However, while only brief, CAP 2030 does propose facets that include biodiversity, adaptation, climate justice, and other elements outside of greenhouse gas emissions reduction. In terms of biodiversity, the CAP 2030 succinctly discusses future plans and adaptation efforts in the "Complimentary Action Areas" section found near the end of the document. In this section, entitled "Adaptation, Resilience and Biodiversity" (*Climate Action Plan 2030*, 2021, pp. 44), UBC acknowledges the impacts that climate change is having and will continue to have on the people, biodiversity, and overall ecosystem within the UBC campus and greater Vancouver area. They then go on to provide actions with varying timelines: immediate (beginning in the fall of 2021), short term (by 2024), and medium term (by 2030). These actions include increasing campus-based and community oriented research around biodiversity, quantifying a baseline of UBC's natural assets to social-ecological and cultural services, and developing a Climate Adaptation, Resiliency, and Biodiversity strategy to be implemented in the upcoming Campus Vision 2050 plan, discussed below. So, while the Climate Action Plan 2030 includes brief ambitions concerning biodiversity, there is no policy regarding pollinators, let alone native pollinators. In comparison, both the IPBES Assessment Report on Pollinators, Pollination, and Food Production and the IPCC Special Report on Food Security (Mbow et al., 2019) give attention to the importance of native pollinators so it is crucial that future UBC policy utilize the distinction and emphasize the importance of native vs. non-native pollinators.

Additionally, in September of 2018 the Board of Governors at UBC approved the Green Building Action Plan (GBAP) (*UBC Green Building Action Plan*, 2018). This action plan was developed for UBC

building development and management. It provides goals, targets, and actions for eight different areas of institutional and residential building development: energy, water, materials and resources, biodiversity, health and wellbeing, quality, climate adaptation, and place and experience (*UBC Green Building Action Plan*, 2018). In terms of biodiversity, the GBAP proposes an institutional and residential target of 100% compliance of UBC Bird Friendly Design Guidelines for Buildings (*UBC Bird Friendly Design Guidelines for Buildings*, 2019) for new institutional (by 2020) and residential (by 2025) buildings. The indicator that will be used for this target is to "Increase opportunities to provide habitat for birds, pollinators, and other species." (*UBC Bird Friendly Design Guidelines for Buildings*, 2019, pp. 55, 77). This action is included within the short-term priority actions and will be done by developing a set of principles that will be used in creating green roofs and natural landscapes that attract pollinators. While this plan actively considers the importance of biodiversity and, more specifically, pollinators, it does not consider nor mention the benefits or consequences of native versus non-native pollinators. As we have now seen, this omission of native vs. non-native pollinator policy is problematic and can lead to an over reliance on managed, non-native pollinators such as honeybees. Participant B touches on this point, "...when you have a diverse and abundant pollinator community then you really don't need to rely on honeybees…getting those healthy and abundant pollinator communities requires going away from the monocultural style of farming because that really doesn't support a diverse or abundant native pollinator community".

The Campus Vision 2050 plan is a currently in-development campus-wide planning process that looks to improve many areas of campus operations and land use over the next 20-30 years. This plan includes seven guiding principles: support UBC's academic mission; strengthen UBC's relationship with Musqueam and campus Indigenous communities; confront the affordability crises; make campus more inclusive, accessible and welcoming; take bold action to address climate change and enhance campus ecology; strengthen connectivity; and ensure the campus lands benefit the UBC community today and for generations to come (University of British Columbia, 2022). As mentioned previously, the Campus Vision 2050 plan will include a "Climate Adaptation and Biodiversity" strategy (*Climate Action Plan 2030*, 2021,

pp. 44) that looks to protect and enrich campus ecology and biodiversity. We hope that our recommendations regarding native pollinators will be incorporated into this strategy.

Outside of policy implementation, the University of British Columbia has supported a handful of research projects surrounding pollinators and biodiversity on campus. A couple of these research projects were sponsored by our partner, the SEEDS Sustainability Program. For example, Alina Kouneva (2016) proposed creating a pollinator garden on campus to increase pollinator habitat. The overall goal of this proposal was to create better habitat for pollinators as well as improve the aesthetic appeal of walking through the garden (Kouneva, 2016). Also, Robertson-Mercer et al. (2017) worked with both the SEEDS Sustainability Program and the City of Vancouver's City Studio to create pollinator homes, small structures designed to safely house a wide variety of native pollinators, that were set up on the roof of the UBC CIRS building as well as at the "Pollinator Pop-Up Park" in Vancouver's Fairview neighborhood (Robertson-Mercer et al., 2017). As a part of our observational aspect, we visited the CIRS roof to see the state of these pollinator homes but unfortunately the roof was inaccessible at this time. However, we did find a great infographic sign by the roof that explained this project and its collaborations (Appendix F). Outside of the SEEDS Sustainability Program, Carillo & Moreau (2019) conducted a pilot study as a part of the BeeHIVE Research Cluster entitled Project BEE Smart. This study sought to monitor and track native bumble bee abundance within campus, the UBC Farm, and the UBC Botanical Garden and to determine which plants and weather conditions affect abundance of native bumblebees across campus, the findings of this study have yet to be presented (Carillo & Moreau, 2019). Additionally, Song (2021) analyzed pollinator habitat on the UBC campus using light detection and ranging (LiDAR). This study found that biodiversity hotpots on campus have an overall area of 2100 m^2, but, although this is determined to be enough to fulfill many pollinators dispersal range, much of this area is highly fragmented. Also, because of their geospatial analysis method, this study did not take into account larger potential biodiversity hotspot patches such as the Botanical Gardens and Farm that likely have a strong pollinator population and diversity (Song, 2021).

**Exploring Institutional Policy Frameworks**

Given the importance of pollinators to global biodiversity, food production, and other ecosystem services, appropriate institutional policy is crucial in sustaining these interconnected systems that are held together by pollinators, and more specifically, native pollinators. Universities, city and state governments, and other institutions in North America have begun to implement policy and programs to preserve, protect, and improve pollinator biodiversity, habitat, and overall health. In this section, we go through a few examples of such pollinator policy and program implementation in order to understand the possible pathways that the University of British Columbia can similarly approach in order to improve native pollinator biodiversity on campus.

