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*MASTER'S PROJECT: EXPLORING AND SUPPORTING
SOCIAL AND ECOLOGICAL DIMENSIONS
OF POLLINATOR HABITAT ENHANCEMENT
IN BURLINGTON, VT*

A Master's Project Presented

by

Victoria Hellwig

to

The Faculty of the Graduate College

of

The University of Vermont

In Partial Fulfillment of the Requirements
For the Degree of Master of Science
Specializing in Natural Resources

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Master's Examination Committee:

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Abstract

Urbanization and other manmade impacts threaten critical pollinator species like the bumblebee, whose populations are significantly affected by habitat loss. In response, activists in the City of Burlington are enhancing habitat to increase biodiversity through collaborative partnerships in urban green spaces. In an effort to explore and support pollinator habitat enhancement in Burlington, I examined social interactions involved in a group highly motivated to enhance habitat at Lakeview Cemetery and Champlain Elementary School, with an emphasis on power dynamics and place meanings of these sites. In conjunction with this exploration, I created landscape designs, planted a native habitat garden, and developed curriculum for elementary education. I used a combination of semi-structured interviews and participant observation to gather and analyze data. Common themes that emerged in the data included values related to education, biodiversity, and aesthetics. These values and the power dynamics between local individuals are influencing the expansion of place meanings people attribute to project sites. Based on these results, I make recommendations to activists as they evolve in their collaborative efforts and work to uphold values related to education and environmental stewardship.

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Bumble bees, for being a source of inspiration and joy throughout my project, helping me connect with social and ecological communities in Burlington and beyond.

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Introduction

Pollination is a vital biological process necessary to sustain the lives of most terrestrial species. While some plants depend on abiotic factors for pollen transport (e.g., water or wind), most flowering species are pollinated by insects (Holm, 2014).

Pollinators provide pollination services to over 180,000 plant species, and more than 1,200 crops (The Pollinator Partnership, n.d.). Increasing concern about these services fuels global research, since widespread declines in both wild and domesticated pollinators parallel declines in the plant communities that rely on them for reproduction (Potts et al., 2010).

As our planet evolves through the 21st century, urban areas grow and develop. Burlington, Vermont, USA is no exception; it is the city with the highest urban population in Vermont, falling just short of 43,000 people (U.S. Census Bureau, 2021). In addition to its human communities, the city is home to a variety of flora and fauna, including wild bumblebees and the plants they pollinate. As land uses change and impervious urban environments encroach on natural areas, pollinators like the bumblebee are threatened by habitat loss, among other factors (Richardson et al., 2019).

In response to this documented threat, the Xerces Society for Invertebrate Conservation launched an initiative to bring communities together and sustain pollinator species. The initiative is known as Bee City USA. It recognizes the high value pollinators hold for sustaining life and food systems in cities, towns, counties, and university campuses across the country (Bee City USA, n.d.). Affiliates pledge to: create and enhance habitat using native plants; reduce pesticide use and increase integrated pest

management practices; and provide education and outreach services (Bee City USA, n.d.). Burlington is one of these cities.

In collaboration with community partners, this project supported Burlington's Bee City designation. The City of Burlington Parks, Recreation, and Waterfront Department (BPRW) has taken the lead in making progress to support and enhance habitat in urban green spaces. With the help of local activists, leaders within the city are collaborating to support pollinators and wildlife at a handful of sites, including Lakeview Cemetery and Champlain Elementary School (CES). Given manmade threats to natural areas in urban environments and the presence of motivated local activists, it is relevant to explore values and motivations associated with conservation in Burlington. Identifying values and motivations can help tailor public outreach materials, and garner future support from other residents. This project explored social and ecological dimensions of conservation work in Burlington, focusing on power dynamics within an evolving organization, and place meanings at project sites. In conjunction with this exploration, garden designs were generated, native habitat gardens were planted, and curriculum for elementary education were created. These products contributed to local efforts and enhanced resilient urban habitat for wild bumblebees and people.

Literature Review

Background

As of 2018, over fifty percent of the world's population lived in urban areas (United Nations Department of Economic and Social Affairs, 2018). By 2050, UNDESA expects sixty-eight percent of the world's population to be urban. Alongside agriculture, urbanization has been identified as a significant threat to pollinator species and the

habitats they rely on (Kopec and Burd, 2017). Managing urban land to support pollinators is one way to slow or reverse the negative effects humans have on our planet and embedded ecosystems.

Despite the negative ecological effects of urban sprawl, considerable potential exists to incorporate pollinator habitat in urban and suburban areas. Hall et al. (2016) identify cities as refuges for pollinating insects, finding numerous cities worldwide that show diverse populations of wild bees persisting in greater abundance than in rural landscapes. Urban land uses that have significant potential for supporting pollinators include private or community gardens, parks, green corridors, and other protected natural areas (Higo et al., 2004).

Enhanced habitat for pollinators is not the only benefit of maintaining urban green spaces for their sake. Benefits to human communities include: social interaction and cohesion; crime reduction; aesthetics; regional identity; recreation; and nature education and experience (Rakhshandehroo et al., 2015). In order to identify social dimensions of pollinator conservation, this project explores organizational and individual values at two local sites. A place-based exploration of individual values and perceptions of urban green spaces provides an opportunity to assess benefits and other social elements involved in the conservation and enhancement of pollinator habitat. See the Section on “Case Setting” for more information about site conditions for this study. Social dimensions of each site influenced the enhancement of habitat for a keystone generalist species native to Vermont: the bumblebee.

Bumble Bee Ecology

Bumblebees are typically found in green spaces throughout Europe, North America, and Asia (Goulson, 2010), with declining populations documented on several continents (Richardson et al., 2019). North American populations are primarily declining as result of habitat loss, the spread of disease, and pesticide use (Cameron et al., 2011). Bumblebees can be found in flower-rich open areas, including fields, roadsides, and mountaintops (Heinrich, 1979). They need three components of habitat to survive: plants to forage on, nesting sites, and places to survive the winter (Hatfield et al., 2012). They are generalists who visit a wide range of plants, and are integral parts of the native plant communities they rely on to sustain their colonies each year (Cameron et al., 2011, Goulson, 2010, Hatfield et al., 2012). Other urban green spaces where one can find bumblebees include elementary schools, cemeteries, and the flower-rich gardens designed and maintained by people on site.

Bees are some of the most effective pollinators in our landscapes. They are the only group of insects that actively collect pollen and therefore transfer it between flowers in the process (Buttala & Siegel, 2015). Bumblebees are particularly resilient pollinators for Vermont's climate. However, Richardson et al. (2019) found significant declines in bumblebee species diversity and abundance in Vermont. The loss of bumblebee species is noteworthy because, in addition to being notoriously cute and easily identifiable, they are some of the best pollinators for several reasons. The life expectancy of a bumblebee colony correlates with the length of the growing season in more temperate regions, beginning in early spring and ending in late summer or fall (Heinrich, 1979). They can fly in cooler temperatures and lower light levels than many other bees, especially at

higher elevations and latitudes (Hatfield et al., 2012). Their size allows them to travel farther than many bees, approximately one mile from their nests (Holm, 2014). To the benefit of wildflowers and other crops like tomatoes and peppers, bumblebees can perform a behavior called “buzz pollination,” where the bee dislodges pollen by holding onto the flower with their mouth and vibrating their wings (“Bumble Bee Conservation”). These are just a few of the reasons to enhance habitat for bumblebees.

Given that the honeybee is not native to North America and faces persistent threats from parasitic mites and Colony Collapse Disorder, managing for native wild bees deserves attention and increased conservation efforts (Winfrey et al., 2007). If honeybee populations continue to decline, wild native bees will become even more valuable for delivering pollination services in the future (Roulston and Goodell, 2011). Departments of government like the Natural Resources Conservation Service (USDA NRCS A, n.d.), and non-governmental organizations like The Pollinator Partnership (Pollinator Partnership, n.d.) and Greenpeace (Greenpeace, n.d.), provide information on how to support honeybees as pollinators. While honeybees do perform important pollination services, wild native bees to North America offer a more resilient “biodiversity insurance policy” by virtue of their activity over a variety of climatic and temporal scales (Nicholson et al., 2017). Offering resilient habitat for native bees can be achieved through a few simple practices.

Designing Habitat for Bees by Providing Seasonal Coverage

Providing food through the growing season is an important step to enhancing habitat for pollinators. Along with other pollinating insects, bumblebees visit a progression of flowering plants from early spring until fall (Heinrich, 1976). Queen

bumblebees overwinter and need early spring flowers at emergence (Holm, 2014). Not only are they hungry after their hibernation, but they must also perform all nest construction, foraging, and provisioning until female offspring hatch and mature (Holm, 2014). Availability of early and mid-season blooms is necessary for the development of immature offspring that rely on winged adults to gather and return with food for them (Goulson, 2010). Mid and late season blooms fuel adult workers and drones in the annual colonies created by new queens each spring (Heinrich 1979). After the nest is buzzing with adult bee activity, the queen can then start the process of growing new queen bees. Developing queens in the reproductive brood require more food than the average larvae, so sufficient mid and late season blooms are as important as availability during the spring. Later season blooms provide new queen bees with resources to bulk up before the winter, when they rely on substantial amounts of fat reserves to survive (Goulson, 2010). Floral resources must be available throughout the growing season if healthy populations are to persist in the present and future.

Composing floral resource availability can be challenging, because plant species flower at different times, which can result in inconsistent availability of floral rewards (Ogilvie and Forrest, 2017). Regardless of this challenge, spaces intentionally designed for pollinators must include plant species that flower at different times throughout the growing season. Effective pollinator habitat enhancement will provide an abundance of floral rewards for bees to feed on and people to enjoy.

Pollinator Habitat: Ecology & Aesthetics

While flowers are often considered to be things of beauty, the role of flowers in an ecosystem are an important function as well as a valued aesthetic feature (Buttala &

Seigel, 2015). Planting more flowering plants that bloom spring through fall will feed the bees with important sugars, proteins, and micronutrients to maintain healthy populations throughout the entire growing season. While food is critical for survival, other important habitat features to include are water and year-round shelter. Leaving the leaves and stalks standing in the fall supports species that survive the winter in hollow stems rather than underground (Hardy, 2021). Using native species in plantings to fulfil this role supports a variety of insects and animals along with other important ecological functions (Rainier and West, 2015; Tallamy, 2017). Scaling up practices in larger landscapes like commercial farms include: planting habitat hedgerows; cover-cropping; and restoring and maintaining neighboring wild habitat (Potts et al., 2016). However, these practices can be interpreted as neglectful or uncared for if they do not meet longstanding cultural concepts of perceived care from humans in the landscape (Nassauer, 1995). Perceived “intent” is an important quality of a landscape design because people are more likely to accept and identify a landscape as beautiful if it appears to be cared for (Nassauer, 1995). Conveying intent can take the form of borders and delineated areas (Burns, 2011).

Many people desire to see, live in, and visit beautiful places (Gobster, 2007). Arranging our landscapes to reflect the patterns, textures, and colors of wilder landscapes speaks to a deeper part of our being that is fulfilled in natural settings and moved by the beauty of them (Rainier and West, 2015). Beauty in nature has also been linked to stronger “nature connectedness” and wellbeing in urban environments (Lumber et al., 2017). According to Lumber et al., shape, color, and form please individual human senses and facilitate perception of beauty (2017, Table 18, p. 19). Designing intentional, beautiful urban landscapes for pollinators may also have benefits for the humans that

experience them and provide additional motivation to support habitat enhancement in urban green spaces. Aesthetics have played an important role in habitat enhancement efforts in Burlington.

Place Meanings & Pollinator Habitat

At the intersection of social and ecological relationships to green spaces is the concept of “sense of place,” a complex term that is sometimes identified as a motivation for individual and collective management of natural resources in local environments (Masterson et al., 2019). Ardoin et al. (2019) describe sense of place as being composed of both meaning and attachment. According to Masterson et al. (2017), “place meanings” are descriptive statements about what a place is like, including adjectives, interpretations, or character. In contrast, “place attachment” is a combination of cognitive, symbolic associations, and affective, personal bonds (Ardoin et al., 2019). Meanings have strong, independent predictions of place-based behaviors, and an analysis of them can help build understanding of what is valued about a place that motivates people to preserve it (Masterson et al., 2017). Components can include characteristic, functional, experiential, and interpersonal meanings, often engendering affective attachments (Rajala et al., 2019).

People actively create meaningful places through conversation and interaction with others through production and re-production of meaning (Stokowski, 2002). Kimmerer (2013) describes how some communities share nature to sustain their communities, relying on natural areas for food, fuel, medicine, and spiritual connection. Blean (2018) describes how sociocultural place meanings can be expanded through volunteerism and direct engagement. Through ongoing dialogue shared among others, collective sense of place may emerge and enhance human capacity to adapt and respond

to change by motivating conservation (Rajala et al., 2019). While sense of place and social conduct may also be shaped by persistent institutionalized ideologies (Gerson and Gerson, 1976), societies that are able to engage multiple place meanings may be more resilient, with a diversity of knowledge and options for dealing with change. Sense of place may be a source of innovative pathways for development (Masterson et al., 2017) and suggests the possibility that adding the meanings of pollinator habitat to some places may increase resilience. Activists in Burlington elaborate their meanings of natural places and project sites through collaborative efforts to enhance habitat. It is important to consider the dimensions of power that contribute to these processes of meaning making and evaluate participation in this process.

Power Dynamics in Collaborative Processes

In recent years, collaborative processes have emerged as a promising route for addressing natural resource management in social and ecological systems. Collaborative approaches offer coordination across scales and boundaries. They are also connected to participatory forms of governance that usually include stakeholder engagement and public deliberation (Cooper et al., 2006, Fung, 2006). According to Emerson and Gerlak (2014), basic principles of collaborative governance include (but are not limited to) fair and civil discourse, open and inclusive communication, and representation of diverse interests, informed by the perspective and knowledge of all participants. Among other things, collaboration can provide important time and place specific information that may foster effective resource management (Koontz et al. 2004).

Collaborative processes can support efforts explored in this project. Purdy (2012) offers concepts for considering the power dynamics in the context of these collaborative

processes. This article assesses power dynamics with consideration given to arenas for power (authority, resources, and discursive legitimacy) as they relate to process elements (participants, process design, and content). Collaborative efforts from Purdy (2012) refer to processes that seek to share power in decision making with stakeholders in order to develop shared recommendations for resilient solutions to public problems. Arenas for power and process elements explored in Purdy (2012) were evident in my project. People work together to enhance habitat for pollinators and wildlife in two specific urban green spaces: Lakeview Cemetery and CES.

Case Setting, Opportunity Statement, and Primary Goals

Case Setting

This project focuses on local organizations and activists who support Burlington's Bee City designation. Burlington was recognized as a Bee City affiliate by the City Council in April of 2019 (Burlington City Council, 2019), pledging alongside 144 cities (and counting) to conserve native pollinators (Bee City USA, n.d.). Burlington's City Council Resolution identified the value of local food sovereignty, which benefits from pollinator-friendly activities. This benefit coincides with economic benefits associated with healthier ecosystems, fruit and vegetable crop yields, and pollinator friendly plant materials provided by local growers.

A local group of dedicated individuals is actively working to support this designation. The work began in the Spring of 2020, when motivated Vermont Master Naturalist students met as a part of their program to organize efforts in support of the Bee City designation. To contribute to this work, I was a participant in meetings beginning in the Spring of 2020. Over the course of one year, what was once "the Bee City

Committee” evolved into a larger group with broader goals related to biodiversity conservation and “rewilding Burlington.” As of this writing, the group is composed of ten people identified as “Grow Wild.” In this project document, I refer more generically to this group as the “Working Group.”

