Blooming Together: An Action Plan for Creating Habitats for Pollinators (CHP)

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Foreword

Throughout the Spring of 2024, our ENVS 50 class had the pleasure of working with Creating Habitats for Pollinators (CHP) and David Hammond ‘89 to help advance their mission of planting native wildflowers to increase pollinator habitat and foster community engagement. CHP is responsible for pollinator plantings in New Hampshire, Vermont, Michigan, and Kentucky, with plans to expand planting activities across the country.

To fully support CHP’s wildflower planting efforts, our class split into four teams: the College Relations, Cost-Benefit Analysis, Pollinator Ecology, and Grant Development and Nonprofit teams. At the same time, the Synthesis groups, composed of at least one member of each of the four teams, created social outreach products to combine our work. These included posters and Instagram content drawing attention to CHP’s activities, the importance of native pollinators and threats to their survival, and new events and pollinator gardens established by CHP. The four groups conducted reviews of extant literature in the social and natural sciences, interviews with experts, field study of CHP’s plots and bee boxes, and economic and environmental impact analyses relevant to CHP’s work.

In addition to this report, our class secured approval for two new wildflower garden plots at the

Kemeny Courtyard and Sustainable Living Center on campus. We participated in ENVS 50 Planting Day at both sites, applying our learning and skills to tangible outcomes for CHP. We are thrilled to have contributed to the advancement of CHP's goals in Hanover and beyond with our research and hands-on activities.

We would like to thank Professor Theresa Ong, Karen Bieluch, David Hammond, and Brian Arruda for their oversight and guidance as we worked on this project. Without them, none of this would have been possible.

Land Acknowledgement & Discussion

Land acknowledgements arose within the past twenty years and have become popular, especially within the past decade, as a means to recognize whose tribal lands we are occupying at a given moment. While these statements are a necessary step forward in acknowledging the history and rights of Indigenous peoples, there is also a danger that once a land acknowledgement is put forth, all other work toward building positive relationships with local Native communities ceases. Instead, we would like to emphasize the need for action beyond simply stating whose traditional territory we are on. Examples of such action might include repatriating culturally significant objects and the remains of Indigenous relatives, creating a system of land co-management, and integrating traditional Indigenous knowledge into educational programs.

With this in mind, we would like to acknowledge the land that Dartmouth College occupies is undoubtedly traditional Abenaki territory. There are currently no federally recognized Abenaki tribes in New Hampshire, which offers its own set of challenges to various groups and organizational entities claiming Abenaki heritage, as many of the legal rights of Indigenous peoples within the United States are dependent upon a tribe's federal recognition status. True sovereignty does not stem from federal recognition, but instead from the communities themselves. However, the reality for many tribes is that acquiring this status allows for a better ability to implement and execute the rights and policies of self-determination.

In order to properly discuss land acknowledgments in the context of Dartmouth, we also believe it is important to recognize the ongoing debate and concerns about which existing entities in New Hampshire and Vermont are truly descended from Abenaki people and which entities are only claiming to have Indigenous heritage. These matters should be taken seriously and should be primarily resolved within the communities themselves.

We would like to conclude by offering suggestions on how CHP could work with tribes on future pollinator projects. There are twelve federally recognized tribes in Michigan; CHP could reach out to any number of them and inquire about creating pollinator gardens on their tribal lands. Additionally, tribes might be open to having culturally significant species planted in or near wildflower plots. If acquiring seeds for these species is not an issue, perhaps CHP would be willing to include certain medicinal, ceremonial, or food-producing plants in wildflower plots located on tribal lands. Above all, communication with Native peoples about pollinator projects should be open-minded so that both tribes and CHP are proud of the work they accomplish when in collaboration.

Mission Statement

Over the last five years, David Hammond '89 and his respective non-profit Creating Habitats for Pollinators (CHP) have been responsible for over a dozen plantings in the Plymouth/Canton area in Michigan as well as plantings in VT, NH, and KY. CHP has also served as a consultant for wildflower planting projects in NY, MA, and RI. Additional pollinator plantings are being added every month. The goal of the CHP is to encourage communities, organizations, and individuals to support and engage with native landscaping. Planting is done by students, alumni, faculty, staff, and local residents who partner closely under CHP, which recognizes the critical importance of pollinating insects like bees, butterflies, beetles, moths, and other pollinators in supporting healthy ecosystems, agricultural systems, and human health.

At Dartmouth, CHP partners closely with the Class of 1989 Pollinator Project, which David Hammond heads. The Class of 1989 Pollinator Project is a multi-year service project created by Dartmouth's Class of 1989 to increase wildflower habitat for pollinating insects and animals throughout the communications of the Upper Valley. The goal of the project is to encourage Dartmouth and Upper Valley communities to support native landscaping. All the planting of the project is done by students, alumni, faculty, staff, and local residents. The project is funded purely by donations from the Class of '89 alumni. The project has planted over 70k square feet of pollinator gardens in the Upper Valley at 22 distinct locations.