Before jumping into regionally (North America) specific programs and institutional policy, it's beneficial to discuss a few important international and global frameworks regarding biodiversity and pollinators. The International Pollinators Initiative (https://www.pollinator.org/international), established by the Convention on Biological Diversity and facilitated by the by the Food and Agriculture Organization of the United Nations (FAO), was created in 2002 and has provided initial policy guidance and development regarding pollinators (Rose et al., 2016). Additionally, the Millenium Ecosystem Assessment (MEA) and the Intergovernmental Science-Policy Platform on Biodiversity Ecosystem Services (IPBES) have additionally been seminal in providing guidance on pollinator policy development and implementation (Gemmil-Herren et al., 2021). The MEA, established between 2001 and 2005, sought to "assess the consequences of ecosystem change for human well-being and the scientific basis for action needed to enhance the conservation and sustainable use of those systems and their contribution to human well-being." (Millenium Ecosystem Assessment, 2005). The MEA was also crucial in bringing the concept 'ecosystem services (ES)' to light as well as understanding the importance of ES for human well-being, including pollination services. Similarly, the IPBES was established in 2012 and its main objective is "to strengthen the science-policy interface for biodiversity and ecosystem services for the conservation and sustainable use of biodiversity, long-term human well-being and sustainable development." (Paulsch, 2019). In 2016, the IPBES published the first thematic assessment entitled "Pollinators, Pollination, and Food Production",

providing vital information to policy makers on the value and status of pollinators, trends and threats to pollinators and pollination, and policy and management response options (IPBES, 2016). As mentioned above, this document specifically highlights native vs. non-native implications such as providing insight on why relying on abundant and diverse native pollinators is more beneficial than an overreliance on a single, managed species. They provide multiple reasons for this: wild pollinators provide "greater cross-pollination, higher efficiency of pollination by complementarity of their foraging behavior, or through positive effects of some pollinators on the pollination function of other pollinators." (IPBES, 2016, p. 39). These initiatives (links can be found in the References section) have the potential to provide excellent insight and guidance for institutions such as UBC to understand the importance of native pollinators with respect to environmental health, food security, and more.

While implementing specific native pollinator policy still isn't commonplace yet, there are a few cities and states across North America that have created protection programs, task forces, and other initiatives to encourage pollinator biodiversity and health. As an example, the City of Toronto has initiated their "Pollinator Protection Strategy" (*Pollinator Protection Strategy*, 2018). This strategy (found here: https://www.toronto.ca/services-payments/water-environment/environmentally-friendly-city-initiatives/reports-plans-policies-research/draft-pollinator-strategy/) includes three guiding principles: to prioritize actions that support and sustain native pollinator biodiversity; to create, enhance, and protect natural habitat in urban areas; and to engage and support the local community in taking appropriate actions in supporting native pollinator species. This strategy also includes six priorities: create and enhance habitat, design and connect green spaces, partner and build relationships, invest and incentivize, educate and train, and celebrate and recognize achievements. Along with educational material, these principles, priorities and actions are broken down in the Toronto Pollinator Protection Strategy report that was created by expert stakeholders, concerned community members, and city officials.

Just across the border, another example of city-implemented policy or programs includes Madison, Wisconsin's "Pollinator Protection Task Force" (*Pollinator Protection Task Force Report*, 2015). As a

response to the White House issued memorandum creating a Pollinator Health Task Force in 2014 (Memorandum, 2014), the City of Madison initiated a task force in which a team of city officials reviewed city policies and practices and recommended actions to take in order to better improve pollinator biodiversity and health. A few of the recommendations made include adopting and implementing pollinator health and habitat policies, exploring alterations to city land management practices to improve pollinator habitat, educating the general public about pollinators and strategies to improve pollinator health and habitat, and creating partnerships at the local, regional, and federal level that assist in improving pollinator health. These recommendations were also made with recommended actions and potential timelines from short (1 year), medium (2-3 years), and long (3+ years). A few notable recommendations made include banning neonicotinoids (multiple North American cities including Seattle, Washington and Portland, Oregon have already implemented this (*Pollinator Protection Task Force Report*, 2015, pp. 6)), planting and managing more native plant species, creating a certification for pollinator-friendly retailers, creating educational opportunities for the general public such as demonstration projects, and more. This task force, along with the City of Toronto's plan, are excellent resources for UBC policymakers to see how other cities are implementing pollinator policy and action plans for possible future directions or even partnering with the City of Vancouver to make succinct policy decisions or action plans regarding native pollinators.

As cities across North America continue to work on appropriate policy implementation to improve native pollinator biodiversity and health, Universities are similarly implementing pollinator policy and programs that are adding to and encouraging city and statewide policy implementation. For example, Emory University in Atlanta, Georgia, implemented a "Pollinator Protection Program" initiative in 2014 and became the first university in the United States to ban the use of neonicotinoid pesticides (*Pollinator Protection Program*, 2014). This program includes six main actions: eliminate neonicotinoid use on campus, purchase plants for campus landscaping that have not been treated with neonicotinoids pesticides, ensure substitutes for neonicotinoids are safe for pollinators, plant pollinator-friendly habitat on campus, and conducts campus outreach and education regarding pollinators. As on-campus neonicotinoid use has

been banned, Emory University also plans to remove invasive species on campus and plant pollinator-attractive species as well as add pollinator habitat along campus water sources to improve water quality and mitigate stormwater runoff. This action conducted by Emory University displays the importance of providing not only more habitat suitable for pollinators but specific native species to encourage native pollinator population. Similarly, the University of California - Berkeley's Food Institute has released an action brief highlighting a few important policy recommendations for pollinators which includes supporting pollinator-friendly pesticides, conserving pollinator habitats, ecosystem services valuation, ensuring participation and empowerment of stakeholders, and support collaborative research and outreach (Rose et al., 2015).

Many of these policy implementations and programs from Universities and city or state governments have also elected to join third-party initiatives in support of biodiversity and more specifically, pollinator health. These initiatives include the Nature Positive Universities (Nature Positive Universities, n.d.) and Bee City/Campus (USA: (Bee City USA, n.d.), Canada: (Bee City Canada, n.d.)). These initiatives are a call-to-action for cities and universities across the country, continent, or even the globe to join and pledge to protect pollinators and to improve sustainability. Nature Positive Universities has already accepted 496 universities and 384 cities across 108 countries worldwide. Universities can join by first assessing the baseline biodiversity impacts (i.e. recording biodiversity present on campus or even quantifying biodiversity impacts of all activities); setting specific targets for biodiversity based on a measurable timeline; carry out such actions using the 4R's (Refrain, Reduce, Restore, and Renew); and then report progress. These initiatives will allow universities to make meaningful goals towards preserving biodiversity on campus, including native pollinators. While UBC already has an established network within the Nature Positive Universities Initiative, they have to move forward and officially make the pledge.