The Working Group started meeting in the Fall of 2020. They eventually agreed to monthly meetings established in strategic planning sessions. In these sessions, they also identified broad values and goals related to biodiversity conservation, with one element being pollinator habitat enhancement. The current mission of the group is to:

...[promote] biodiversity and climate resilience in Burlington, Vermont by increasing and connecting native plant habitat across public and private lands. [They invite] everyone to be active participants in rewilding [Burlington].

During this project, the group focused on establishing this collective mission, and pursued projects at specific sites with this mission in mind. Two sites receiving attention from the Working Group were supported in the process, Lakeview Cemetery and CES (see Figure 1).

Lakeview Cemetery is located in Burlington’s New North End and is the last active burial site in the city. The property is about 43 acres located on the shores of Lake Champlain, within walking distance of Lone Rock Point. It contains burial sites and trees dating back to the late 1800s. Steep sandy slopes are planted with a mix of native and exotic woody trees and shrubs maintained by BPRW staff. While the cemetery is commonly understood as a place for burial of human remains, it is also a place for people to walk and reflect in a peaceful, beautiful setting.

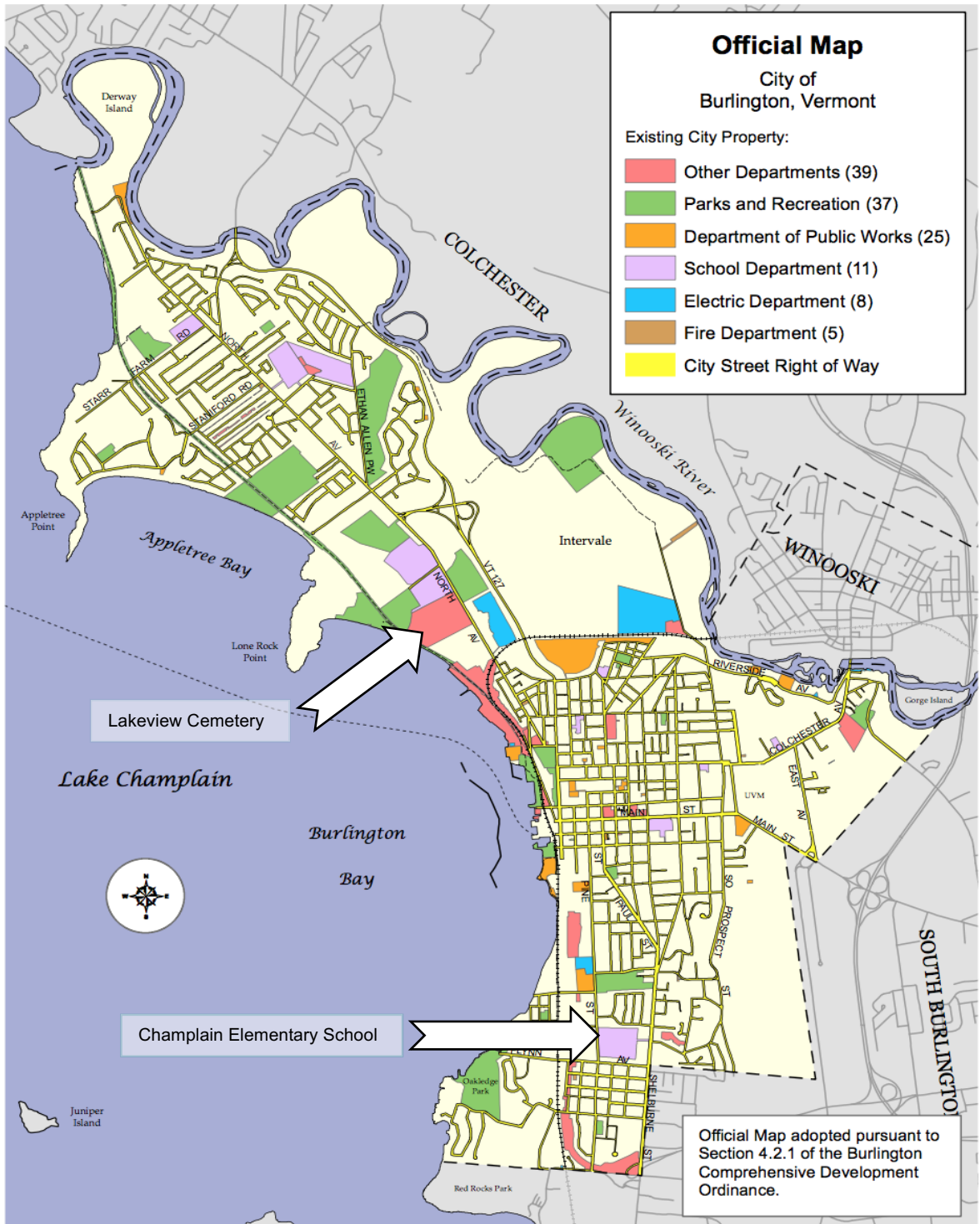


Figure 1. Official Map of the City of Burlington adapted from the city's Comprehensive Development Ordinance (The City of Burlington Office of City Planning, 2021). Lakeview Cemetery is the block east of Lone Rock Point. CES is the block east of Oakledge Park.

Located in Burlington's South End, CES on Pine Street is about three miles south of Lakeview Cemetery, within walking distance of the waterfront at Oakledge Park. The school was originally across the street in what is now the Champlain School Apartment building. It now resides on the lot across the street with coarse-loamy, poorly drained soils alongside Englesby Brook. The site contains a few large trees within a large expanse of mowed fields around the school, with a thick canopy of trees shading southern edge. The teaching gardens are found in the southeast corner of the site behind the Champlain Community Gardens. These are a source of education and joy for the students and educators of CES.

Opportunity Statement

Burlington, VT was designated a Bee City USA Affiliate in 2019. This designation and excitement among the local activist community presents a significant opportunity to support and explore local conservation efforts. This project explored organizational and individual values and motivations, along with meanings people attribute to project sites and power dynamics in collaborative processes. Useful products were also created that reflect the values held and needs identified by local activists involved in this work.

Project Goals

- A. Assess how the Working Group and its members draw on organizational resources to promote habitat enhancement, and approach participation, process design, and content of collaborative efforts

- B. Assess how habitat enhancement is connected to organizational and individual values and motivations
- C. Identify social and ecological meanings individuals attribute to the places they have identified for habitat enhancement
- D. Contribute to local activist work by providing support and products based on these assessments

Methods

This project drew primarily on qualitative, case study methods. A combination of semi-structured interviews, participant observation, and landscape design were used. Data collection focused on ecological dimensions of pollinator habitat, social dimensions of values, motivations, and place meanings of sites, and how important resources are leveraged at the nexus of social and ecological systems. Interviews were analyzed and coded for associations between individuals, organizations, and sites. As a result of this exploration, garden designs and lesson plans for elementary education were produced. This combination of methods provided the basis for recommendations to be shared with project partners, as presented in the “Future Recommendations” section.

Comparative Case Study: Tracing Across Sites, Scales, and Over Time

This comparative case study was guided by Barlett and Vavrus (2017), with porous boundaries, permitting information to flow and boundaries to be defined in an iterative process by social actors and other factors. The authors encourage comparison across three axes: vertical, horizontal, and transversal. In this project, the vertical axis includes different organizations and people at project sites, from volunteer groups to departments in city government. There were a handful of organizations active at different

levels, including the Burlington Parks, Recreation, and Waterfront Department, Vermont Master Naturalist, the Cemetery Commission, and the Working Group. The horizontal axis includes social actors and documents across project sites. The transversal axis compares site development and meanings people attribute to each site over time.

Bartlett and Vavrus emphasize the value of tracing across these boundaries. They also suggest keeping in mind relations of power, paying attention to actors who do not sit physically in the bounds of a traditional case study. Although engaging in a project that is flexible to the flow of information allows for a creative process and outcomes, having boundaries defined in the three axes identified by this framework helped the project focus and “attend to the social relations and networks that constitute the most relevant context” of research (Bartlett and Vavrus, 2017). Using this approach allowed for comparisons that yielded practical results for the social actors interested in Burlington’s Bee City designation and the projects it has generated to conserve natural resources.

Semi-Structured, Qualitative Interviews

To assess connections between local activists and their conservation work, I conducted twelve individual, semi-structured interviews. The purpose of these interviews was to gather data about organizational and individual values and motivations for pollinator and biodiversity conservation, along with place meanings associated with project sites.

In compliance with the institutional review board and with informed consent from voluntary participants, local activists and leaders were interviewed about their perceptions of pollination ecology, motivations for engaging in conservation work, and perceived meanings associated with each site. Interviews were conducted and recorded

using Microsoft Teams and telephone over the course of six months. Interviews were transcribed by Microsoft Teams software, subsequently edited the author. See Appendix A for a guide for semi-structured interviews.

Key participants were selected in the Burlington area associated with the Working Group and one of two project sites. Criteria affecting the selection of participants reflected the organizations affiliated with this work and individuals who are engaged at project sites. Selected individuals possessed significant leverage through their knowledge of plants and pollinators, the ecology of Burlington, project sites, and/or active engagement in the process of habitat enhancement. Organizational and individual perspectives represented in my interview data included:

- ◆ The City of Burlington Parks, Recreation, and Waterfront Department (2)
- ◆ Vermont Master Naturalist (5)
- ◆ Champlain Elementary School (1)
- ◆ Burlington Cemetery Commission (1)
- ◆ The University of Vermont (3)

Individuals who agreed to take part in an interview for this project provided valuable perspectives. However, this sample was limited by the scope of the project. Valuable viewpoints are missing from the individuals connected to Burlington, project sites, and the Working Group, including those of Lakeview Cemetery constituents, CES administration, additional BPRW groundskeepers, New Americans, and Indigenous Peoples of Vermont.

Participant Observation

To assess power dynamics, how the group draws on collective resources, and actively contribute to the group, the author attended Working Group meetings on a regular basis. The author began as an interested graduate student, and later adopted a leadership role facilitating monthly meetings and organizing planting designs and projects. As an active member of the Working Group, observation of monthly meetings was possible. Meeting minutes were recorded and reflections in field notes allowed an analysis of the group's values, motivations, and power dynamics present in their collaborative processes. As members of the Working Group were contacted for potential interviews, a contact information log was recorded. Participation yielded results that will be useful for project partners moving forward.

Landscape Design

To contribute a strong foundation of enhanced seasonal habitat for wild bumblebees, pollinator habitat garden plans were created for Lakeview Cemetery and CES. Project partners associated with habitat enhancement projects at each location were consulted, and site analyses were performed to gather data relevant to the selection and layout of plant species that support bumblebees. Relevant design principles utilized came from "Plant and Soil Science 238" a course at the University of Vermont led by Professor Annie White, PhD. Course lectures and texts influenced my design process. Species growing requirements were documented in Excel spreadsheets and planting plans for the gardens were drafted by hand for each site. One plan was installed at Lakeview Cemetery in the Spring of 2021, and one is slated for installation at CES in the Spring of 2022. See

Appendix B for landscape designs and plant lists. Appendix C includes lesson plans to accompany the garden plan for CES.

Results & Discussion

The following sections outline the results of the data collected from project field notes, interviews, and participation in Working Group meetings. Data were coded for themes related to power dynamics, organizational and individual values and motivations, and place meanings at project sites. A discussion of the participants, process design, and content of Working Group meetings is presented first, followed by an outline of significant themes regarding values and motivations from individual interviews and Working Group meetings. Education, biodiversity conservation, and aesthetics were mentioned the most among interviews. A discussion of values is followed by place meanings at project sites, and changes of meaning over time. Modern values and meanings attributed to project sites are discussed in relation to past meanings, and how these may be changing as activists engage in a collaborative process with one another.

Power Dynamics in Collaborative Processes

Collaborative processes gather multiple perspectives to search for solutions, including forums such as multi-stakeholder roundtables and community advisory councils (Purdy, 2012). Barring conflicting goals, inflexible administrative procedures, and constrained financial resources, collaborative governance of natural resources is suggested to produce more effective and flexible results with greater acceptance from the public (Sousa and Klyza, 2007; Gerlak and Heikkala, 2005). In Burlington, the Working Group is one collaborative partnership guiding the enhancement of habitat at project sites.

Over the course of roughly one year, the Working Group formed broader goals and values extending beyond the support of one category of pollinating insects. Relevant to this work is the assessment of power dynamics in Purdy (2012), considering authority, resources, and discursive legitimacy. These elements are viewed as sources of power in three different arenas: participants, process design, and the content. Dimensions of power from this framework are evident in pollinator habitat enhancement efforts in Burlington.

Arena 1: Participants

According to Straus (2002), vital participants in collaborative processes should include: those with formal power to make a decision; those who can block a decision; those affected by a decision; and those with relevant information or expertise. Participants in the evolving Working Group came from each of these categories. One member has formal authority to make or break decisions on behalf of Burlington's public parks and is a part of the Working Group. The group also includes advisory committee members on the Burlington Conservation Board and Cemetery Commission, who make recommendations to decision-makers regarding actions related to natural resource management. Local residents who are potentially affected by land use changes in public green spaces are also involved, alongside ecological experts from the Native Plant Trust and Vermont Master Naturalist.

Participation in the Working Group draws heavily on key individuals identified by BPRW staff, who convened the initial meetings. The group is able to leverage important resources instrumental to enhancing habitat for pollinators and wildlife, such as municipal funding, public and private land, knowledge, technology, and human resources. Expertise about native plants and local soils is held by group members, an

important component to the success of plantings for pollinators and wildlife. Other members are well-versed in social dimensions of natural resource management (i.e., administrative, advisory, and public processes in local government). This expertise stems from education and experience, since many members received formal education about topics related to natural resources. Members also possess discursive legitimacy through the advisory positions on Burlington's boards and commissions, along with careers that interface with students and members of the public interested in learning more about the story of pollination ecology.

In the Working Group, internal decision making is by consensus, used to decide measures like who may attend full group and subcommittee meetings. Decisions also are made with group values in mind. The group explicitly values environmental stewardship, empowerment, and diversity, which they are currently trying to address through plantings at both project sites and curriculum development at CES. CES is one place to interact with a diverse community in Burlington, since some students have heritage tracing back to countries in Africa and Southeast Asia. The school is a great site to help enhance social and ecological services in Burlington through their educational ethos dedicated to field-based learning opportunities and celebrating diverse cultures and learning needs.

Although the group is making an effort to engage diverse communities in the city, participation in the group and the power to influence internal process design still reflect a white, privileged population that should be diversified in the future. Increasing participation from representatives of other organizations may help address this moving forward. For now, the group is still working on solidifying design of a routine process for enhancing biodiversity using native plants in Burlington.

Arena 2: Process Design

Process design in collaborative governance of natural resources describes the where, when, and how it happens (Purdy, 2012). According to Purdy, authority, resources, and discursive legitimacy shape beliefs about who owns the process, set the agenda, and determine how frequently and formally the collaboration will proceed. Results reflect this process and the values held by the individuals involved.