There are a multitude of benefits that these pollinator gardens have provided the Upper Valley Community and, more specifically, Dartmouth: they have brought the community such as beautifying local areas, engaging community members, bringing people together with a common goal, and saving money in staffing and maintenance costs. For this reason, this group wants to help Hammod, CHP, and the 1989 Pollinator project expand connections and reinforce relationships in Dartmouth and its surrounding community so that it is easier for David and his work to continue with institutional support.

GROUP 1: COLLEGE LAND TRUST AND RELATIONS

Message to the Reader

The College Land Trust Group has been working on the following objectives: (1) institutionalizing the process of planting pollinator gardens at Dartmouth, (2) strengthening stakeholder relationships between CHP and the College, Pine Park Association, and the Town of Hanover, the student-body population, and (3) finally identifying additional sites where CHP can establish gardens.

As a group, we met with David Hammond, the head of Creating a Habitat for Pollinators, and the stakeholders he outlined as important to start this process of institutionalization. We also endeavored to identify new stakeholders and partners to CHP. We did this by talking first to the stakeholders David outlined and then asking these stakeholders who else it would be beneficial for us to talk to. Our goal is to ensure that David's Pollinator's Gardens are recognized as an institutional priority even after we graduate from Dartmouth; to create a contact guide to improve the process for David or other students to reach out to stakeholders at Dartmouth about the wildflowers planted at Dartmouth. We also want to create a culture where students, Professors, and residents engage with the non-profit to increase the number of sites that the CHP has at Dartmouth and beyond. Thus, keeping these ideas in mind, our deliverables take the following forms:

- **Additional Sites:** on Dartmouth's campus, we have identified additional planting sites for CHP pollinator garden planting. Some of these sites have already been successfully pitched and their tilling will begin shortly, while other sites are being investigated.
- **Resource Guide**: Our primary research focus this term has been on developing a research guide, which serves as a cornerstone of our work. A research guide functions as a relationship-building tool designed to highlight the strengthened connections between Dartmouth, the Pine Park Association, and the Town of Hanover. Throughout this process, we have engaged with numerous stakeholders both within and outside Dartmouth: FO&M, the Sustainability Office, the Landscape Committee, student groups, Dartmouth Faculty, and the Pine Park Association in various meetings to generate a desire for campus institutionalization of pollinator gardens. This guide serves as a comprehensive documentation of these interactions, illustrating the interconnectedness between various parties and identifying key individuals for specific purposes. Moving forward, David will have a consolidated and readily available resource providing information on upholding and cultivating stakeholder relationships.
    - This resource guide also includes the following components:
        - Plans for institutionalizing pollinator gardens and legacy building
        - Locally sourced Research Data
        - Class of 1989 reunion site map

Part 1: Locations for Pollinator Gardens

Introduction

Through collaborative efforts with various stakeholders, we have identified and have been approved for a few locations for upcoming planting initiatives. The first plot of land is outside the Fairchild building[1], which emerged as a recommendation from department administrator Kim Wind. The success of this location will further endorse department support. The second location is at the Sustainable Living Center[2] in North Hall, next to Shabazz Hall, which has already scheduled a tilling date. This achievement was made possible through close coordination with the Living Center itself and the Dartmouth Student Government. The third plot is behind Baker-Berry Library[3] on the North side behind the granite wall and along the Eastern sidewalk. This plot was done in collaboration with FO&M, which approved and helped prepare the location. Currently, our organization is trying to secure its fourth location by collaborating with Professor Emeritus Linda Fowler to explore additional planting opportunities at Pine Park. This endeavor aligns with Pine Park's inclusion within the broader Pine Park Association, underscoring a commitment to leveraging existing resources and partnerships for environmental conservation.

Identified Pollinator Garden Locations

1. Outside of the Fairchild building

This sun-drenched area outside Fairchild, currently occupied by declining shrubs, has the potential to be reborn as a vibrant wildflower garden. Imagine a tapestry of colorful blooms attracting butterflies and bees – a symbol of the Environmental Studies department's commitment to biodiversity and ecosystem health.

This is the location right outside of Fairchild Tower.[1]

2. Sustainable Living Center

This small patch outside the Sustainable Living Center (SLC) has the potential for a delightful transformation. Instead of plain grass, there will be a wildflower garden, alive with vibrant blooms and the gentle hum of insects. This garden will be small but mighty, showing that the SLC is committed to sustainability and will take measures to achieve its goals.