**Recommendations for Policy-Makers at UBC**

Through our mixed-methods approach of literature and policy review, personal observations, and semi-structured expert interviews we have identified four main areas that we are recommending UBC

implement into future biodiversity policy. These four main areas are as follows: Improve native habitat, greater educational and community outreach initiatives, increased monitoring and management, and de-emphasizing honeybees at the UBC Farm. While these four areas are our main points of emphasis, we would also like to briefly include the recommendation of continuing the acquisition of expert opinion and following up with the success of the initiatives discussed above in order to provide UBC policymakers with the most up-to-date information on successful policy, programs, and research. Additionally, as previously mentioned, we strongly believe in creating a reciprocal relationship and collaborating with the local Indigenous community and would like to recommend that this be a priority for future pollinator initiatives and policy implementation at UBC.

**Improve Native Habitat**

In order to improve the presence of native pollinators on the UBC campus, it is crucial that there be enough and appropriate (native plant species) habitat to host native pollinators. All of our expert participants mentioned this as a pivotal aspect to improving native pollinator health and presence within campus. For example, participant C said, “I am in support of more use of compost and native blooms to enrich bumblebee habitat on campus.” Additionally, many other institutional frameworks regarding native pollinators include improving native habitat such as the Pollinator Protection Strategy in the City of Toronto (*Pollinator Protection Strategy*, 2018) or the Pollinator Protection Task Force in Madison, Wisconsin in the United States (*Pollinator Protection Task Force Report*, 2015). Our recommendation to improve native habitat includes a planting more native flowering plant species, installing more Pollinator Homes throughout campus since much of the green space is fragmented (Song, 2021), and preserving and protecting nesting habitat for ground nesting pollinators (i.e. Mining Bees such as *Andrenidae*, *Halictidae*, *Colletidae*, all of which are commonly found in B.C. (Campbell, Udal, & van Reeuwyk, 2017)), which was pointed out by participant B. The first step in improving the native pollinator presence at UBC is to improve the habitability of this space.

**Greater Educational and Community Outreach Initiatives**

Our second recommendation is to increase educational and community outreach initiatives. In order to create meaningful policy, there must be community support and understanding of how such policy will improve ecosystem services and biodiversity at UBC. Participant A particularly noted how important educating people about the importance of native pollinators is, "...I believe in stewardship, and I think that like we should be educating people about how they're a piece of the environment…". Similarly, many other institutional policy regarding pollinators speaks to the need for community education and outreach (*Pollinator Protection Strategy*, 2018; *Pollinator Protection Task Force Report*, 2015). So, our recommendation to improve education and community outreach includes working with the UBC Farm and Botanical Gardens as an educational tool to provide community workshops and including diverse knowledge systems with specific emphasis on collaboration with the local indigenous community (i.e. through the xʷc̓ic̓əsəm garden or Indigenous Health Research and Education Garden on the UBC farm). Additionally, as UBC already has an established network with the Nature Positive Universities initiative, as a part of this recommendation we are suggesting that UBC commit to making the pledge and officially joining the Nature Positive Universities.

**Increased Monitoring and Management**

To ensure that the native pollinator population on the UBC campus is healthy and can continue to thrive, we need to improve monitoring and management services. Multiple participants (participant A and B) emphasized the importance of monitoring and entrenching it within policy as well as educational and community outreach. In particular, participant B mentioned the importance of monitoring biodiversity on campus and its application within the Nature Positive Universities initiative. Additionally, many of the institutional frameworks that we reviewed included a monitoring aspect. For example, as a part of the Partner and Build relationships priority for the City of Toronto's Pollinator Protection Strategy, there is emphasis on supporting monitoring programs to measure and track the success of this program (*Pollinator Protection Strategy*, 2018). UBC, in the Climate Action Plan 2030, has already laid out future actions of quantifying the campus biodiversity baseline which is the first step for monitoring (*Climate Action Plan*

*2030*, 2021, pp. 45). So, our recommendation for monitoring and management includes creating a landscape framework for monitoring, preserving nesting habitat, and transitioning to a pesticide-free campus.

**De-Emphasize Honeybees at UBC Farm**

De-emphasizing and ultimately transitioning away from the use of honey bees and apiculture is a final recommendation for UBC biodiversity policy. This commitment could be made after implementing the above listed recommendations, when monitoring programs of native pollinators and land management is in place to foster and maintain strong populations. This was a recommendation suggested by participant A and B, and was stated could most likely be done in a 3-4 year timeline. This recommendation is consistent to Nature Positive goals of preserving biodiversity, and is aligned with Toronto's Pollinator Protection Strategy (*Pollinator Protection Strategy*, 2018) to prioritize native pollinator's success and conservation. This would likely make it possible to reinvest funding and resources used to maintain honey bee colonies into native pollinator monitoring and land use management. Implementing the aforementioned recommendations would make this transition more seamless, and would promote native pollination at UBC's organic farm, which could be a form of CSR for the university and build a stronger food resiliency and culturally appropriate farming practices (). Agriculture focused universities such as the university of Guelph still heavily rely on and promote the use of honey bees (UOG, 2022), so this recommendation is also a chance to be leaders in native pollinator prioritization, while reducing costs, disease and sufficiency externalities associated with apiculture. This is also very consistent with the recommendation to improve education opportunities. Entrenching a native pollinator transition could be promoted and shared with similar institutions, and with the city of Vancouver to help raise awareness between native and non native pollinators – helping to mitigate the greenwashing associated with apiculture that was expressed in expert interviews .

## CONCLUSION

Pollinators are incredibly important for environmental health, plant reproduction, food security, and many other ecosystem services. However, humans have officially placed their fingerprint on the surface

of the Earth through intense greenhouse gas emissions, mass deforestation, mining, and more. Global biodiversity is under serious threat from climate change and pollinators are no exception. It is now more important than ever to protect, preserve, and encourage biodiversity not only in protected areas but also institutional lands such as university campuses like the University of British Columbia. In order to appropriately protect pollinators, and specifically native pollinators, we must begin to create meaningful and extensive policy that encourages community engagement and reconciliation, is inclusive of diverse knowledge systems, and seeks to make true change. Through a mixed-methods approach of literature and policy review, semi-structured expert interviews, and observations we are recommending that UBC implements policy regarding native pollinators in these four areas: improve native habitat, greater educational and outreach initiatives, improve monitoring and management services, and de-emphasizing honeybees at the UBC farm. We are hopeful that these recommendations will be implemented into future biodiversity policy and that UBC pledges to join the Nature Positive Universities initiative. The time to act is now.