The location and modes of interaction of the Working Group have varied through the seasons. During the COVID-19 pandemic, members met virtually during monthly Zoom meetings. Virtual meetings created greater opportunities for participation during winter months. As folks returned to in-person work and the process was shifted to outdoor meetings, fewer participants were able to convene and participate in the process all at once. One participant continues to engage in meetings remotely and considers the “speaker phone meetings” to be a hinderance to contributing to group discussions. This stands in contrast to recent increases in participation at public assemblies. Virtual access to meetings has shown increased participation from members of the public in other settings, since some people find it easier access and participate in meetings (Vermont Secretary of State, 2021). Access to technology affects the nature and level of participation depending on the setting.

Education is another valuable resource vital to shaping process design in this context. One participant has a lifetime of experience gardening with native plants and, accordingly, holds a lot of formal authority in the eyes the group. This authority combined with time available through her retirement status gives her frequent and authoritative opportunities to shape discussion of topics related to habitat enhancement. It

is clear that she has taken ownership of the group's process and shapes how the group evolves, especially related to content to be shared with the public. Her frequency of communication about the process and content shared in between meetings give her significant discursive power in this group.

Another member has strong working relationships with a variety of important folks around the city, playing a significant gatekeeping role for making change on the land a reality. Gatekeeping provides access to multiple ways of knowing through connections to other stakeholder groups (Goelz et al., 2020). This member of the group gathers information and communicates with other relevant stakeholders about project goals and needs. He uses his structural power with groundskeepers at both Lakeview Cemetery and CES to frame a shift in land management in a way that does not interfere with their routines. He can also provide reliable funding for plantings at project sites. Having a gatekeeper of this nature has proved invaluable to the success of development at project sites.

Participation in the group process is crucial for agenda setting, identifying what content to share in public settings and how it is shared. Finances affect individual capacities to participate. Presence of financial resources was helpful in this setting. Its absence can be a challenge. Some participants are city employees and receive monetary compensation for their time participating in group meetings during the workday. Other group members volunteer their personal time and often forego pay to participate in activities. Meeting times during the workday created unequal opportunities for participation for people who could not leave work or travel to meetings around the city in

a timely fashion. Meeting times outside the workday would encourage greater support from volunteers.

During monthly meetings, participants rotate facilitation, allowing for flexibility and creativity in meeting flow and content. This also helps different individuals take ownership of the process. Moving forward, it will be important for the Working Group to consider who is currently participating in this process, and how to expand participation to reflect group values related to diversity and inclusion. The Working Group should also consider potential barriers to participation in group meetings and educational opportunities, including access to funding and technology.

Arena 3: Content

A third and final element under Purdy's framework discusses the scope of what issues are addressed and what outcomes are pursued. Content development is important because it ultimately determines who has a legitimate claim in the process and how the process will unfold, connecting it to power exercised in the two other arenas. It is also relevant for achieving goals related to the Bee City designation. Content shared during group meetings is primarily linked to collective city goals of climate resilience, biodiversity conservation, and restoration of native plant communities. These are reflections of individual values and motivations of Working Group members.

The authority of certain individuals influences who participates as a guest in subcommittee meetings and what outcomes are expected of the subgroup. One member who has a prominent voice in meetings and has taken ownership in the process is using their authority to direct content being generated. For example, she has shared plant-related links in emails and group documents that she recommends group members read,

informing plant selections. This has alleviated the burden of doing research and developing a unified message with her predetermined resources. However, this is also limiting the perspectives being shared amongst group members who are less confident in their working knowledge of plants and ecology.

The Working Group has been described as a vehicle for change and information exchange. Information shared between group members is shared internally and shared in other related organizations by Working Group individuals. Group members are framing the agenda and content of other projects that align with the Working Group's values and goals (i.e., enhancing and connecting wildlife habitat). In addition to the content being circulated internally, content to share with the public that reflects group values is being developed by a subcommittee that spends regular time on these efforts. One mode for communicating information is a website, identified by all core group members as an important resource to share with interested members of the public.

Another mode of communication currently being developed is educational signage at demonstration sites. Members are collaborating to develop a concise way to communicate works in progress for public education. One individual is able to draw on Vermont Master Naturalist students as resources for designs, a helpful starting point for the group to develop ideas. Discussion is in progress about what story the group is trying to convey on the signage. While pollinator habitat gardens are one proposed lens, other suggested frames for the discourse around resource management include restoration of native plants and wildlife corridors. Framing messages in this way helps the public make sense of site development, and also speaks to broader goals of ecological function for biodiversity. Collective agreement remains to be seen about what the signage should

convey. Authority currently rests with individuals in the group with prior experience in sign development and education.

Values & Motivations Across Organizations and Individuals

A thematic analysis of project data indicates an array of values and motivations between interviewees and the Working Group. A vertical comparison of values and motivations between related organizations and interviewees shows varying interests. A horizontal comparison of motivations at sites revealed a common theme of enhancing sites as habitat for wildlife. Values and motivations interact in meetings and at project sites over the course of roughly one year.

Three significant themes emerged: education, biodiversity conservation, and beauty and aesthetics (See Table 1). Some values were mentioned less frequently but were voiced by some individuals who hold significant authority. Key themes were translated into products created at the end of this research for both project sites, including garden designs and lesson plans for elementary education (see Appendix B and Appendix C). These products were meaningful for project partners in the language used and knowledge transferred through educational efforts, the most significant theme throughout project data.

Education

More than half of interviewees and Working Group participants valued and were motivated by education. Interviewees and Working Group members are interested in advancing public understanding of biodiversity in general and pollinators more specifically. Some individuals are also highly motivated to expand educational

Table 1. Values and motivations mentioned in interviews and the Working Group, listed from most to least frequently mentioned.

<i>Value (# of interviewees; WG identified)</i>	<i>Summary</i>
<i>Education (7, WG)</i>	Self-education; Public education; Childhood education; Pollinator gardens as “living laboratories”; Empowering people through educational opportunities to investigate, ask questions, build skills, and contribute to their community
<i>Biodiversity (6, WG)</i>	Native plant species; Rippling effects of plant choices in ecosystems; Conservation goals
<i>Beauty & Aesthetics (6, WG)</i>	Achieve an aesthetically pleasing landscape; Enjoying beauty in the landscape; Restoring vibrant landscapes; Butterflies as signifiers of beauty

opportunities for elementary students. Others are interested in self-education about pollination ecology and how pollinators are embedded in Burlington’s landscape. Only one interviewee had little to no knowledge about pollinators, and was not actively pursuing education, but was open to learning more. Thus, three distinct categories of educational values were identified: public education, elementary education, and self-education. The following sections discuss results in these three categories.

Public Education

Data collected for this project revealed public education as a significant educational value and motivation. Organizations collaborating in this effort value public education, made evident in their mission statements and other related public education initiatives in Burlington. In addition, seven individuals mentioned this as a value in their interviews.

BPRW aims “to connect diverse and dynamic public spaces and programs which grow, inspire, and create inclusive social interaction through land, water, and people” (Burlington Parks, Recreation, and Waterfront Department A, n.d.). The department as a whole reflects this through education and outreach programs offered in public parks, information shared in publicly emailed issues of the BTV Conservation News, and website articles in their Conservation Blog.

In addition to BPRW, the Vermont Master Naturalist (VMN) program educates individuals with an eye for long-term public education and community building. Their mission of “advancing conservation, building community, and connecting people to the wild heart of a place” (Vermont Master Naturalist, n.d.) aligns with the personal missions of students from the program interviewed and participating in the Working Group. They are inspired to advance conservation and connect people to places through education and outreach efforts geared towards native plants, pollinators, insects, and other wildlife. All students who were interviewed from VMN are actively interested in “advancing conservation,” though they articulate this mission in different ways. One student has made their mission to make information about plants more accessible to the public, along with enhancing ecological function and integrity on her private property.

The value of public education was also reflected in an interview with one BPRW employee who is highly motivated to connect public and private landscapes to “rewild” Burlington. She also aims to inspire other individuals to participate in habitat enhancement efforts through education and outreach. Another city employee discussed their collaborative partnership with BPRW employees and UVM professors to develop

corridors for pollinators and connect greenways between the UVM campus and downtown Burlington.

One BPRW employee in particular was referenced in multiple interviews and actively participates in the Working Group. He constantly strives to create inclusive environments in public green spaces, by organizing volunteers and staff for conservation planting projects like the pollinator habitat garden supported by this project at Lakeview Cemetery. This individual makes a strong effort to mobilize funds to support local people and groups to create signage and educational materials. Making information widely accessible on signage that can be used by a diverse group of individuals is an important part of his educational values. It is clear that employees from BPRW share similar values related to public education and the mission of the department.

At the site level, one Cemetery Commissioner and Working Group member is actively supporting habitat enhancement at Lakeview Cemetery. She also adamantly supports the development of interpretive signage to educate cemetery constituents on the value of transforming sites and planting gardens with native plants. This value is also reflected in her participation in public education and outreach through the Working Group website, where she is drawing on her previous experience in non-profit website development to create a website for public reference.

Public education was also an important component for site design. This is evident in project work at Lakeview Cemetery, where one pollinator habitat garden was designed and planted using native plants (Appendix B). This garden will be accompanied by interpretive signage currently being developed by Working Group members as of this writing. One sign will be formatted as an easy step-by-step process so visitors can follow

a similar procedure in their own garden. This could empower individuals to act in their own space using inviting language providing a concise education of a design process. Pollinator habitat garden designs for both project sites are presented in Appendix B.

Elementary Education

Data collected for this project also revealed elementary education as a significant value and motivation. Three individuals mentioned this as a value in their interviews. Developing curriculum around pollinator habitat, native plants, and biodiversity for Champlain Elementary School (CES) is highly valued for at least two Working Group Members, inspiring my contribution to this work in the form of lesson plans around pollinators and growing plants from seed (Appendix C).

Aligned with the school's mission of offering high-quality outdoor education, teachers and parents of CES are working together to help advance garden-based education related to plants and pollinators. One interviewee and teacher at the school is working to enhance these learning opportunities with both BPRW and Burlington Wildways, a local partnership working together to successfully protect, connect and make accessible Burlington's natural areas (Burlington Wildways, n.d.). She values garden-based education and is highly motivated to engage students around the value of pollinators in our food systems. In her interview, she stated:

...I see it as an opportunity to teach kids about stuff that they would walk by every single day, you know, and there's just so much learning within it. And if you can learn to respect and understand where your food comes from or how nature plays a role in the health of the planet, I think that is just huge.

This is significant given the explicit value of supporting Burlington's local food system stated in the Burlington City Council Bee City Resolution. It also speaks to the

interconnectedness of humans and nature, and the value of learning about pollination ecology in an elementary school setting.

In line with the mission of the department, one BPRW employee and Working Group member is highly motivated to develop educational programs for elementary schools, piloted at CES. As of this writing, he is developing a native plant nursery where students at CES can grow native plants to be planted at the school and shared at other sites in Burlington. Along with other Working Group members, he would like to empower students through hands-on educational opportunities to learn about and grow plants.

In support of these efforts, one goal of this project was to design a native plant garden outside the school's new native plant nursery. The garden will be well-suited for the site conditions and supporting pollinators. These designs are accompanied with lesson plans for elementary education on pollination ecology, seed saving, and growing plants from seed, in line with the mission and values of these community partners. See Appendix B for a garden design for CES and Appendix C for lesson plans about plants in the design.

Self-Education

Finally, data collected for this project also revealed self-education as an educational value and motivation for organizations and individuals. Two out of twelve of individuals mentioned this in their interviews. Self-education is also important to VMN, a program that offers field-based learning opportunities outside of a traditional university setting. VMN students continue to be active in their communities for the sake of the natural world and their individual education. In addition, the Working Group is working

on developing a common understanding through self-education via content shared in and between monthly meetings. Self-education was also an important component of my master's project.

One VMN student and member in the Working Group has made it their mission to make information about plants more accessible to the public, along with enhancing habitat for pollinators on her private property. In her interview, she shared stories of taking walks, observing plants in gardens, and wondering what they were, all the while eager for more information about them. She enjoys working with another Working Group member and native plant expert to enhance an underutilized space in her yard to support pollinators and insect diversity. After completing the VMN course, she volunteered to take over writing the annual Bee City report and is working with the Working Group education and outreach subcommittee to develop signage that informs visitors about garden habitats in an accessible way.

Another student was inspired by the VMN program to become more educated about different layers of Burlington's landscape. He discovered his passion for bees as a result. This person shared an experience from the spring of 2020 that informed his decision to learn more about bees and pollinators in Burlington. After setting up a clay dish with water and pebbles to give some passing bees a drink, this interviewee would observe visitors to "witness and situate the self in 'bee habitat'." In one instance,

...a bee with lots of yellow on the thorax got up, turned, and looked right at [him], a direct connection... the need to locate and situate ourselves and witness ourselves in shared experience of being... should be the foundation of the pollinator education process.

Pollinators are now one significant lens for him when viewing Burlington's landscape, where he now observes spaces in an effort to map pollinator garden and habitat hotspots.

Lakeview Cemetery has become one of these places for him, whose meaning would be enriched with increased pollinator activity. According to this interviewee, the cemetery holds great potential to act as “a meeting ground, conjoining human and animal activity. Pollinators could do that.”

This project was also motivated by to desire learn more about habitat for pollinators, finding opportunities to learn from community partners. Designing and installing a garden at Lakeview Cemetery was a valuable experience to learn how to communicate needs as a designer to partners who helped prepare the garden bed. There was also an opportunity to learn about necessary tools, and how much plant material is required to fully fill in a garden bed intended to be a meadow. Observing the plants mature in the garden over the course of a year was informative; it allowed documentation of pollinators and demonstrated that certain plant choices do attract and support a diversity of insect life, most notably bumblebees. Appendix B includes these plant choices, accompanied by before and after photos of the garden over the course of one growing season.

Biodiverse Ecosystems

Enhancing biodiversity was another significant topic of discussion during Working Group meetings and interviews. This was relevant for several key groups, and six interviewees. Pollinators were often discussed in the context of biodiversity and resilient ecosystems, particularly in the face of a changing climate. This value was reflected in garden designs, which included native plants well suited for bumblebees’ foraging needs throughout the growing season. Garden maintenance practices that provide opportunities for nesting and overwinter habitat are also promoted, such as not

mulching and leaving behind stalks and leaves in the fall throughout the winter (Hardy, 2021).

The Working Group has a mission that guides activity at project sites: connecting public and private lands using native plant habitat and providing educational opportunities to learn how to do it. This mission also aligns with the missions of other project partners like BPRW, Burlington Wildways, and VMN. One BPRW employee interviewed values enhancing habitat for a variety of wildlife and sees the Bee City designation as an opportunity to support a diversity of insect species, not just bees. Other employees involved in this work are helping stitch together social institutions like CES, enhancing habitat and “food forests” at other schools and public spaces in the city. Enhancing habitat for pollinators has provided BPRW employees with the opportunity to enhance public green spaces and educate park visitors on how to emulate this habitat in their own yards and gardens. These opportunities and local activism to enhance biodiversity align with the BPRW conservation mission.

CES is working to enhance wildlife habitat at the school in partnership with BPRW, Burlington Wildways, and the Working Group. With the help of this collaborative partnership, students at CES recently helped install a wildlife corridor using native plants well-suited for the school grounds. Educating students about the positive impact they can have in ecological systems is an important value and motivation for educators at CES, employees in BPRW, and the Working Group.

One interviewee from the Working Group frequently described their fascination with and reverence for “the whole dance of biodiversity,” and how pollinators fit into that dance. Another interviewee described how honeybees and bumblebees are good starting

points to dive deeper into pollination ecology, eventually broadening conversations to whole ecosystems. He discussed the pros and cons of enhanced habitat for pollinators in the grand scheme of a landscape, and the tradeoffs of managing for one species in a dynamic ecological system. Other interviewees recognized the value of choosing plants that are “the best bang for your buck,” simultaneously supporting pollinators and other kinds of wildlife.