Sustainable Living Center[2]

3. North Side of Baker-Berry

This shaded strip along the library's granite wall offers a unique opportunity to showcase the beauty of woodland wildflowers. Transform it into a vibrant tapestry of woodland wildflowers. This prominent garden will surprise and delight students, introducing them to the quiet charm and ecological importance of plants adapted to the shady sun.

Baker-Berry Plots [3]

Part 2: Resource Guide

Introduction

Welcome to our resource guide; it represents the culmination of our primary research focus this term. At the heart of our efforts lies the development of a stakeholder research guide, outlined to serve as a cornerstone of our work. Throughout this journey, we have engaged with a multitude of stakeholders, both within and outside Dartmouth, weaving together a web of collaborative efforts.

This guide stands as a testament to our commitment to fostering meaningful connections and partnerships for CHP. It serves not only as documentation of our interactions but also as testament to the interconnectedness between various parties between the College, the Pine Park Association, and the Town of Hanover. Through its pages, you'll find a depth of insights, highlighting key individuals and delineating pathways for future collaboration, including with Professors in the Environmental Studies (ENVS) department and through the Landscape Committee at Dartmouth.

At its core, this resource guide functions as a powerful relationship-building tool. It showcases the strengthened connections between Dartmouth, the Pine Park Association, and the Town of Hanover, underscoring the mutualistic relationship that exists between academia and community development.

As we forge ahead, this guide will serve as a compass for David and others, offering invaluable insights into how they can navigate and cultivate these vital relationships. We hope that through its guidance, we can continue to foster a culture of collaboration. In terms of concrete deliverables in the guide, the guide will first start off by breaking down who we have talked with, why we have talked to them, and how they are related. Then, in the next part of the guide, we will go into the institutionalization and legacy building part of the guide and how we will implement that. Then, we will highlight the data from our population survey. Finally, we will show our site map for the 1989 class reunion.

Contacts and Departments

These stakeholders at Dartmouth are useful for building connections within the College. Many of these contacts are tied to the landscape committee. They meet once a term and make important decisions regarding grounds maintenance. If we want to prioritize CHP's pollinator gardens at an institutional level, then we need to talk to the landscaping committee and get them on board.

Dartmouth Contacts

Sustainability Office

The mission of the Sustainability Office is to challenge and empower Dartmouth College and its respective students to take on the human and environmental problems of a rapidly changing planet. They do this via hands-on learning, building inclusive community, supporting research and teaching, and transforming campus operations. The Sustainability Office has pledged to support the longevity of CHP and the Class of 1989 Pollinator Project's Mission even after we leave and both Rosi Kerr, the Director of Sustainability, and Marcus Welker, the Assistant Director of Sustainability, are on board to help the non-profit and project financially and through other resources.

Rosi Kerr, Director of Sustainability, Rosalie.E.Kerr@dartmouth.edu

- Rosi was a large proponent of our work at the landscaping meeting on May 9th. She told us that she would create a job for our Teaching Assistant Brian Arruda so that he could continue to help David plant more pollinator gardens and she was also very supportive of student groups getting involved in the effort.

Marcus Welker: Assistant Director Dartmouth Sustainability Office.
marcus.welker@dartmouth.edu

- Marcus is helping facilitate many of the relationships at the College level. Marcus helped us organize a time to present at the landscape committee meeting on May 9th and has agreed to be a liaison for any other stakeholder relationships in the future.

Landscape Committee:

The Landscape Committee is an advisory board in charge of operational control of Dartmouth lands. They vote on issues such as tilling, planting, and mowing on various Dartmouth lands. The committee meets once a term and consists of the following people: Joanna Whitcomb, Timothy J. McNamara, Patrick R. OHern, Martin, Keith, Cathy Henault, Douglas Cosentino, Karen F. Brown, Scott R. Melendy, David J. Newlove, Glen A. Cross, Frank A. Roberts, David M. Anderson, Julie E. Findley, Christopher M. Johnson, Josh Keniston. While the tenure of these committee members is unknown, the landscape committee does meet consistently – once a term. In order to get on their docket, it would be best to contact Director of Sustainability, Rosi Kerr (her contact information is above).

Some of the most important landscape committee members include:

Josh Keniston, Senior Vice President of Capital Planning and Campus Operations, josh.keniston@dartmouth.edu

- Josh implements the strategic vision and manages operations of the Campus Services division, which includes Facilities Operations & Management. We met with the

landscape committee on May 9th. Josh deferred to other members of the committee for their expertise.

Frank Roberts, Associate Vice President, Facilities Operations and Management, frank.a.roberts@dartmouth.edu

- Met with the landscape committee on May 9th. Frank deferred to other members of the committee for their expertise. He oversees Douglas Cosentino.