# References

Barter, C., Renold, E., (1999). The Use of Vignettes in Qualitative Research. Sociology at Surrey. https://sru.soc.surrey.ac.uk/SRU25.html

Bee City Canada. (n.d.) Bee City Canada. Retrieved December 9, 2022 from https://beecitycanada.org/

Bee City USA. (n.d.). Bee City USA. Retrieved December 9, 2022 from https://beecityusa.org/

BREB. (2022). Guidance Notes on Behavioural Application. University of British Columbia. https://ethics.research.ubc.ca/sites/ore.ubc.ca/files/documents/BREB_Guidance.pdf

Byrne, A., Fitzpatrick, U. (2009). Bee conservation policy at the global, regional and national levels. Apidologie 40. DOI: 10.1051/apido/2009017

Byrne, A., Fitzpatrick, Ú. (2009). Bee conservation policy at the global, regional and national levels. *Apidologie* **40**, 194–210. https://doi.org/10.1051/apido/2009017

Campbell, Udal, & van Reeuwdyk. (2017). *Common Pollinators of British Columbia: A Visual Identification Guide* (2nd Edition). Border Free Bees and the Environmental Youth Alliance. https://eya.ca/wp-content/uploads/2017/07/Common-Pollinators-of-BC-v.3.pdf

Carrillo, J., & Moreau, T. (2019). Project BEE Smart | CSFS at UBC Farm. https://ubcfarm.ubc.ca/csfs-research/project-bee-smart/

CBD. (2022) Agricultural Biodiverity. Convention of Biological Diversity. https://www.cbd.int/agro/. city-initiatives/reports-plans-policies-research/draft-pollinator-strategy/

*Climate Action Plan 2030*. (2021). University of British Columbia. https://planning.ubc.ca/sites/default/files/2021-12/UBCV_CAP2030_FINAL.pdf Columbia (UBC) Vancouver Campus", https://doi.org/10.5683/SP2/1AKN18, Scholars Columbia https://sustain.ubc.ca/sites/default/files/seedslibrary/DM3_Pollinators_SALA1_0.pdf

Dixon-Woods, M. (2011). Using framework-based synthesis for conducting reviews of qualitative studies. *BMC Med* **9**, 39 https://doi.org/10.1186/1741-7015-9-39

Döringer, S. (2021). 'The problem-centred expert interview'. Combining qualitative interviewing approaches for investigating implicit expert knowledge, International Journal of Social

Gemmill-Herren, Barbara, Lucas A Garibaldi, Claire Kremen, and Hien T Ngo. "Building Effective Policies to Conserve Pollinators: Translating Knowledge into Policy." *Current Opinion in Insect Science* 46 (August 2021): 64–71. https://doi.org/10.1016/j.cois.2021.02.012.

Guzman LM, Kelly T, Elle E. (2022). A data set for pollinator diversity and their interactions with plants in the Pacific Northwest. Ecology. doi: 10.1002/ecy.3927. Epub ahead of print. PMID: 36415907. *in Agriculture*. https://food.berkeley.edu/wpcontent/

IPBES (2016). The assessment report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services on pollinators, pollination and food production. S.G. Potts, V. L. Imperatriz-Fonseca, and H. T. Ngo (eds). Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany. 552 pages.

Kearns, Carol A., et al. "Endangered Mutualisms: The Conservation of Plant-Pollinator Interactions." *Annual Review of Ecology and Systematics*, vol. 29, 1998, pp. 83–112. *JSTOR*, http://www.jstor.org/stable/221703. Accessed 10 Dec. 2022.

Kirskey, S., Helmreich, S., (2010). THE EMERGENCE OF MULTISPECIES ETHNOGRAPHY. *American Anthropological Association***https://doi.org/10.1111/j.1548-1360.2010.01069.x**

Kouneva, A. (2016). Sustainability Street Pollinator Garden Proposal. University of British Columbia. https://sustain.ubc.ca/sites/default/files/seedslibrary/KOUNEVA%20ALINA%20Sustainability%20Street%20Pollinator%20Garden%20Proposal%20J2517-1_0.pdf

Lowenstein, David M., Kevin C. Matteson, and Emily S. Minor. "Diversity of Wild Bees Supports Pollination Services in an Urbanized Landscape." *Oecologia* 179, no. 3 (2015): 811–21. http://www.jstor.org/stable/43671710.

Mbow, C., C. Rosenzweig, L.G. Barioni, T.G. Benton, M. Herrero, M. Krishnapillai, E. Liwenga, P. Pradhan, M.G. Rivera-Ferre, T. Sapkota, F.N. Tubiello, Y. Xu, 2019: Food Security. In: Climate

Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D.C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. https://doi.org/10.1017/9781009157988.007

Miles, M.B., Huberman, A.M. and Saldana, J. (2014) Qualitative Data Analysis: A Methods Sourcebook. Sage, London.

Millennium Ecosystem Assessment. (2005). *Overview of the Milliennium Ecosystem Assessment.* Millennium Ecosystem Assessment. Retrieved December 9, 2022 from https://www.millenniumassessment.org/en/About.html#

Nature Positive Universities. (n.d.) Nature Positive Universities. Retrieved December 9, 2022 from https://www.naturepositiveuniversities.net/

Ollerton, J. (2017). Pollinator Diversity: Distribution, Ecological Function, and Conservation *Annual Review of Ecology, Evolution, and Systematics* 48:1, 353-376

Paulsch, A. (2019). *IPBES - An Introduction for Stakeholders*. 27. https://ipbes.net/sites/default/files/downloads/2019_ibn_an_introduction_for_stakeholders_-_broschuere-ipbes-en.pdf

*Pollinator Protection Program.* (2014). https://sustainability.emory.edu/programs/pollinator-protectionprogram/

*Pollinator Protection Strategy*. (2018). City of Toronto. https://www.toronto.ca/services-payments/water-environment/environmentallyfriendly-

*Pollinator Protection Task Force Report.* (2015). City of Madison, WI. https://www.cityofmadison.com/sites/default/files/city-of-madison/mayor/documents/Pollinator%20Protection%20Task%20Force%20Report%20Final.pdf

Portal Dataverse, V1

Potts SG, Biesmeijer JC, Kremen C, Neumann P, Schweiger O, Kunin WE. Global pollinator declines: trends, impacts and drivers. Trends Ecol Evol. 2010 Jun;25(6):345-53. doi: 10.1016/j.tree.2010.01.007. Epub 2010 Feb 24. PMID: 20188434.