One interesting note regarding “biodiversity” was the concept of native versus non-native plant species. Native plant species are often promoted in plantings for their high ecological value, supporting a variety of insects and wildlife in addition to pollinators. Doug Tallamy, an inspirational guiding figure for the majority of interviewees and Working Group members, promotes planting native species like *Quercus alba* (white oak), since oaks support the greatest diversity of insect species and the birds that feed on them (Tallamy, 2011; Tallamy, 2020). Several interviewees valued native plant species over non-native when enhancing habitat for wildlife.

While most interviewees and Working Group members were motivated to increase the presence of native plant species in public and private landscapes, one interviewee who was not a part of the Working Group had a neutral, if not positive outlook on the presence of non-native plant species in the landscape. In a response to questions about what motivates him to engage in habitat enhancement and conservation work, he states:

the idea of, you know, conservation, restoration... that's [found] around most of the places that we actually live in and work, which are these novel ecosystems... [the novel ecosystems] are frowned upon by a lot of ecologists. But actually, when you look at where they are, and how they function there, they do provide a lot of

ecological benefits even though they're not this like pristine idea of a restored indigenous landscape.

This interviewee interprets “novel ecosystems” to mean natural areas composed of different assemblages of species than past systems, as a result of land use changes and climate change (Evers et al., 2018). In his interview, he recognized that landscapes are dynamic spaces that change as a result of both natural disturbance and human influence. Although he recognized the negative effect some species have in the landscape, he perceived positive impacts of invasive species like Japanese knotweed, which he identified as a floral resource for pollinators with their late fall blooms. Most interviewees associated habitat enhancement with native plantings: however, this interviewee saw things differently. This raises questions about values around ecological effects of native versus non-native plant species in the landscape. This idea may have implications for future projects pursued by the Working Group. For more information on future implications, please see the section on “Future Recommendations.”

Despite conflicting opinions about the value of plant species, and in support of the Working Group’s emphasis on native species, my landscape designs for both project sites were primarily composed of plants native to this area. These landscape designs and plant lists can be found in Appendix B.

Beauty & Aesthetics

Native plants that naturally evolved to support important ecological functions were also intentionally arranged to convey beauty, another significant value that emerged in project data. What is considered “beautiful” is a social construction of aesthetic values in a given place. People often have aesthetic and emotional responses to plant colors, which reflects the diversity of ways in which people live in different cultures around the

world (Lee, 2007). The field of Landscape Architecture and Design has a prominent component of beauty and aesthetics. For example, the American Society of Landscape Architects approaches designs with functional intent and aesthetics in mind (American Society of Landscape Architects, n.d.).

Aesthetics have also been codified as a motivation for action at Lakeview Cemetery. In the “Rules and Regulations of Lakeview Cemetery,” the following text was codified by the original Cemetery Commissioners:

If any trees or shrubs, situated in any lot, shall by means of their roots, branches, or otherwise, become detrimental to the adjacent lots, or unsightly or inconvenient to passengers, it shall be the duty of the Cemetery Commissioners, and they shall have the right, to enter the said lots and remove the said trees and shrubs... (Section 8).

Aesthetics and beauty were valued by the original Cemetery Commissioners and continue to be a topic of discussion in present day commission meetings. It is their duty as commissioners to monitor and uphold an aesthetically pleasing space. While one Cemetery Commissioner and interviewee is promoting habitat enhancement on cemetery land, other commissioners are concerned about the aesthetics of certain “no mow zones” and lack of mowing in local cemeteries. Because of staffing and budget cuts, some areas of local cemeteries were mowed less frequently, or not at all during the timeframe of this project. Although BPRW and Cemetery groundskeepers capitalized on the decreased mowing efforts to save money and time, and support wildlife, one overgrown area in Lakeview Cemetery seemed unintentional and neglected without the visible effects of mowing (Nassauer, 1995). The “no mow” areas were thought to be an aesthetic eye sore by some members of the public and brought to the commissioner’s attention. Signage

about the intent behind the “no mow” area helped quell concerns about the previously mowed area.

Beauty was valued by many other interviewees and motivated them to become more involved in habitat enhancement beyond the cemetery. Providing important habitat resources for pollinators was often perceived as beautifying a garden, yard, or urban green space. Seasonal forage availability was described by one of the Working Group members as beautiful, since there were always colors to enjoy when walking past the native plant garden at Lakeview Cemetery. Perception of beauty was facilitated by the constant presence of colorful flowers (Lumber et al., 2017).

One interviewee enjoyed building her garden around bloom colors and times that support pollinators. Another interviewee valued the beauty of enhancing “novel ecosystems” that support pollinators and wildlife in unconventional places, like highway medians, unused fountains, and cemeteries. Although one interviewee acknowledged the beauty of his pollinator garden, he recognized that beauty cannot be the only factor when considering to planting gardens for pollinators.

One interviewee told a story about the garden planted fairly recently outside City Hall in downtown Burlington. A combination of native and non-native plants was installed in collaboration with Vermont Master Gardeners. Within a day of planting floral resources for pollinators in this space, this individual witnessed the exciting arrival of bees, monarchs, and other butterflies. In this person’s assessment, the effect was immediate and beautiful. In addition to cemetery commissioners, educators, and other City employees, a Lakeview Cemetery groundskeeper is also highly motivated to work on cemetery grounds for the beautiful result of daily maintenance. His aesthetic is

informed by his horticultural background, and the result brings him great pride and satisfaction.

Although plants were chosen that would bloom throughout the growing season, the garden at Lakeview Cemetery was primarily designed to function as habitat for bumblebees and wildlife. Since its installation, the garden has been monitored by seasonal city employees but little to no maintenance has occurred by the seasonal employees or cemetery groundskeepers. This can be attributed to the intent behind the design, which included ecological considerations such as sun and soil preferences, and social considerations such as the need to view beautiful flowers. In this space, flowers are considered both a source of food for pollinators and a thing of beauty providing aesthetic value to the area (Buttala and Seigel, 2015).

Additional Values & Motivations

Some themes were mentioned less frequently than others across interviews and Working Group meetings. However, they are included here because they were voiced by individuals with significant authority in the process or are growing values in the broader scheme of biodiversity conservation. One influential BPRW employee values reciprocity and is actively trying to heal our human relationship with nature on public lands. Another influential BPRW employee converted plantings in public spaces from annuals to perennials, to align several other city goals. Some of the impacts of my project aligned with these values as well. Additional values and motivations identified in project data are presented in Table 2.

Table 2. Other values and motivations from interviews and the Working Group, listed from most to least frequently mentioned.

<i>Value (# of interviewees; WG identified)</i>	<i>Summary</i>
<i>Reciprocity & Indigenous Wisdom (2; WG)</i>	Give and take; Balance of relationship between plants, people, animals, and insects; Reciprocal relationship between pollinators and flowers; Gratitude for places, people, and ecosystems
<i>Practicality & Efficiency (2; WG)</i>	Aligning goals within the city; Being efficient with resources; “best bang for your buck”; Common sense; Switching city plantings from annuals to perennials to free up time for city employees & spend money elsewhere
<i>Wild Spaces (2; WG)</i>	Places for wildlife & nature to define itself; A place for people to define themselves in nature
<i>Food Systems (1; WG)</i>	Would not have some foods without pollinators
<i>Collaboration/Partnership (1, WG)</i>	Strength and resilience in community; Food service program & parents helping CES with summer gardening and funding; BPRW & BTW Wildways working with Lakeview Cemetery & CES to support wildlife habitat & corridors on site
<i>Nature Based Solutions for Climate Change (WG)</i>	Resilient ecosystems for climate change; Supporting Burlington’s Climate Action Plan with perennial plantings; Reducing Burlington’s carbon footprint

Reciprocity & Indigenous Wisdom

Several Working Group members value reciprocity and codified it in their group “charter.” BPRW also elevates stories of reciprocity on the Conservation Blog (“Getting to Know Your Natural Neighborhood”). Traditional ecological knowledge can offer a means to improve resource management in ecological systems (Huntington, 2000). Furthermore, reciprocity with the land is fundamental to many indigenous belief systems,

expressed through gratitude and playing a positive, active role in the well-being of the land (Kimmerer, 2011). Attending to this natural responsibility was expressed by Working Group members and guides their relationship with public and private lands in Burlington. Focusing more on this value is one recommendation for the group moving forward, discussed in the section of this paper on “Future Recommendations.”

In addition to the Working Group, two interviewees value and are motivated by reciprocity and indigenous wisdom in their conservation work. One interviewee said her land ethic is informed by indigenous wisdom. In her interview, she stated:

...I've become much more spiritual about my relationship to the natural world, and thankful in the Kimmerer sense, you know, developing a gratitude for this place and for other than human beings, for the abundance and the resilience that I see in ecosystems. As a part of those ecosystems...a real responsibility to steward.

This quote reflects the ideas present in Kimmerer (2011), and other discussions of traditional ecological knowledge in natural resource management (Huntington, 2000; Rathwell et al., 2015). It also speaks to the values some individuals in Burlington place on reciprocity.

Practicality & Efficiency

Working Group members value making practical choices when approaching habitat enhancement projects at demonstration sites. Climate change was mentioned in Working Group meetings as a motivator for conservation work. One member on the Burlington Conservation Board recently finished drafting an addendum to the Burlington Open Space Protection Plan that guides the implementation of Nature Based Solutions to Climate Change (City of Burlington, 2021A). According to the plan, nature-based climate solutions are multifunctional, providing benefits to nature and human communities to

support a resilient future. Supporting pollinators in lawns, fields, and small open spaces are one practical nature-based solution to climate change.

One interviewee also described their motivation to be practical with plant choices and efficient with use of municipal funding in public green spaces. He chose to convert annual plants in city gardens to perennials for the sake of efficient use of the city budget and align greenhouse gas emission reduction goals with Burlington's Climate Action Plan (City of Burlington, 2000). Practical decision making is a valuable tool in the context of habitat enhancement and this project.

Food Systems

Although food systems are rarely mentioned in the Working Group, the value of pollinators in our food systems was mentioned in one interview with a CES teacher. In her interview, she stated:

...pollinators are important because we wouldn't have some of our foods if we didn't have [them] helping us along the way... we need things they can pollinate... for food and nature both.

This is noteworthy because the value of pollinators in our food systems were not mentioned in any other interviews. Although some future Working Group projects intend to increase opportunities for urban foraging, the group did not discuss this value at length in many meetings. However, the value of pollinators in our food systems was explicitly mentioned in the 2019 Burlington City Council Resolution in support of the Bee City Designation. It is interesting that this document and the Bee City Initiative value this service provided by pollinators, but local organizations and individuals do not appear to be as motivated by this. Working within the local food system is outside the scope of the Working Group's mission. Although they value this aspect of supporting pollinators and

wildlife, others like the Intervale Center Conservation Nursery are taking the lead on this front (Intervale Center, 2017).

Place Meanings Attributed to Local Project Sites

Along with power dynamics, and values and motivations, data was analyzed for how people described place meanings associated with Lakeview Cemetery and CES. Rajala et al. (2019) provided a useful framework that guided my analysis of place meanings. The place meaning typologies from this framework were helpful for exploring individual meanings across project sites. They provided four distinct categories for me to compare ideas (see Table 3).

While these typologies appear to be distinct categories, my data indicated overlapping typologies between individuals at project sites. Overall, characteristic place meanings were most commonly held by all individuals at both sites and were the strongest motivator for action. The following sections discuss place meaning at Lakeview Cemetery and CES.

Table 3. Typologies of place meanings from Rajala et al. (2019). Four categories of meanings create a basis for comparison across project data.

Typology	Definition	Examples
characteristic	attributes of the biophysical setting	beautiful natural scenery, habitat for wildlife
functional	utilitarian meanings related to desired uses	outdoor recreation
experiential	formed through individual experiences	peace and quiet, source of inspiration, connection to nature
interpersonal	interactions with others, social aspects of a place	enjoying time with friends and family, community

Lakeview Cemetery

Meanings of Lakeview Cemetery were discussed in six interviews. Three interviewees did not describe specific meanings about Lakeview Cemetery but had memories about what cemeteries meant to them in general. In terms of the typologies from Rajala et al. (2019), most meanings were characteristic and functional, with some being interpersonal and experiential. The Working Group is primarily viewing Lakeview Cemetery as characteristic, since it is accessible to work there under BPRW jurisdiction and has valuable habitat features for pollinators and wildlife. Meanings of Lakeview Cemetery in the past were largely interpersonal and experiential. However, the Working Group is expanding meanings to include those more characteristic meanings of wildlife habitat.

Historic Place Meanings of Lakeview Cemetery

According to an article reviewing cemeteries as cultural landscapes, one understanding of a cemetery is a socially bounded space with material features that transform the deceased into living time, helping individuals maintain symbolic relationships with the dead and their identities (Francis, 2003). The author presents another definition of cemeteries as secure, attractive, sacred spaces suitable for the expression of private feelings of affection. Lawn-park cemeteries emerged as urban residents attempted to control increasingly chaotic environments, ease conflicts, and bring communities together, brought into wider acceptance with the help from well-known landscape designer Frederick Olmsted (Sloane, 1991).

Lakeview Cemetery is an example of a Victorian Lawn Park Cemetery, first opened to the public in 1872 (Burlington Parks, Recreation, and Waterfront Department

B, n.d.). The cemetery was designed by E.C. Ryder, known also for designing Church Street's Bacon Block and the Franklin County Courthouse in St. Albans, VT (Lewis, 2020). According to Lewis, historical uses of the cemetery included the management of a greenhouse to cultivate flowers for ornamental decoration of cemetery grounds in addition to planting native and non-native ornamental trees that remain rooted in the cemetery today.

Place Meanings of Lakeview Cemetery: Present & Future

Place meanings of Lakeview Cemetery expressed in interviews and meetings fell into all four typologies identified by Rajala et al. (2019). The most common meaning discussed was characteristic in nature. In addition to the property's high value as the last active burial ground in the city, Lakeview Cemetery is a widely valued public green space acting as wildlife habitat. It is physically located at the "wild heart" of Burlington, a natural land bridge between Lake Champlain and the Winooski River Valley. It is also a corridor for animals to move safely through the landscape near the newly developed Cambrian Rise apartment building next door. Its sandy, well-drained soils are highly prized by solitary pollinating insects since relatively large sandy particles are easier for them to build nests in.

BPRW chose this space to "rehome" some trees removed from a development project at a nearby site. They organized volunteers to plant birch trees on a steep, sandy slope near the entrance for soil stabilization and wildlife habitat. Members of the Working Group also gathered regularly to plan for future habitat enhancement projects on site, plant the native pollinator garden at the entrance, and chose Lakeview as a beautiful meeting place to spend quality time together outside of volunteer work.

Given its physical location and attributes, many individuals are motivated to enhance this valuable space for pollinators and wildlife habitat. One Cemetery Commissioner continues to engage Burlington city officials, students at UVM, and volunteers to help enhance and protect the space as habitat. She also uses the cemetery to recreate with her family. Other city officials and volunteers of the Working Group see the value of the sandy soils on the shores of Lake Champlain and the potential for native pollinators and insects to thrive there. When prompted about what comes to mind when they think of Lakeview Cemetery, some interviewees recalled the beautiful collection of “old, grand trees” present in the landscape, and the views of Lake Champlain available along the bike path. Another interview discussed the potential of Lakeview to enhance Burlington’s native plant communities and host plants for important wild pollinating species.

Abundant characteristic place meanings of Lakeview Cemetery overlapped with functional, experiential, and interpersonal meanings. Several individuals who value Lakeview Cemetery as wildlife habitat also value the peaceful, quiet atmosphere, and enjoy a respite from the hustle and bustle of North Avenue and downtown Burlington. Two individuals interviewed work regularly at Lakeview Cemetery managing trees, shrubs, and mowing the grounds. One individual interviewed even consulted headstones for baby names and uses the cemetery to view fireworks for the United States Independence Day.

The commonly held characteristic place meanings of Lakeview Cemetery are a strong motivator for individuals and organizations to act as environmental stewards for this place. Volunteers in the Working Group regularly discuss an umbrella plan for

transforming mowed spaces around the cemetery into habitat for pollinators and wildlife. Municipal funding, city staff, and volunteers were used to help plant garden habitat on site this spring. Cemetery visitors often commented to staff about the garden's beautiful aesthetic and valuable addition to the overall aesthetics of the Cemetery.

Functional place meaning influences habitat enhancement at the cemetery as well. Working relationships between the land and city employees helped them identify prime locations for habitat enhancement, including the steep southern bank along the bike path and steep banks at the cemetery entrance. One cemetery groundskeeper interviewed for this project is in favor of converting steep slopes around the perimeter of the cemetery into planted habitat since they are difficult to mow. Widespread support for pollinator habitat enhancement is shared across individuals at this site.

Interviews for my project took place in the year 2021. It is noteworthy that modern interviewees continue to define cemeteries like Lakeview as quiet spaces removed from the noisy, chaotic environment of North Avenue and the City of Burlington. Opportunities for participants exist at Lakeview and in other cemeteries for reflection and recreation. Two interviewees shared fond memories of recreating in cemeteries as a child. While meanings of cemeteries continue to carry the lasting legacies of their original intended functions, some have additional ecologically oriented understandings and uses. Mount Auburn cemetery is one well-known example where "history and beauty meet memory and nature" (Mount Auburn Cemetery, n.d.). The cemetery was designed to be a tranquil, natural setting with help from the president of the Massachusetts Horticultural Society (Mount Auburn Cemetery, 2021). Like Mount

Auburn, other cemeteries have the potential to be embraced as a site where history, politics, emotions, landscape and design coexist (Woodthorpe, 2011).

In the past, Lakeview Cemetery was understood by some as a peaceful place for urban dwellers to reflect and recreate (Burlington, Department of Parks Recreation, & Friends of Lakeview Cemetery, 2008). To certain individuals and organizations, it continues to hold that meaning. In her book on prominent historical figures buried in Lakeview Cemetery, author and tour guide Thea Lewis introduces the cemetery as a beautiful, peaceful landscape to explore European settlers influential in shaping Burlington into place is known to be today (Lewis 2020).

Participants interviewed for my project show a collective interest in enhancing urban green spaces for the sake of pollinators and other wildlife. Lakeview Cemetery was identified by several interviewees as one of those places. In addition to being a place to memorialize human remains, Lakeview Cemetery possesses the potential to create corridors and refuge for wildlife, while maintaining its status as a peaceful and beautiful place for people to enjoy urban green space. In contrast to previously held meanings, the people interviewed did not describe it as a place to maintain a collection of trees and display of ornamental plants. These meanings stand in contrast to the characteristic meaning of habitat for wildlife. Values described in interviews are being mobilized in this place and helping to transform its historic meanings into something more ecological in nature. A full range of frequently mentioned meanings about the cemetery can be found in Appendix D.

Design Principles Reflected in the Lakeview Cemetery Garden

Similar to the motivations of organizations and individuals associated with the Working Group, ecological landscape design is motivated by environmental stewardship, promoting biodiversity, preserving wildlife populations, and climate change (White, 2021). These ecological landscape design practices can be combined with more traditional design principles, including color, and repetition and rhythm (White, 2021). According to White, repetition and rhythm can be achieved with repeated plantings throughout the design. For example, repeated planting of *Schizachrium scoparium* throughout the Lakeview garden helped create a flow from one end of the garden to the other. This also contributed to the meadow effect hoped to be achieved.

Color choice was an important design principle in this garden for the sake of bumblebees. Since bumblebees see colors of higher spectral purity, most plants chosen were on this end of the color spectrum (White, 2016). They are also less sensitive to reds, so this color was avoided. Plants chosen in the design also attended to the abilities of different bumblebee species: the tubular shape of *Monarda punctata*, *Pycnanthemum tenuifolium*, and *Asclepias tuberosa* suit the needs of species with different length tongues (White, 2016). Selection of plants also took into account the economics of foraging. Clusters of flowers available on *Eupatorium hyssopifolium* help the bees save energy, since bees expend little energy crawling across the platform from one flower to the next (Kearns and Thompson, 2001).

Plants chosen for the design are native to sand prairies, midwestern ecosystems similar to the sandplains on the shores of Lake Champlain. They are also native to ecoregions present in the Champlain Valley and tolerate sandy soils that are well-drained

and prone to drought in seasons with little rainfall. This garden ultimately enhances habitat for bumblebees by focusing on valuable social and ecological dimensions of habitat for multiple pollinators and wildlife. See Appendix B for a complete list of plants chosen for this garden.

Champlain Elementary School

Place meanings of CES were discussed in three interviews. Interviewees worked at CES or were parents of students who attended the elementary school. Working Group members are also very passionate about working at this site for the habitat value and educational value of working with a diverse group of elementary students. In the context of this project, place meanings were largely characteristic since projects at the school are aimed at enhancing wildlife habitat on site. However, there were several interpersonal and experiential meanings discussed by interviewees that are meaningful to them and the CES community. New educational opportunities are being created through these new characteristic meanings at the school, while the function of the school as a place of learning and to gather as a community remains the same.

Historic Place Meanings of Champlain Elementary School

CES has always been located in the South End of Burlington. Until 1968, the school was across the road at 809 Pine Street. The elementary school then moved to its current location, and the original school building was converted into apartment buildings. Its current location has been the site of field-based elementary education for a number of years. The school has a history with educational gardens dating back to the 1980s, when students would take care of gardens on site (Burlington Free Press, 2018).

In 2008, CES established a Fresh Garden for school use only, which students visit most Fridays during the growing season to harvest and learn about food systems in garden-based education (“Champlain Elementary School Fresh Garden,” n.d.). These gardens are visited by curious students and teachers during the school year, maintained primarily by a knowledgeable and dedicated teacher and parent all year long. Recent development of this garden and others on site has been a source of inspiration for this primary leader, who described the planting and work involved in the garden as a “poetic experience.” This speaks to the value of beauty and aesthetics present in this work, shared by others in the Working Group and interviews.

Champlain Elementary School: Present & Future

Much like Lakeview Cemetery, CES is understood as a place to enhance habitat for pollinators and wildlife. The school’s physical location alongside Englesby Brook on the south side of town provides a complementary opportunity to enhance habitat in a place with different site conditions than the cemetery. While Lakeview Cemetery has primarily sandy soils and lots of canopy coverage by virtue of the collection of old, mature trees, CES has somewhat poorly drained, silty soils and canopy coverage limited mainly to the perimeter of the school.

A field visit with a CES Outdoor Committee member and parent revealed a poetic and philosophical understanding of the school gardens. To her, the gardens at CES are a source of inspiration, and the native plants there provide valuable habitat for pollinators like the bumblebee that regularly visit the plants there. She plays a leading role managing the school’s grant-funded learning gardens. We toured both the learning and sensory gardens, where she highlighted strengths and needs in each space.

Meanings of CES from interviews were largely functional, experiential, and interpersonal. A few folks in the Working Group are also parents of children who attended CES as a student. One Working Group member is not a parent, but a highly motivated individual engaged in field-based learning opportunities for young students. He hopes to empower elementary students with hands-on experience and develop skills to identify and grow native plants in the CES gardens and natural areas.

One individual interviewed is a teacher at CES passionate about enhancing field-based learning opportunities for students about pollinators and plants. In her interview, she told a story about the sense of wonder students experience in the gardens when they dig in the soil, or witness wildlife like a turtle using their space to move through the landscape. These interactions are valuable to her as an educator and motivate her to pursue more outdoor learning opportunities for students. In her interview, she stated:

Seeing it in the book is exciting too, but not the same as being out there. Getting connected is probably my main motivator... Anything that moves is definitely, immediately, just excitement galore...in the first week of school, I take them out to the garden a few times and we're picking things. And you know, usually we have them all take a flower home at the end of the day, which is like the sweetest, cutest thing. They're overjoyed at being able to take one flower...it's like finding treasure.

She is collaborating with the school's Outdoor Committee, along with BPRW, Burlington Wildways, and the Working Group to enhance habitat through regular meetings with partners at the school. In a related event this spring, students planted native trees and shrubs on the eastern perimeter of their property to build a corridor for wildlife. These interpersonal activities are enhancing the meaning of CES as an educational institution.

Ecological endeavors on site for this project and other related projects are led by individuals who are motivated by characteristic place meanings to enhance the space as a

wildlife corridor and habitat for pollinators. Interpersonal meanings are also highly valued in this space, since interviewees and the Working Group are motivated to gather and engage future generations attending CES in this type of work. CES is a prime place to achieve these goals given the school's educational philosophy combined with its physical location and attributes. Providing young students with opportunities to experience the natural world and learn from it is a value held by many within the bounds of this case study. A full list of other meanings about CES can be found in Appendix D.

Design Principles for the CES Garden

The garden design for CES is also motivated by environmental stewardship, promoting biodiversity, preserving wildlife populations, and climate change (White, 2021). Design principles similar to those used for Lakeview Cemetery are reflected in the CES garden design. In contrast to the cemetery garden, the plants chosen for this site are tolerant of the shade and poorly drained soils characteristic of the CES site. Plants were chosen to support bumblebees and also identified by the Vermont Audubon Society as beneficial to avian species. Plant species identified for this design are also native to the area. Many are found near woodland edges and wetlands, such as *Tiarella cordifolia*, *Zizia aurea*, and *Geranium maculatum*. See Appendix B for a complete list of plants chosen for this garden.

Plants chosen for these gardens also reflected social dimensions of the site. Plants bloom at times the elementary students will be able to enjoy in session, where they can also observe pollinators visiting their blooms. Many are also easy to germinate and provide opportunities for students to learn how to propagate plants from seed. See Appendix C for lesson plans about seeds and the species to be planted in this garden.

Discussion

Values, Meanings, and Ecological Effects at Project Sites

According to Ardoin et al. (2019), sense of place can be a motivation for action. In the case of the Burlington Bee City designation, and within the Working Group, this is the case. Meanings people attach to Lakeview Cemetery and CES are motivating the enhancement of habitat for pollinators and wildlife. Their value as ecological entities in an urban area are motivating people to restore the presence of native plants and support a diversity of insects and wildlife. Conservation is also motivated by a collective sense of place through shared dialogue in Working Group meetings (Rajala et al., 2019). Although this is present in the data collected in this project, this may not be the only motivation. As alluded to in Bartlett and Vavrus (2017), it is worth paying attention to actors who do not sit physically in the bounds of a given case. This is a recommendation discussed in the “Future Recommendations” section.

Values and motivations were described during interviews and Working Group meetings. A highly regarded mode of communicating these sentiments was through storytelling. People told stories to elaborate on values, motivations, and meanings of habitat enhancement projects, held individually and in community. These stories also highlighted another element of sense of place that was unanticipated at the beginning of this project: emotional attachments. While place meanings are important motivators for people to act on behalf of the natural world, emotions associated with the relationships people have at project sites played an important role in this work. These relationships involved the land and wildlife, along with other folks in community.

One interviewee told stories about walking with her daughter at Lakeview Cemetery, and the memories being created in community with the wildlife and land there. The more experiences she shared with her family at the cemetery deepened her connection to that place and motivated her to act on its behalf. Another interviewee discussed storytelling to connect with others and share the value of biodiversity. Perhaps the most vivid story told in an interview involved students witnessing a turtle at CES and digging to discover insects in the soil. The joy experienced in this form of learning felt tangible to a listener in a way that inspired a desire to continue connecting with students, teachers, and the land at CES. In all of these instances, stories were able to convey more than just ideas people hold about what a place means to them. Ideas and emotions work together to motivate action to enhance biodiverse habitat at both project sites.

Habitat is being enhanced for pollinators and other wildlife associated with biodiverse ecosystems. While bumblebees are more charming, resilient insects than some other pollinating creatures, this project shows that a broader approach to conservation is valuable in an urban setting. Enhancing habitat for wild bees is important, but not exclusive. Supporting habitat for a diversity of flora and fauna is key in the grand scheme of the landscape. Urban areas like Burlington is no exception, where green spaces are found in gardens, yards, parks, and the spaces between.

This project also demonstrates how quickly you can see results of efforts to enhance habitat for pollinators. Within one growing season, bumblebees, wasps, monarch caterpillars and other insects frequently visited a small garden patch that mimics a sandplain meadow. Excitement about the beauty of the garden was expressed by visitors to the Cemetery. Delight about presence of pollinators in the garden was also expressed

by members of the Working Group. Education about threats to wildlife can be a motivation for action, but visible results can help reinforce motivation and demonstrate the possibilities for change in any place people want to see it.

Social Constructions of Meaning in Ecological Landscapes

In a recent special feature attempting to advance research around sense of place, Masterson et al. (2017) pose an interesting question that intersects with the bounds of this case study: *whose place meanings are favored, and why?* As discussed in Stokowski (2002), certain place meanings are privileged over others, and the discourse around place is largely shaped by the language used in the process. Stokowski (2008) notes “places” do not exist until they are contextualized by social interactions and shaped by the human experience, when they are named, identified, categorized, and talked about between individuals in a community. While they may be influenced by individual attachments to places, meanings are often constructed using language and conversations among individuals in community with one another.

As Stokowski points out, some meanings assume an air of permanence over time, appearing as “stable” features of social life. Lakeview Cemetery and CES are two sites in Burlington that have existed as relatively stable places of local urban life, dating back as early as 1872. Burial and education are two social activities that are fixtures in various cultural groups of Burlington. Historic meanings of cemeteries as burial grounds and places to find respite from busy city life have persisted into the modern day. Although different educational philosophies exist between public and private institutions, elementary schools continue to be places to educate children.

Through collective governance of natural resources, the meaning of Lakeview Cemetery is being expanded from a place to bury human remains and enjoy peace and quiet to a place that supports a diversity of life and educational opportunities. Native plants are being planted on site by volunteers in the Working Group who value this element of supporting biodiversity. Individuals in the group are establishing common understandings and values to approach landscape development. After establishing understanding and trust through regular collective meetings, city employees are supporting motivated volunteers with important resources including money, technology, water, and plants. They are also helping garner social support with groundskeepers at both sites and city commissioners through ongoing relationships. This differs from historical landscape architects and commissioners who designed and planted a collection of native and exotic trees based on a different set of aesthetic goals and design preferences. Through public plantings, the Working Group is expanding what this land means.

Social constructions of place are being enhanced at Chaplain Elementary School. Teachers and members of the school's Outdoor Committee are building social relationships and knowledge capital with BPRW employees and volunteers to enhance the school's land as wildlife habitat. Native plants are being planted on site and lesson plans are being developed to empower young students with the ability to grow plants and impact their landscapes, in line with the values of the Working Group and some CES teachers. Enhancing habitat for wildlife at the school in turn enhances educational opportunities for teachers and students at their own school grounds.