Potts, SG., Biesmeijer, JC., Kremen. C., Neumann, P., Schweiger, O., Kunin, WE. (2010). Global pollinator declines: trends, impacts and drivers. *Trends Ecol Evol*. 25(6):345-53. doi: 10.1016/j.tree.2010.01.007. Epub 2010 Feb 24. PMID: 20188434.

Robertson-Mercer, A. et al. (2017). *Pollinator Homes on UBC Campus*. University of British

Rose, T., et al. (2015). *Policies to Protect Pollinators: Actions Needed to Avert a Global Crisis*

Rose, T., Kremen, C., Thrupp, A., Gemmill-Herren, B., Graub, B., & Azzu, N. (2016). *Mainstreaming of biodiversity and ecosystems services with a focus on pollination*. Food and Agriculture Organization of the United Nations.

Song, Jia Yi, 2021, "Pollinators Habitat Capability Analysis of the University of British

The White House. (2014). *Presidential Memorandum -- Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators.* The White House: President Barack Obama. Retrieved October 7, 2022 from https://obamawhitehouse.archives.gov/the-press-office/2014/06/20/presidential-memorandum-creating-federal-strategy-promote-health-honey-b

Tracy, Sarah. Qualitative Research Methods. 2nd ed. (2019) Wiley Press.

*UBC Bird Friendly Design Guidelines for Buildings.* (2019). University of British Columbia. https://planning.ubc.ca/sites/default/files/2019-11/GUIDELINES_UBC_Green_Building_Action_BirdFriendlyDesign.pdf

*UBC Green Building Action Plan.* (2018). University of British Columbia. https://planning.ubc.ca/sites/default/files/2019-11/PLAN_UBC_Green_Building_Action_Plan_Full.pdf

United Nations (2015). *The Paris Agreement*. United Nations. https://www.un.org/en/climatechange/paris-agreement

University of British Columbia. (2022). UBC Campus Vision 2050. Retrieved December 9, 2022 from https://campusvision2050.ubc.ca/ uploads/2015/07/FINAL_PollinatorBrief.pdf.

Watzold, F., Schwerdtner, K. (2005). Why be wasteful when preserving a valuable resource? A review article on the cost-effectiveness of European biodiversity conservation policy

Wiles, R. (2013). Informed consent. In *What are Qualitative Research Ethics?* (The 'What is?' Research Methods Series, pp. 25–40). London: Bloomsbury Academic. http://dx.doi.org/10.5040/9781849666558.ch-003

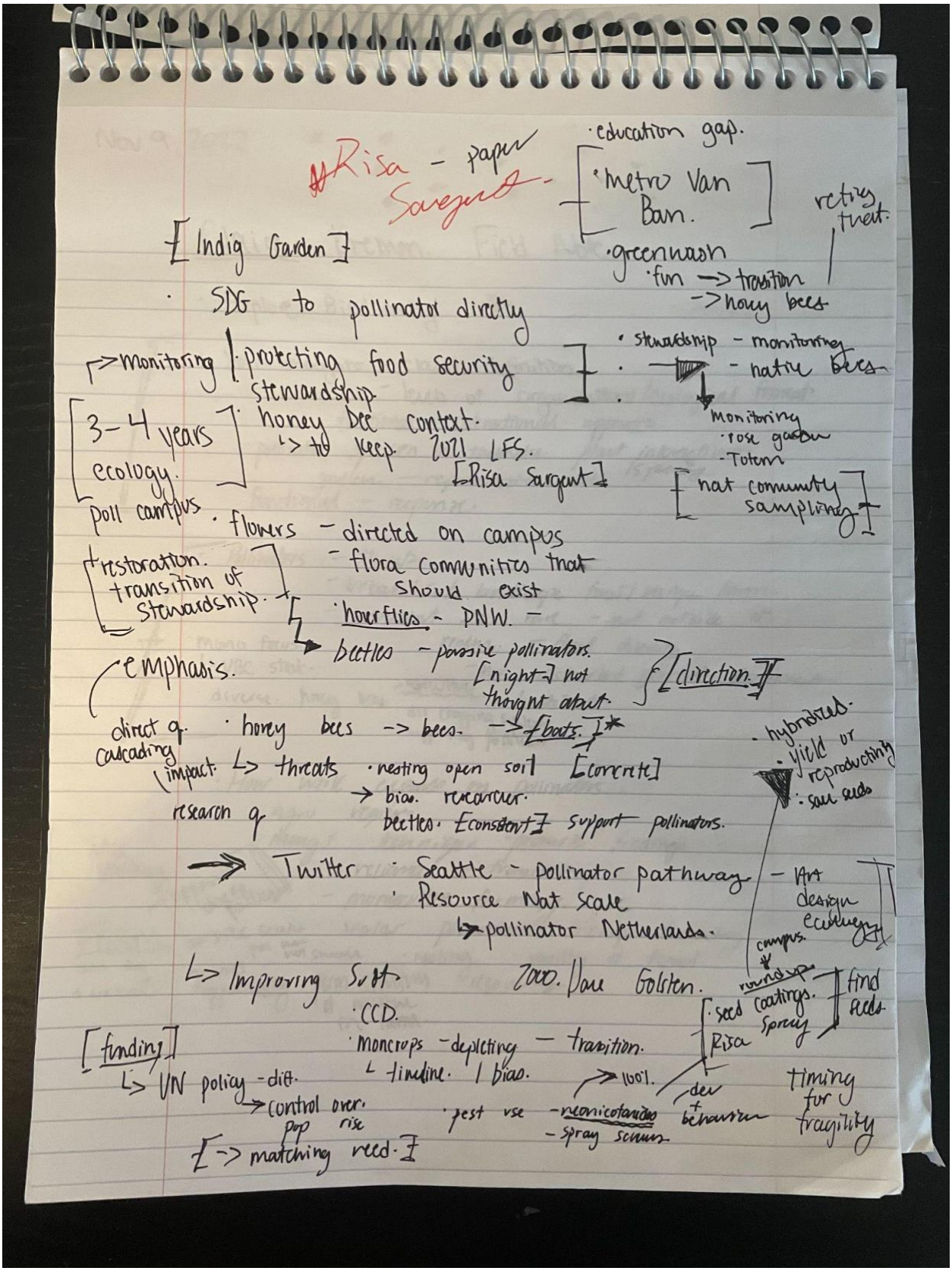
Wilson, S. (2008.) *Lake Simcoe Basin's Natural Capital: The Value of the Watershed's Ecosystem Services. David Sazuki Foundation & Partners. Retrieved From:* https://davidsuzuki.org/ *science-learning-centre-article/lake-simcoe-basins-natural-capital-value-watersheds- ecosystem-services/*