With the help of collective actions informed by the participants present in the Working Group, meanings are changing at both project sites. Characteristics, functions, individual, and interpersonal experiences are expanding at Lakeview Cemetery, and are being enhanced at CES. A privileged group of individuals are convening to take collective action to conserve and enhance biodiversity at these sites in Burlington. Individual actors are generally white, well-educated, and have access to important instrumental resources that are shaping the discourse around land management practices that reflect their values. Although values related to reciprocity and indigenous wisdom are held by some individuals involved in this work, traditional ecological knowledge and other ways of knowing the natural world are missing in Working Group discussions at this point. While current participants are well-intentioned, skilled, and committed volunteers and loyal employees, it should be noted that others who were not interviewed for this project may have alternative place meanings, ideas about place management, and resources and relationships that could be valuable to advance these efforts and produce resilient results.

Conclusion

In the final analysis, it is apparent that pollinators are a highly valued natural resource to some people in Burlington. A variety of resources are being mobilized by individuals who value pollinators and biodiverse ecosystems they are nestled in. This is made evident through the city's public pledge to uphold its Bee City designation and enhance pollinator habitat annually. It is also of interest to the Working Group which continues to work toward an evolving mission of enhancing biodiversity in Burlington.

Lakeview Cemetery and CES are two sites identified by organizations, individuals, and this project to enhance habitat. As a result, landscape designs were developed to facilitate public access to information about pollination ecology. A combination of interviews and participant observation around values, motivations, place meanings, and power dynamics at these sites reveal education, biodiverse ecosystems, and aesthetics at the forefront of values and motivations. Education helps make meaning of sites, but meanings exist outside of listed values and motivations. Characteristic place meanings of both sites are informed by educational efforts and motivate action at each site. People are in conversation about these meanings and are expanding and enhancing longstanding historic meanings of these places in Burlington.

Furthermore, place meanings attributed to project sites are linked to emotional connections experienced there. Sense of place was expressed by individuals in terms of both place meaning and place attachment, leading to the conclusion that neither exist in isolation. Tales of joy and wonder were told in interviews about both Lakeview Cemetery and CES. One CES educator is motivated to educate her children by moments of discovery and learning in the garden. Other interviews and Working Group meetings featured stories about the beauty found in biodiverse spaces that moves people to action. Storytelling is an important mode of communication to portray multiple dimensions of sense of place. It has the potential to facilitate communication between a diverse set of communities, since most people have a story to tell in one way or another. Storytelling ultimately helps describe the human experience, including what people value and what motivates them to act.

Values are mobilized in this case with the help of local organizational and individual power dynamics. Instrumental, structural, and discursive powers interact in various ways to both help and hinder the process of habitat enhancement. BPRW remains a critical leverage point for enhancing pollinator habitat by virtue of their combined resources, structural, and discursive powers in relation to other organizations in the city. Individuals are coming together in the Working Group to support their efforts. The relationships that continue to emerge and enhance habitat for pollinators are a product of the privilege held by people with a seat at the table. Although diversity and inclusion are explicitly valued amongst those involved, there remains a significant opportunity to address these values and give voice to alternative viewpoints about this topic.

Pollinator habitat enhancement can happen anywhere, so long as the right plants are chosen to work with site conditions. Taking social values into account will also help strengthen the results and create resilient spaces accepted by people affected by them. At Lakeview Cemetery, the maintenance crew is one primary constituent. One crew member was interviewed for this project and feels strongly in favor of the first site garden enhanced as habitat. Future work should expand input from other cemetery constituents, like plot owners or other BPRW staff. At CES, teachers and students benefit the most from habitat enhancement alongside wildlife. Interviewees and active members at the site are in favor of enhancing garden-based educational opportunities. The Working Group is championing efforts and are helping enhance habitat in an equitable and adaptable way. Including more voices in the conversation will help create, enhance, and expand new meanings at future project sites identified as habitat for pollinators and wildlife.

Future Recommendations

The Working Group defined values held in common between all group members, including reciprocity, environmental stewardship, and empowerment through educational opportunities. These values are guiding project development and inform plant choices for habitat enhancement. Native plants are of great interest for the sake of biodiversity. Diversity and inclusion are also of increasing interest as the group begins to determine how they can address environmental justice.

The Working Group acknowledges the room for growth that remains to achieve their goals and maintain their values. The following are recommendations for future research and the Working Group based on results from interviews and participation in the group to date.

Recommendation 1: Expand Participation in the Working Group

The Working Group values diversity and inclusion and is aware of the need to consider input from diverse communities in Vermont. Now that group members have worked together for one year to define their collective mission, values, and goals, they are grappling with addressing issues related to environmental justice. The core group is currently composed of predominantly white, educated leaders in the City and the values and motivations of group project reflect their privileged ideas.

Contributions from complementary ways of knowing can improve collaborative efforts in environmental resource management (Rathwell et al., 2015). Incorporating expertise from those well-versed in Traditional Ecological Knowledge alongside dominant paradigms of western science can improve resource management (Huntington, 2000). Shared goals are evident between the Working Group and the philosophy of

reciprocal restoration described in Kimmerer (2011). In addition, Working Group members and interviewees explicitly value reciprocity and indigenous wisdom. Thus, a more pointed effort to incorporate the perspectives of people who share this philosophy is warranted.

Expanding BIPOC input in monthly core meetings or subcommittee meetings would be one step to addressing this shortfall. One option is to identify a key informant in the community, or, if appropriate, approach the community council to help select knowledgeable individuals (Huntington, 2000). This may be simpler in the coming months as meetings likely move back to remote, digital forums. The Working Group member who has played a gatekeeping role in the past may be best suited for identifying members in the community from a diverse background who may be interested in participating.

Increasing involvement from other members in the Burlington community is an important element of this work. However, expanding *how* people participate is as important as *who* is participating. Storytelling could be pursued as a tool for education and outreach initiatives, to connect people with places and each other. It may help tap into other ways of knowing a place, as made evident in interviews that described emotional attachments to places through stories. Stories of places and people's relationships to them could help uncover other dimensions of this work that enhance and expand collective senses of place at current and future project sites.

Recommendation 2: Expand Range of Plant Selections for Habitat Enhancement

The Working Group is highly motivated to increase the presence of native plants in Burlington for enhanced biodiversity. Plants native to North America grew on the

continent prior to European colonization (Johnson, 1999). Non-native plants with origins in Asia, Europe, or South America remain popular in suburban landscapes for their ornamental qualities and non-invasive growing habits (Burghardt et al., 2009).

Conventional landscaping typically creates homogenous landscapes composed of non-native species (Burghardt et al., 2009). This is of concern for insects, since they typically cannot successfully reproduce without plants that share their evolutionary history (Southwood et al., 1982). Furthermore, over half of the land in North America is now suburban (Tallamy, 2020). This will have rippling effects on insect herbivores who depend on insects as a major part of their diet.

Individuals involved in this project expressed concerns about the use of non-native plant species. Native plants are valued by people in this case because of the relationship they have with pollinators and other wildlife in a biodiverse ecosystem. Individuals are also concerned that non-native plants outnumber native plants in our urban and suburban landscape and thus have a negative impact on the life cycles of pollinating insects. Although non-native species do not support all aspects of wildlife habitat, they do provide shelter and other important ecosystem services for humans. They also provide floral rewards during the growing season, potentially filling gaps in bloom time in urban areas (Goulson, 2010). Most non-native plant species are not a problem, and some are considered beneficial (USDA NRCS B). For example, mature Norway spruce found in Lakeview Cemetery are contributing to a cooling urban tree canopy, stormwater management, and erosion prevention. However, they are not native to this area.

Future research would benefit from a deeper exploration of organizational and individual values regarding this issue. Social constructions of what constitutes beauty do not always align with ecological needs. If certain people value one species for their ornamental value, they will continue to have effects on the local biodiversity based on their plant choices. Questions remain about what plant choices are considered valid, and what value native plants hold in the minds of those making choices about plantings that have reverberating ecological effects. These questions were beyond the scope of this project.

Recommendation 3: Make Climate Change Resilience Explicit in Messaging

Climate Change was mentioned in Working Group meetings as a motivation for action. Although it was made explicit by certain members, it remains largely unspoken in ongoing meetings and pilot projects in the community. Alongside urbanization, our changing climate is another significant threat to Burlington's natural areas and wildlife habitat.

According to a press release regarding the contributions to the upcoming International Panel on Climate Change, human activities and carbon emissions are driving warming globally (Intergovernmental Panel on Climate Change, 2021). As the world warms, changes in climatic extremes are project to be larger in frequency and intensity: hotter temperatures, heavy precipitation, and agricultural and ecological droughts are likely to increase, with significant impacts on all types of social and ecological conditions.

As of this writing, Burlington is drafting an addendum to their Open Space Protection Plan guiding the implementation of Nature-Based Solutions to Climate

Change. Working Group members aim to support the implementation of goals in this addendum, including conversion of green spaces to pollinator and wildlife friendly habitat. Group documents and outreach materials currently lack explicit mention of climate change. Mention of climate change resilience in messaging will help support this addendum and make the goals of the group clearer to the public.

Recommended Project Site Selection Criteria

The mission of the Working Group is to connect public and private lands with native plant habitat, involving any willing individual. Given this mission and other values identified in Working Group meetings and interviews, the following list can guide the selection of project sites moving forward.

Social Conditions:

- ◆ **Resistance.** Community concerns or fears, lack of resources (financial, human, technological, etc.), or aesthetic needs should be taken into consideration. For example, if demonstration sites do not meet cultural expectations of human intention or picturesque nature (Nassauer, 1995), people may perceive the space as messy and unkempt, and resist involvement in future plantings. Finding stakeholders with the right leverage to build acceptance and support is an important step in identifying a site.

- ◆ **Support.** In public spaces, support could come from community leaders, “champions” of change, administration, management, groundskeeping, and other relevant stakeholders. Support could be built by identifying a collective sense of place through shared dialogue and collaborative processes (Rajala et al., 2019). Private landowners who share similar values or are interested in participating in habitat enhancement can also provide support.

- ◆ **Education and Outreach Potential.** Schools are ideal places to pursue habitat enhancement projects. Students can benefit from increased field-based learning in green spaces (Rakhshandehroo et al., 2015), and help maintain spaces where there may be limited capacity to manage the land. Other social institutions that have potential interface with the public include parks, community gardens, or public buildings (i.e., libraries, post offices, or cemeteries). These are places where people can observe demonstration sites, find inspiration, and locate resources to inform land management decisions.

Ecological Conditions:

- ◆ **Landscapes dominated by non-native plant species.** Conventionally designed landscapes are typically laden with non-native species (Burghardt et al., 2009), such as forsythia, hydrangeas, and hostas. While some non-native species provide floral resources to fill gaps in bloom time, an accepted ratio of native to non-native species is seventy percent native, thirty percent non-native (Tallamy, 2020; White, 2021). Assess spaces that are dominated by non-native species and provide alternatives to plant based on site conditions and social factors.
- ◆ **Buffer areas.** Buffers are designated areas that minimize impacts of negative external pressure on ecological processes (USDA National Agroforestry Center, n.d.). Buffers can protect important habitat for wildlife to breed, live, and hibernate in. The City of Burlington recognizes and protects important buffer areas in Riparian and Littoral Conservation Zones, Wetland Conservation Zones, and Natural Area Zones (City of Burlington, 2021B, Sec. 4.5.4). There is significant potential to work with landowners with access to these formally recognized buffer areas. On a smaller scale, buffers could be between sidewalks and roads, under tree canopies, over tree roots (to protect from lawnmowers), or between property boundaries in residential neighborhoods.
- ◆ **Lawns.** Green turf common in many urban and suburban plots are underutilized, open green spaces, playing little to no ecological function. They lack components

of habitat necessary for pollinators and other wildlife to survive, including plants to forage on, nesting sites, and places to overwinter (Hatfield et al., 2012). Since pollinators are negatively impacted by habitat loss (Cameron et al., 2011), and suburban landscapes with mowed yards contribute significantly to this trend (Tallamy, 2020), mowed lawns have great potential to improve habitat and biodiversity.

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Appendix

Appendix A. Semi-Structured Interview Guide. Interviews were recorded and transcribed remotely on MS Teams, using the following guide.

Introductions

1. Tell me a bit about yourself:
 - a. Where are you from?
 - b. When did you move to Burlington? What brought you here?
 - c. Tell me a bit about what are you doing (in career or life) now.
2. What organization do you work for, study, and/or volunteer with? Tell me about them.
 - a. In your own words, could you describe the mission of the organization? What is their role in Burlington?
 - b. When did you get involved? How did you get involved? What did you do for them when you started? What do you do for them now?
 - c. How is this organization connected to land in Burlington and management of that land?

Pollinator Habitat

3. Describe what you know about pollination ecology. For example, describe knowledge related to pollinators in general and/or a specific pollinator (like the monarch, bumblebee, or ruby throated hummingbird).
 - a. Describe a recent conversation you had with another person about this topic.
4. Are you currently working on pollinator habitat enhancement or conservation? Have you in the past?
 - a. Could you please describe some projects you are currently working on?
 - b. What motivates/motivated you to be involved?
 - c. What do you value about this work?
 - d. If no, what would motivate you to be more involved?
5. Is your organization currently working on pollinator habitat conservation? Or have they in the past?
 - a. If yes, how? What kind of activities does the organization pursue? Who leads the efforts?
 - b. If no, what reasons might motivate them to be more involved?
6. What would the ideal pollinator habitat look like to you? Feel free to describe a specific example or what it might look like generally.
 - a. How would you define “enhanced pollinator habitat?” How does your organization define it?
 - b. What are the costs and benefits of habitat enhancement?
 - c. What land management practices do you think are best for pollinators?

- d. [For organizations that manage land] Does your organization currently employ these techniques? Why or why not?
7. Have you noticed any good examples of pollinator habitat around Burlington? Describe them to me.
 - a. How did they come to be this way?
 - b. What do you value most about them?
 8. Have you noticed places around Burlington that do not currently have habitat beneficial for pollinators, but have potential for habitat enhancement? Describe them to me.
 - a. What do you value about these places / what do these places mean to you now?
 - b. How would this place change if habitat was installed?
 - c. What would need to happen? What resources would be needed to implement this change?

Champlain Elementary School

9. What is your relationship with and work connected to Champlain Elementary School?
 - a. What does this place mean to you?
 - b. What stories about the school or experiences come to mind?
 - c. Who is currently using the land? For what purposes?
 - d. How is the land currently being managed? Who makes these decisions and implements them? Are there any challenges associated with this?
 - e. What is the current status of pollinator habitat here? Tell me a story about pollinator habitat here/your experience with pollinator habitat here.
 - f. If this place were to incorporate more habitat for pollinators, how would it change?
10. Do you think elementary schools would be a good space for pollinator habitat? Why or why not?

Lakeview Cemetery

11. How did you come to know Lakeview Cemetery?
 - a. What experiences have you had there? Tell me a story about this place/describe it to me. Has your experience with Lakeview changed over time? If so, how?
 - b. What are three words that come to mind describing this place?
 - c. How is Lakeview currently being managed? For what purposes/functions/activities? Who uses this space?
 - d. If this place were to incorporate more habitat for pollinators, what would change about this place? For you, others, your organization?
 - e. Have you ever considered cemeteries as places for habitat enhancement? What do you think about this idea?