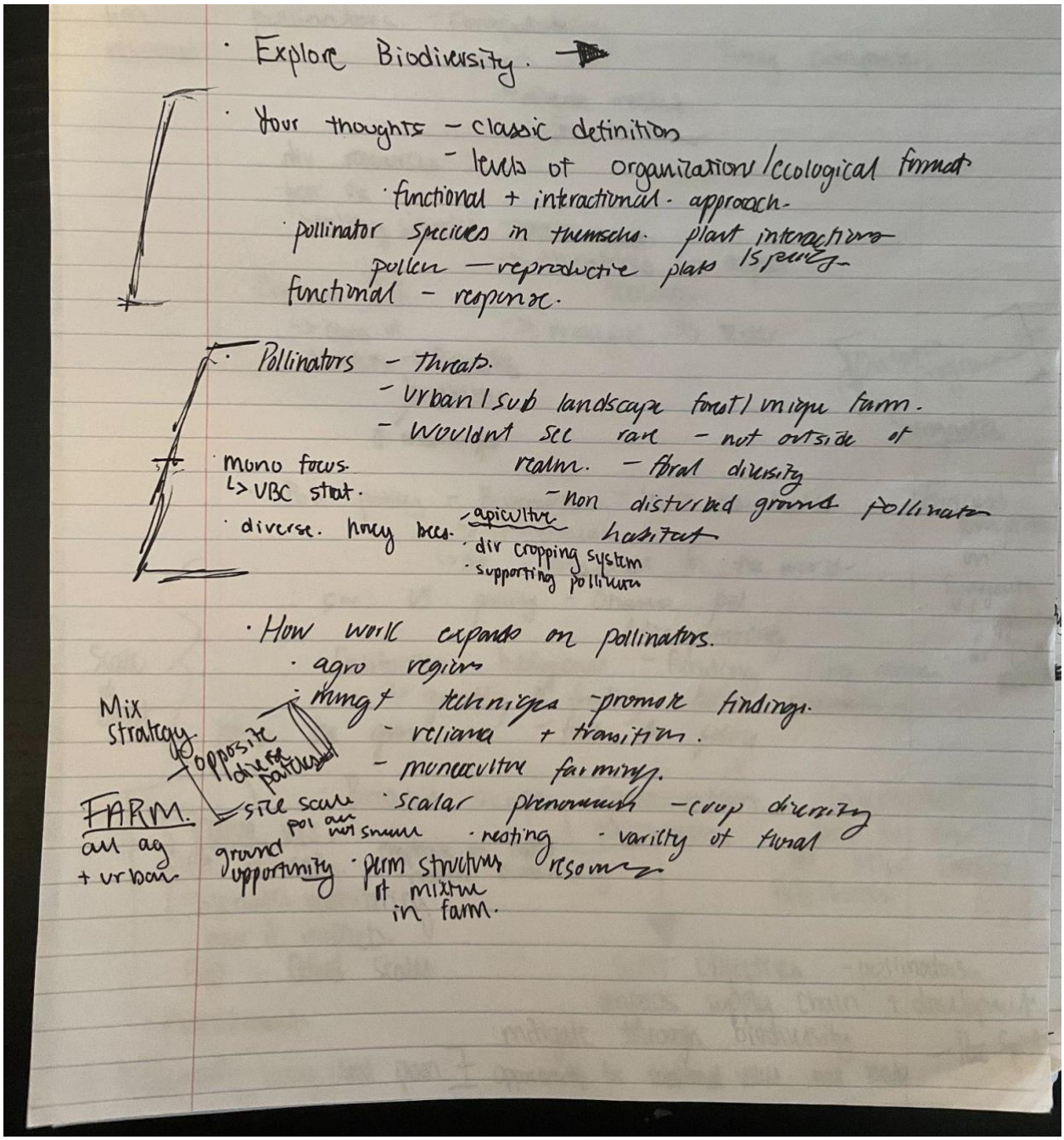
Wilson, V. (2012). Research Methods: Interviews. Evidence Based Library and Information. https://journals.library.ualberta.ca/eblip/index.php/EBLIP/article/view/17196/14053

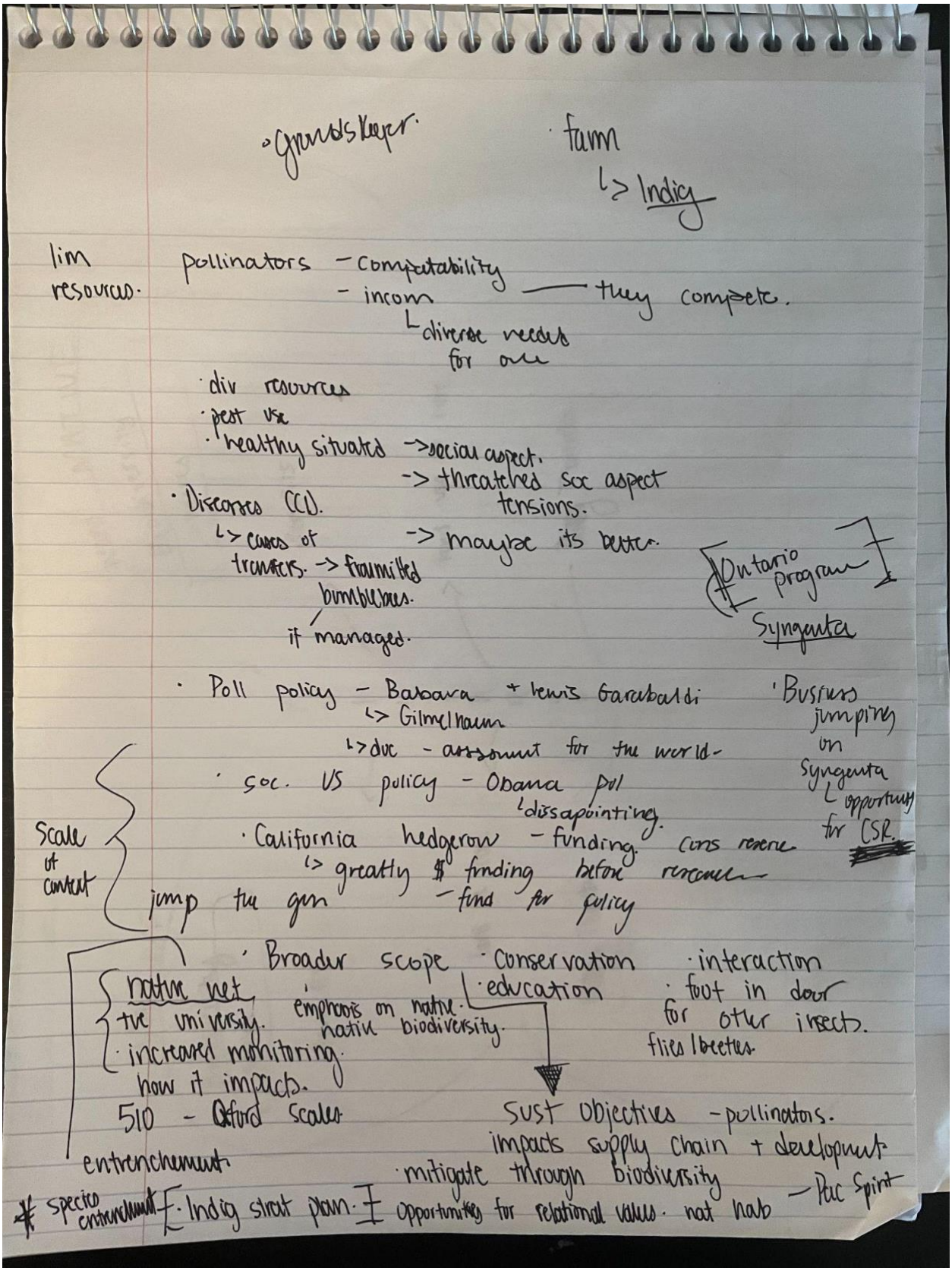
Winfree, R., Bartomeus, I., Cariveau, D., (2011). Native Pollinators in Anthropogenic Habitats. *The Annual Review of Ecology, Evolution, and Systematics.* 10.1146/annurev-ecolsys-102710-145042

Young, D., Casey, E (2018). An Examination of the Sufficiency of Small Qualitative Samples, *Social Work Research*, 43 (1), 53–58 https://doi.org/10.1093/swr/svy026

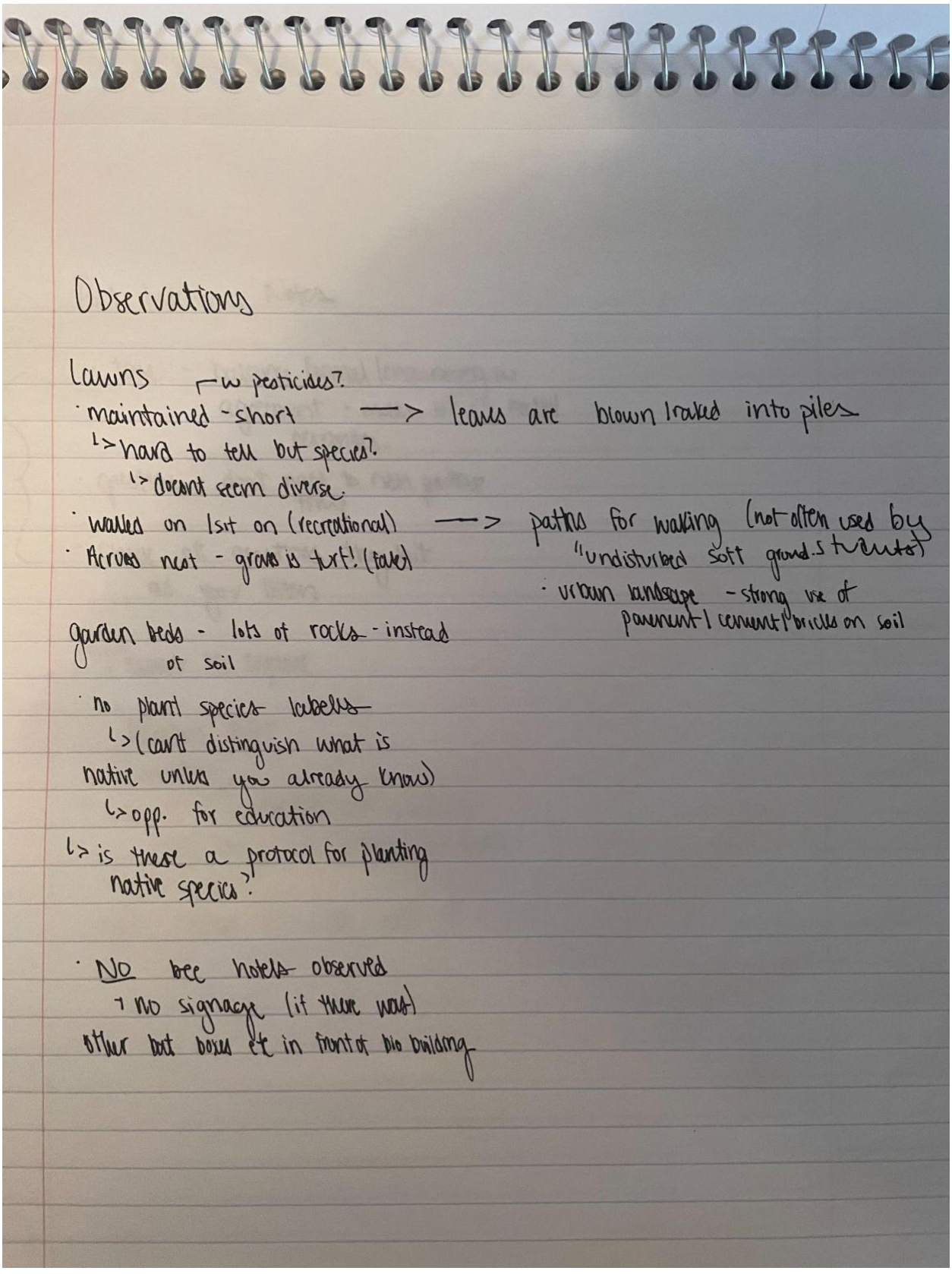
Appendix A: Fieldnotes From Transcripts




· Explore Biodiversity.
· Your thoughts – classic definition
– levels of organization / ecological format
· functional + interactional · approach.
· pollinator species in themselves · plant interactions
pollen – reproductive plant is seeing
functional – response.
· Pollinators – threats.
– urban / sub landscape forest / unique farm.
– wouldn't see rare – not outside of
realm. – floral diversity
– non disturbed ground pollinator
habitat
· mono focus.
└> VBC strat.
· diverse. honey bees. apiculture
· dir cropping system
· supporting pollinators
· How work expands on pollinators.
· agro regions
· things techniques promote findings.
– reliance + transition.
– monoculture farming.
Mix strategy
opposite directions
FARM.
all ag + urban
site scale
· scalar phenomenon – crop diversity
· nesting · variety of floral resources
ground opportunity · perm structures
& mixture in farm.