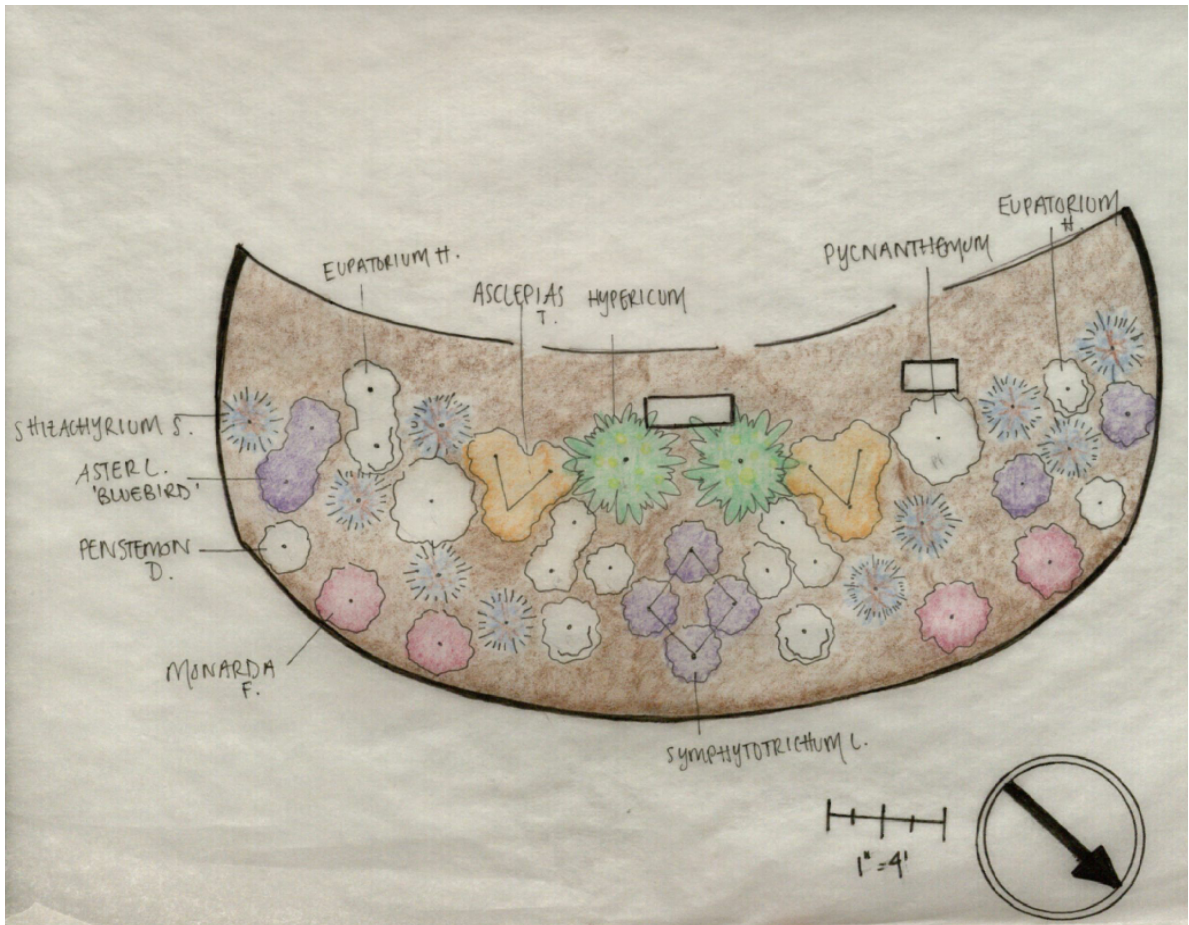
Closing

- a. What do you think was the most important thing we talked about today? Why?
- b. Is there anything about this topic you think I should know that you didn't say yet?
- c. Do you have any recommendations for other people that would be good for me to talk to? Do you have their contact information?
- d. Thanks! A reminder that your responses will remain anonymous.

Appendix B. Habitat Garden Designs

Design 1. Garden Design for Lakeview Cemetery, including a hand-drawn plan and plant list. The garden was installed in the spring of 2021, so the design is accompanied by before and after photos from the time of planting to maturity at the end of the growing season.

A. Design

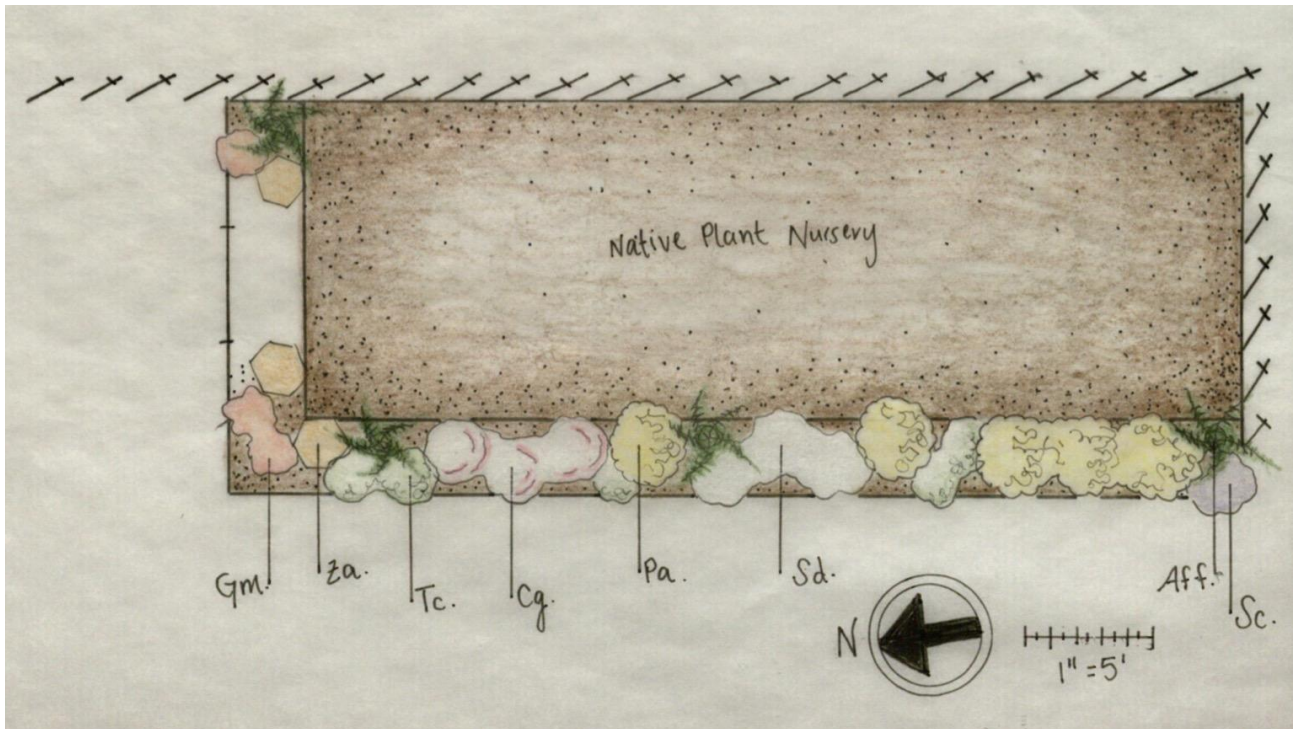


Botanical Name	Common Name	Plant Type	Sun/Shade Needs	Flower Color	Bloom Time	Mature Heigh/Width	Moisture Preference
<i>Penstemon digitalis</i>	Beardtongue	perennial	Sun/Pt Shade		early/spring	12-36" HT / 14-18" SP	average - dry
<i>Monarda fistulosa</i>	Beebalm	perennial	Sun/Pt Shade		mid/summer	24-42" HT / 12-18" SP	average
<i>Pycnanthemum tenuifolium</i>	Mountain Mint	perennial	Sun/Pt Shade		mid/summer	8-16" HT / 12-36" SP	average - dry
<i>Asclepias tuberosa</i>	Butterfly Weed	perennial	Sun		mid/summer	12-30" HT / 12-24" SP	average - dry
<i>Eupatorium hyssopifolium</i>	Hyssopleaf boneset	perennial	Sun/Pt Shade		late/summer-fall	12-36" HT / 16-24" SP	average - dry
<i>Schizachyrium s.</i>	Little Bluestem	perennial	Sun/Pt Shade		late (fall foliage)	12-48" HT / 8-24" SP	average - dry
<i>Aster laevis</i>	Fall-blooming aster	perennial	Sun/Pt Shade		early fall	12-36" HT / 12-18" SP	average - dry
<i>Hypericum perforatum</i>	St. John's Wort	shrub	Sun/Pt Shade		mid/summer	2-4' HT / 2-4' SP	average - dry

B. Photos of Lakeview Garden



Design 2. Garden Design for Champlain Elementary School, including a hand-drawn plan and plant list. Lesson Plans in Appendix E accompany this garden plan.



Botanical Name	Common Name	Sun/Shade Needs	Flower Color	Bloom Time	Mature Height/Width	Moisture Preference
<i>Symphytotrichum cordifolium</i>	blue wood aster	Sun/Pt Shade/Shade		fall	HT: 12-36"; SP 18-24"	average - dry
<i>Symphytotrichum divaricata</i>	white wood aster	Sun/Pt Shade/Shade		fall	HT: 12-24"; SP: 12-18"	average - dry
<i>Athyrium filix-femina</i>	lady fern	Pt Shade/Shade	N/A	N/A	HT: 12-24"; SP: 12-18"	average - wet
<i>Chelone glabra</i>	white turtlehead	Sun/Pt Shade		fall	HT: 18-30"; SP:12-24"	wet
<i>Geranium maculaum</i>	wild geranium	Sun/Pt Shade		spring	HT: 12-18"; SP: 8-12"	average - wet
<i>Packera aurea</i>	golden groundsel	Sun/Pt Shade		spring	HT: 8-16"; SP: 10-30"	average - wet
<i>Tiarella cordifolia</i>	foamflower	Pt Shade/Shade		spring	HT: 3-12"; SP: 12-24"	average
<i>Zizia aurea</i>	golden alexander's	Sun/Pt Shade		spring	HT: 12-24" SP: 10-14"	average - wet

Appendix C. Lesson Plans for three grade levels at CES about pollination ecology and seed saving, to accompany garden bed designs around the perimeter of a new “native plant nursery” being developed by the school in partnership with the Parks, Recreation, and Waterfront Department.

Lesson 1. Earth and Human Activity: Golden Alexander’s & the Great Seed Hunt

Students who demonstrate understanding can:

K-ESS3-1. *Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live.*

Students will learn:

- Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.
- Systems in the natural and designed world have parts that work together
- How to develop and use a model to represent relationships in the natural world

Common Core State Standards Connections:

ELA/Literacy

SL.K.5 Add drawings or other visual displays to descriptions as desired to provide additional detail

Mathematics

K.CC Counting and Cardinality

Overview: In this *fall activity, students will identify and observe *Zizia aurea* or golden alexanders in the garden and create a drawing describing the life cycle of the plant.

Students will explain the mutual relationship between the pollinator and the plant and how the seeds were produced due to insect pollination. Students will collect seeds as a class to save for their native plant nursery to propagate in the spring, and describe the seeds using senses of sight, touch, and sound. After collection, teachers will mix seeds into a batch of other seeds and have students hunt for seeds in the mix, categorizing seeds by descriptive terms used in a previous exercise. Students will count how many seeds they collected at the end.

*In a spring rendition of this activity, students could observe and identify pollinator species that are visiting the flower. Since it is a host plant for swallowtail caterpillars, they could try to hunt for caterpillars. Students could hunt for *Zizia aurea* seeds in a mixture of other seeds collected, and then propagate the seeds in the native plant nursery.

Grade Level/Range: K-2

Objectives:

Students will learn:

- What ecological conditions plants need to survive and thrive
 - o Different plants need different conditions
- Pollinators need plants to survive
- Plants need seeds to reproduce
- How pollinators are involved in the life cycle of plants

Time: 45 minutes -1 hour

Materials:

- Literature on plants and pollinators
- Flower garden
- Paper
- Writing utensil
- Worksheet
- Art supplies, colored pencils, crayons, markers, blank paper or coloring worksheets

Advanced Preparation:

Prior to the activity, have students bring in seeds from their home to compare and contrast different seed shapes and types. They can be edible or from ornamental plants. Seeds will be used in subsequent seed hunt.

Background Information:



Species Profile: Zizia aurea, aka “golden alexander’s”

Height: 12-24”

Spread: 10-14”

Hardiness Zone: 4-9

Sun Exposure: Sun to Part shade

Soil Moisture: Average to Wet

Special Features: Winter interest, host plant for swallowtail caterpillars, and red fall foliage.

Photo credit: Tori Hellwig

Biological terms and scientific names of plants are generally understood and communicated in Latin. *Zizia aurea* is the Latin, or botanical, name for this plant. “Aurea” is Latin for gold or golden, hence the common name “golden alexanders.” All plants in the wild and in our gardens are known in the scientific community by these botanical names. They also all need sun and water to live, along with nutrients found in the soil.

Zizia aurea is an “umbelliferous flower,” shaped like a patty with little clusters of yellow flowers filled with nectar (sugar) and pollen (protein). Other plants with this flower shape are carrots, fennel, and anise. All of these plants usually smell good too! The small yellow flowers of golden alexander’s are perfect for small pollinating insects with smaller tongue to reach the bowls of sugary nectar offered by each little flower.

Bees are particularly good at pollinating because they have hairy bodies that create a sticky surface for the flower’s pollen, like a tennis ball. When they visit the flower for nectar, pollen sticks to their body hairs and are transferred to other flowers when they visit them for more food. Some bees even collect pollen specifically to feed their young.

After bees leave pollen behind in a different flower, the flower is pollinated, and the flower produces seeds. The seeds contain everything that is needed to make a new plant: roots, shoots, stems, even food! Growing new plants will feed more bees once the new plants bloom.

Activities:

1. Read a story. Suggested reading based on the South Burlington Seed Library reading list:

- a. Holub, Joan. *Spring Is Here: A Story About Seeds.*
- b. Mackay, Elly. *If You Hold a Seed.*
- c. Nelson, Kadir. *If You Plant a Seed.*
- d. Ransom, Candace. *Garden Day!*
- e. Schubert, Jan. *The Sun Seed.*
- f. Sollinger, Emily. *Olivia Plants a Garden.*
- g. Ward, Jennifer. *What Will Grow?*

2. Visit the garden. Observe and record observations using the following worksheet:

3. **Draw and design.** Have students draw a representation of the complete life cycle of the plant, including a visit from a pollinator of their choice. Alternatively, students could color in a pre-drawn *Zizia aurea* flower and draw a pollinator of their choice pollinating the flower.
4. **Seed hunt.** Teachers will mix seeds collected from the gardens and mix them into a batch of other seeds student bring in from home. Students will separate and categorize seeds, describing each seed using senses of sight, sound, and touch. Students will complete this exercise by counting how many *Zizia aurea* seeds they separated from the bunch.

Additional Resources:

<https://www.seedsavers.org/starting-seeds>

<https://www.seedsavers.org/learn>

<https://blog.seedsavers.org/>

<https://vcgn.org/honoring-seeds-their-stories/>

<https://vcgn.org/seed-libraries-sowing-together-our-community-fabric/>

<https://southburlingtonlibrary.org/seed-library>

<https://www.highmowingseeds.com/blog/how-to-do-a-quick-germination-test-at-home/>

<https://www.highmowingseeds.com/blog/best-practices-for-long-term-seed-storage/>

<https://www.uvm.edu/news/extension/new-e-book-inspires-pollinator-gardening>

<https://www.fs.fed.us/wildflowers/pollinators/animals/index.shtml>

https://www.fs.fed.us/wildflowers/pollinators/What_is_Pollination/syndromes.shtml

Lesson 2. Interdependent Relationships in Ecosystems: The Monarch & the Milkweed,
Modelling & Mathematics

Students who demonstrate understanding can:

2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow.

2-LS2-2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants

2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.

Connects to Common Core State Standards

ELA/Literacy:

W.2.7 Participate in shared research and writing projects

W.2.8 Recall information from experiences or gather information from provided sources to answer questions

SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings

Mathematics:

MP.2 Reason abstractly and quantitatively

MP.4 Model with Mathematics

Overview

In this activity, students will develop skills related to listening and recalling information from a story shared aloud about the monarch and the milkweed. Students will listen to a story and reflect on takeaway lessons on pollination in a journal. In one related partner activity, students will research and develop a skit, sketch, drawing, diorama or physical model of swamp milkweed being pollinated by bees or butterflies. Students will be able to describe the life cycle of the plant and the development of seeds by pollinators.

In another related Spring activity, students will take seeds they have collected from *Asclepias incarnata* (swamp milkweed) and grow it in in the classroom or the native plant nursery. Students will plan and conduct experiments with a partner based on previous lessons about plant needs and research. If propagation is successful and the plants are grown to maturity, plants could be planted in the garden at school or at Oakledge Park to help build pollinator habitat.

Grade Level: 2

Students will learn:

- Plants depend on animals for pollination
- Plants depend on water and light to grow
- How to develop a model based on evidence
- Designs can be conveyed through sketches, drawing, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people
- How to plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question
- Events have causes that generate observable patterns

Time: ½ day to walk to Oakledge Park; 60-90 minutes to read story and reflect in journal. 60 minutes to develop a model. 15 minutes daily to check on plant development.

Materials:

- Books or stories on the monarch and the milkweed and seed gardening
- Digital resources about plants and pollinating insect habitats
- Creative/art resources: Pencil, colored pencils/markers/crayons, paper, shoe boxes, pipe cleaners, old magazines, fun clothing (fluffy scarves, hats, pom poms)
- Seedling or plant growing medium
- Water
- Seed growing containers (plastic seed growing trays donated from plant nursery, yogurt/cereal cups, etc.)

Background Information:



Species Profile: *Asclepias incarnata*, also known as swamp milkweed

Height: 24-42”

Spread: 12-24”

Hardiness Zone: 3-9

Sun Exposure: Sun to Part Shade

Soil Moisture: Average to Wet

Special Features: Deer and Rabbit Resistant, a host plant for monarch caterpillars and attractive to pollinators & other wildlife.

Photo credit: Tori Hellwig

The monarch and the milkweed are one of the most iconic pairs of plants and pollinators in the scientific community. Monarch caterpillars are specialists and feed exclusively on the leaves of milkweed species, including *Asclepias incarnata* (swamp milkweed), *Asclepias tuberosa* (butterfly weed), and the common roadside milkweed, *Asclepias syriaca*. Adult monarchs will also sip on the nectar of milkweed flowers, occasionally collecting pollen and transferring it to other flowers. When they visit and move pollen from one flower to another of the same species, they are helping to pollinate the flowers. This process creates seeds and future milkweed plants to feed other monarch caterpillars.

Monarch butterflies are unique because they migrate every year, just like migrating birds such as geese, osprey, and orioles. The monarchs seen in Vermont must migrate south all the way to forests in the mountains of Mexico. This migration takes a lot of energy, which monarch butterflies get from sugary nectar in milkweeds and other wildflowers. Bees, wasps, and other flying insects also visit milkweeds for their sugary

nectar. Along with nectar, Bees collect pollen from flowers for their young, and transfer it to other flowers when they visit them for more pollen and nectar. Insects transferring pollen between flowers is known as “insect pollination,” and plants like the milkweed rely on insects to perform this process for them.

When pollen from the “stamen,” or male part of the flower, comes in contact with the “pistil,” or female part of the flower, it germinates and grows down towards the ovary, where it will hopefully be fertilized and produce seeds. Seeds are future generations of the plant, and are only created when pollen from one flower is transferred to another flower of the same species. The seed has an embryo on the inside, and endosperm on the outside, which provides nutrition to the embryo as the seed develops. These two parts are wrapped up in a “seed coat.” Once the seed coat is broken, the seed will start to germinate and grow into a mature plant. The embryo will develop into roots, shoots, and leaves, fed by the nutrition from the endosperm along with enough sunlight and water to the seedlings liking.

Activities:

1. Read a story. Suggested reading based on the South Burlington Seed Library reading list:

- a. Andrews, Courtney Marie. *Old Monarch: Poems*
- b. Aragwal, Anurag. *Monarchs and Milkweed: A Migrating Butterfly, a Poisonous Plant, and Their Remarkable Story of Coevolution*
- c. Argueta, Jorge. *Xochitl and the Flowers.*
- d. Brown, Peter. *The Curious Garden.*
- e. Carle, Eric. *The Tiny Seed.*
- f. Fogliano, Julie. *And Then It's Spring.*
- g. Pak, Soyung. *A Place to Grow.*
- h. Steward, Sarah. *The Gardener*

2. Reflect. Have students write in a journal what they learned from a story, and where they may have seen these events in their own life/experience. At school? At the park? At home?

3. Design a model. In a partnership, students develop a skit, sketch, drawing, physical model or diorama of the relationship between plants and pollinators. Students will present their representation to the class.

- 4. Grow.** Have students work in pairs to grow seedlings and record observations in a growing journal. Students will design an experiment to test solutions to growing seeds indoors, potentially testing soil, water, or sunlight needs between seedlings (2 per group). Students will observe their plants daily and record observations about growth rates, water needs. Experiment could be based on the following worksheet:

Science Experiment Form

Name _____

On _____ (date) Plant A was _____ (Tell what happened to it.)



It received _____ of water.
(how much)



It received _____ of sunlight.
(how many hours)

It looked _____ because _____
(Describe its condition.) (Speculate about the reasons.)

This may prove that _____

On _____ (date) Plant B was _____ (Tell what happened to it.)



It received _____ of water.
(how much)



It received _____ of sunlight.
(how many hours)

It looked _____ because _____
(Describe its condition.) (Speculate about the reasons.)

This may prove that _____

Fig. 2.1. Science Experiment Form.

From *Cultivating a Child's Imagination Through Gardening*. © 1996. Nancy Allen Jurenka and Rosanne J. Blass.
Teacher Ideas Press. (800) 237-6124.

Additional Resources:

<https://www.seedsavers.org/starting-seeds>

<https://www.seedsavers.org/learn>

<https://blog.seedsavers.org/>

<https://vcgn.org/honoring-seeds-their-stories/>

<https://vcgn.org/seed-libraries-sowing-together-our-community-fabric/>

<https://southburlingtonlibrary.org/seed-library>

<https://www.highmowingseeds.com/blog/how-to-do-a-quick-germination-test-at-home/>

<https://www.highmowingseeds.com/blog/best-practices-for-long-term-seed-storage/>

<https://www.uvm.edu/news/extension/new-e-book-inspires-pollinator-gardening>

<https://www.fs.fed.us/wildflowers/pollinators/animals/index.shtml>

https://www.fs.fed.us/wildflowers/pollinators/What_is_Pollination/syndromes.shtml

Lesson 3. Earth and Human Activity: Human Impacts on Plants and Pollinators

Next Generation Science Standards Addressed:

Students who demonstrate understanding can:

5-ESS3-1: *Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.*

Connects to Common Core State Standards:

ELA/Literacy:

RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text;

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently

RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgably

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital resources; summarize or paraphrase information in notes and finished work, and

provide a list of sources

W.5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research

Overview:

In this activity, students will develop research skills by obtaining, evaluating, and communicating information about human impacts on pollinators and natural communities that are best suited for *Chelone glabra*, or white turtlehead. Students will take a field trip to a local park to learn about natural communities and how plants and pollinators mutually exist there. Students will then research and report on a specific human activity in Vermont that negatively impacts pollinators. They will present existing solutions or propose a novel, creative solution to this problem based on solutions being implemented by other local individuals and organizations. Students will then grow saved seeds and

identify future locations around the school and Burlington to continue planting and propagation in the future.

Grade Level/Range: 5

Objectives:

Students will learn:

- Human activities in our every-day economy have major impacts on land, vegetation, streams, and air, but some individuals and communities are doing things to help protect Earth's resources and environments
- Creative problem-solving skills; how to obtain and combine information from books and other reliable media to explain phenomena and solutions

Time: 1-2 days, plus collection of written report

Materials:

- Books and/or digital resources on:
 - o Native plants,
 - o pollinators, and
 - o the State of Vermont
- Maps of Burlington/Vermont's natural areas
- Paper
- Pen, pencils, or writing utensils

Background Information:



Photo credit: Tori Hellwig

Species Profile: *Chelone glabra* aka “white turtlehead”

Height: 18-30”

Spread: 12-24”

Hardiness Zone: 3-9

Bloom Color: White

Sun Exposure: Sun/Part-Shade

Soil Moisture: Wet

Special Features: Deer and Rabbit

Resistant but attractive to bumble bees and other pollinators, turtlehead a fall blooming native host plant for Baltimore checkerspot and buckeye butterflies.

White turtlehead, known in its botanical terms as *Chelone glabra*, is an herbaceous perennial native to Vermont and many other ecoregions in the Eastern United States. They are typically restricted to moist soils in the wild but can tolerate average soil conditions in the garden, so long as there is no drought. Pollinators like the bumble bee are attracted to these flowers whose white blooms are shaped like little turtle heads. When the bees visit the flowers, they receive floral rewards such as pollen (protein) and nectar (sugar) to help fuel their flight and feed their young. In return, the flowers produce seeds that help the plant continue to reproduce and grow in other places in the future.

One place you can find *Chelone glabra* in the wild is on the shorelines of Green River Reservoir State Park, visited by both bumble bees and boaters. Green River Reservoir State Park in Hyde Park, Vermont is one example of a place whose human influence has had significant impacts on Vermont’s flora and fauna. A reservoir can be a natural or artificial body of water used for storage or regulation of water. The land that Green River Reservoir is located on was flooded in 1946 for flood control and to create a

hydro-electric dam for the village of Morrisville, Vermont. Although this place was impacted by the desire for humans to control water, it is now used for recreational purposes and serves as valuable habitat for wildlife. From spring ephemeral wildflowers to eagles and bumble bees, this place is a source of food, water, and shelter for a variety of life that makes Vermont a special place to live.

Activities:

1. **Field trip.** Have students visit Oakledge Park and learn about the human communities that exist within some of Burlington’s valuable natural resources and communities. This could be led by the 5th grade teacher, or willing partners from local organizations such as BPRW or Burlington Wildways.
 - a. Reflect on observed human activities there and how they may be helping or hurting this place.
 - b. Ask them to observe plants and wildlife.
 - i. What do they see?
 - ii. What parts of Oakledge are supporting wildlife, and how?
 - iii. How could some areas be improved?
 - c. After a group assessment of this site, have students determine individually if *Chelone glabra* would thrive there, and explain where and why.
 - i. Where are the sun conditions favorable?
 - ii. Where is the soil moisture favorable?
 - iii. What kinds of pollinators are present to help the plant pollinate?

2. **Research.** Visit the library to access books and digital resources related to this topic. Some suggested literature to get started:
 - a. **Literature**
 - b. **Websites:**
 - i. <https://vtfishandwildlife.com/pollinators-in-peril>
 - ii. <https://xerces.org/>
 - iii. <https://www.pollinator.org/>
 - iv. <https://burlingtonwildways.org/>

3. **Report.** This will be a two-part exercise on communicating environmental problem solving.
 - a. **Part 1: Writing.** Students will gather information and write a report about a human activity in Vermont that is negatively affecting pollinators and plants. This can be local in Burlington, or somewhere else in the state.
 - i. Describe this place and it's physical geography.
 - ii. Describe the human activity and how it affects a pollinator.
 - iii. Propose a solution
 - b. **Part 2: Presentation.** Students will present the information they have learned to the class. Presentations must describe the problem and solution in a creative way but be based on their research. Presentations can be individual, or in groups, and take the form of:
 - i. Poetry
 - ii. Story
 - iii. Skit or play
 - iv. Drawing
 - v. Poster
 - vi. PowerPoint
4. **Grow!** In the Fall, collect seeds from *Chelone glabra* in the native perennial garden near the tree nursery and gardens.
 - a. Save the seeds in an envelope or container labeled with the name of the plant on them and date when they were collected.
 - b. In the spring, when the temperatures begin to consistently remain above 50 degrees, gather seeds and supplies for growing and have groups of students propagate seeds to be grown in the native plant nursery.
 - c. Materials you will need include:
 - i. Saved seeds
 - ii. Containers (egg cartons, yogurt cups, recycled bottles cut in half)
 - iii. Access to water
 - iv. Space to start seeds indoors

Additional Resources:

<https://www.seedsavers.org/starting-seeds>

<https://www.seedsavers.org/learn>

<https://blog.seedsavers.org/>

<https://vcgn.org/honoring-seeds-their-stories/>

<https://vcgn.org/seed-libraries-sowing-together-our-community-fabric/>

<https://southburlingtonlibrary.org/seed-library>

<https://www.highmowingseeds.com/blog/how-to-do-a-quick-germination-test-at-home/>

<https://www.highmowingseeds.com/blog/best-practices-for-long-term-seed-storage/>

<https://www.uvm.edu/news/extension/new-e-book-inspires-pollinator-gardening>

<https://www.fs.fed.us/wildflowers/pollinators/animals/index.shtml>

https://www.fs.fed.us/wildflowers/pollinators/What_is_Pollination/syndromes.shtml

Appendix D. Meanings associated with Lakeview Cemetery and Champlain Elementary School, based on semi-structured interviews, field notes, and participant observation in Working Group meetings. Meanings are categorized by the typology framework from Rajala et al. (2019), and shared meanings are highlighted.

Table 1. Meanings of Lakeview Cemetery

Characteristic meanings	Wildlife habitat, wildlife corridor , beautiful views, beautiful place to work, a collection of grand trees, sterile mowed environment, sandy lakeshore soils
Functional meanings	Burial grounds, recreation (walk dogs, ride bikes), place of work , place to view wildlife, place to learn, gardens to support pollinators
Experiential meanings	Respite from the City, peace and quiet, a place to situate the self in space and time, place to learn, place pay respects to loved ones that have passed
Interpersonal meanings	Connect with volunteer community, Meeting place to spend time with friends and family, place to be introduced to others, place for student groups to study birds & trees

Table 2. Meanings of Champlain Elementary School

Characteristic meanings	Wildlife habitat, wildlife corridor , wet land adjacent to Englesby Brook, mowed lawns, teaching gardens, poorly drained, wet soils
Functional meanings	Place for children to learn, place of work , place to grow food, place to grow native plants, gardens to support pollinators
Experiential meanings	Sense of wonder in interactions with plants and wildlife, sensory gardens, inspiration, meaningful work with children
Interpersonal meanings	Connect with students, parents, faculty, neighbors, & the City, students connecting over gardens, knowledge sharing