·Grantskeeper
·farm
↳> Indig
lim resources.
pollinators - Compatability
- incom
↳ diverse needs for one
——— they compete.
· div resources
· pest use
· healthy situated -> social aspect.
-> threatened soc aspect tensions.
· Discusses CCD.
↳> causes of transfers. -> transmitted bumblebees.
if managed.
-> maybe its better.
Ontario program
Syngenta
· Poll policy - Barbara + lewis Garabaldi
↳> Gilmelhaum
↳> doc - account for the world-
· soc. US policy - Obama pol
↳ dissapointing.
· California hedgerow - funding.
↳> greatly $ finding before research
- find for policy
cons reserve
· Business jumping on Syngenta
↳ opportunity for CSR.
Scale of context
jump the gun
· Broader scope
native vet
the university.
· increased monitoring.
how it impacts.
510 - Oxford scales
entrenchment.
emphasis on native.
native biodiversity.
· conservation
· education
· interaction
· foot in door for other insects.
flies / beetles.
Sust objectives - pollinators.
impacts supply chain + development
· mitigate through biodiversity
opportunities for relational values. not hab - Rec Spirit
species entrenchment
· Indig strat plan.

Appendix B: Fieldnotes From Campus Observations



Observations

Lawns ⌐w pesticides?
- maintained - short ——> leaves are blown/raked into piles
  - ↳ hard to tell but species?
    - ↳ doesn't seem diverse.
- walked on/sit on (recreational) ——> paths for walking (not often used by "undisturbed soft ground-structure)
- Across neat - grass is turf! (take)
- urban landscape - strong use of pavement/cement/bricks on soil

garden beds - lots of rocks - instead of soil

- no plant species labels
  - ↳ (can't distinguish what is native unless you already know)
    - ↳ opp. for education
- ↳ is there a protocol for planting native species?

- No bee hotels observed
  - ↳ no signage (if there was) other bat boxes etc in front of bio building

Appendix C: Coded Interview Transcripts* (May reach out to authors to request.)

Appendix E: Interview Guide Used

Introductory Points to Cover Ourselves Before we ask Questions:

- Our names / class # / supervisor / SEEDS partner name (Leila and SEEDS)
- The signed consent form - re go over that they can choose to not participate at any times
- Give verbal signal that we will begin recording
- Scope of our two main questions - making recommendations for policy on UBC campus relating to native pollinator biodiversity. (explain that we will also be conducting a literature review of other North American institutions, so that if they have knowledge of policy/programs in your scope of knowledge, please feel free to share them!)

INTRODUCTORY QUESTIONS (Objective: get to know participant, experience, and how they frame and view native pollinator species)

1. Can you introduce yourself for the recording purpose, including your name and any current position or title you may hold?
2. A) What is your experience with pollinators – in any scope?
   B) What about pollinator species native to UBC/Vancouver [if they have any expertise/knowledge]? This may include research, current projects, policy, programs, in your personal life, job, etc.
      - Follow up [if they do not specify dates/locations] Does any of this work occur on our UBC campus right now (or previously)? What years were you active on [xyz] for?
3. How do you view and define the term biodiversity – what is important to you?
      - How does your definition of biodiversity relate to pollinators? What about for native pollinators at the UBC level?
4. A) What do you identify to be threats to [native] pollinator biodiversity?
   B) Do the threats you identify match any threats that you feel or see occur on campus to pollinators?
   C) And to clarify – are these threats to all pollinators on campus, or are specifically native (zooming in to B/C for claire and other research experts w distinct pollinator knowledge)
      - Follow up [to gauge proximity/relation to efforts and areas of concern on campus] do you see those threats occurring on UBC's campus? Also, focus in on native pollinators if they have experience/knowledge?

TO ANSWER RQ 1i)

5. Are there areas of content/success regarding (and benefitting) native pollinators biodiversity on campus that you know of? (this can include, programs, research, policy, activism/discussion, etc.)
    - For landscaping: are there certain areas on campus that you've noticed an abundance of pollinators? Are there any landscaping projects that you've seen affect pollinators?
6. In relation to anything you have just mentioned [refer specifically in each interview], do you have any concerns or see any larger barriers/issues on campus that you feel threaten native pollinator biodiversity or the success of what you have just mentioned? [how to re word this to be clear one sentence delivery]

TO ANSWER RQ 1ii)

7. A) There are many facets and viewpoints that are encompassed within the broad term of biodiversity. (*facets of biodiversity - explanation without leading*)
   B) Is there any facet of biodiversity you feel needs to be emphasized and entrenched within policy decisions on the UBC campus?
   C) What about in terms of native pollinator species specifically?
    - Follow up options: So some policy suggestions or findings we have had included things like (XYZ - list policy options specific to person or suggestions they made) How do you feel we could get this done on our campus – if at all?

ANSWER RQ 2)

8. We are also investigating other institutions and current biodiversity policy for native pollinators that may currently exist. Are there any models of existing policy/frameworks that you are aware of that you would recommend UBC implements?
9. Are you aware of any initiatives and can you share with us any knowledge or insights you may have regarding such initiatives or communities that might be insightful for UBC moving forward?
10. Finally, as UBC is looking to entrench biodiversity policy in a broader scope, how do you view the importance of biodiversity (goals and policies) compared to other campus goals.
    A) Do you see these fitting in the broader context of our mission on campus?
    B) Are there any trade-offs you may see with a focus on native pollinator policy?

Questions for Landscapers:

Are there any specific areas on campus that you see an abundance of pollinators?

Are there currently any regulations/standards regarding biodiversity that guide your job?

Have you encountered any issues with landscaping because of pollinators or because of regulations regarding biodiversity/pollinators?

Are there landscape areas on campus that you think could benefit from additional pollinator monitoring, support, or protection?

Questions for Students:

Have you discussed this topic in any of your classes or approached this in a research questions format?

How familiar do you think your peers are with this issue in their fields? Have you heard native pollinators come up in any other research across campus?

Your work is specifically in X. Do you see your work having any implications or help in creating targets or thresholds for UBC campus?

We have spoken a lot about the growing reliance on non-native pollinators such as honey bees. How do you feel we can motivate a shift in focus to native pollinators over honey bees?

Probing / Follow up Questions: What do you mean by that?
What year/area was that?
What was your involvement in that? Is it fair to say?
Can you please explain further?
Could you please tell us more about that?

Appendix F: Infographic for Pollinator Home Project