Douglas Cosentino, Director of Grounds, douglas.cosentino@dartmouth.edu

- **Primary Source**
- Doug is the lead manager at FO&M; he can provide labor and equipment to prepare and plant wildflower sites.
- Can help schedule tilling dates, tilling, identifying planting sites
- Previously met with and is extremely encouraged to institutionalize the process. We also met with him at the landscape committee on May 9th.

Timothy J. McNamara, Previous Director of Groups, Timothy.J.McNamara@dartmouth.edu

- Tim used to have Doug's job and he had a good relationship with David in terms of plotting wildflower gardens. He is a good person to rely on if we need an advocate in the landscape committee in the future.

Dartmouth Groups

Sustainable Action Program Wildflower Project, sustainable.dartmouth@dartmouth.edu

Partnering with the Sustainability Office, the Sustainable Action Programs is a campus organization that empowers Dartmouth College students to take on the human and environmental problems of a rapidly changing planet. They work predominantly via hands-on learning, building inclusive community, supporting research and teaching, and transforming campus operations.

- These students have already been working with David and Brian on planting wildflowers and collecting data. They are also freshmen and so these students are great to have for plantings because they are young and have more time on their hands.

Professors

Professor Tumber-Davila, ENVS, Joseph.Tumber-Davila@dartmouth.edu

Professor Tumber is a terrestrial ecosystems ecologist studying the response of ecosystems to global environmental change. His research investigates global environmental change effects on terrestrial ecosystems, plant functional traits, and subsequent consequences for global carbon cycling and policy.

- We discussed incorporating work for his Fall Forest Ecology Class with Professor Tumber-Davila. He would be open to having you as a guest speaker in the fall and dedicating at least one hour to outside work in the garden.
- Currently finding other professors to join in on work similar to this.

Pine Park Association:

Professor Linda Fowler, President of Pine Park Association, Term Expires: Next Year
Contact Information: Linda.L.Fowler@dartmouth.edu

- We talked to Professor Fowler in the middle of Week 5 and scouted out new sites with her at Pine Park. She is one of the keys to getting more places to plant, and we hope to build more rapport with her this term for CHP's sake. She is currently preparing a new site for David by the base of the park.

Hanover Contacts:

The term "town and gown" typically refers to the relationship between a university town and its associated academic institution. It highlights the dynamic interaction, sometimes positive and sometimes strained, between the local community (the "town") and the university (the "gown"). In our case, it is important to have a positive relationship with the town, where they support CHP's pollinator gardens. Here are some people we have identified to build this relationship with the town for CHP.

Yolanda Baumgartner, Sustainable Hanover Co-Chair, Term Expires: October 2024
Contact Information: yfoursh@gmail.com

- Her committee pushes for sustainable landscaping and would be amenable to additional wildflower plantings in Hanover.

Francis Kennedy, Hanover Community Garden Chairman, Term Expires: Indefinite
Contact Information: francis.kennedy@dartmouth.edu, 603-277-1084

- Mr. Kennedy runs the Hanover Community Garden. About 30 families work one of the garden plots each year. Located between the Dartmouth Rugby Fields and the Dartmouth College Child Care Center on land owned by Dartmouth College, the gardens cover more than half an acre, including two flat sections separated by a sloped vacant section, along with a parking area. The space is divided into twenty full plots, each 20-by-20 feet, with walkways between them. Some of the full plots are further divided into half-plots.

Peter Kulbacki, Director of Hanover Public Works, Term Expires: Unknown
Contact Information: peter.kulbacki@hanovernh.org, **Phone Number:** 603-640-3371

- Peter is a good resource for understanding more about storm water management as well as being a supporter of wildflowers because he grasps the mechanics of how wildflowers help with erosion control and long term sustainability.

Legacy Building

A. Plan for Landscape Committee Meeting

We talked to Marcus Welker during Week 5, and he suggested several projects for legacy building, guest lectures and classroom visits, individual and department-oriented research, planting days, and naming gardens after the inaugural planting class to generate awareness for the institutionalization of the pollinator gardens. He also encouraged us to present to the Landscaping Committee. The committee has the opportunity to prioritize planting pollinator gardens as often as possible to improve the biodiversity of the environment, local community land engagement, and beautify any suitable land on campus. He first reached out to Rosi Kerr, the Director of Sustainability, to get us 10-15 minutes with the Landscape Committee on May 9th in the afternoon. He explained that it would be good for us to talk about CHP, what it has accomplished, and what we hope to accomplish with this institutionalization process.

B. Plan for ENVS and Earth Science Classrooms

Integrating this project into classroom opportunities will establish a connection from the classroom to hands-on environmental stewardship. ENVS and Earth Science students could study the wildflowers themselves or the pollinators that come and interact with all of the flowers. We talked to Professor Tumber-Davila about integrating work on the pollinator gardens with his Fall Forest Ecology Class and he was interested. At this point, he said that he would be open to having David as a guest speaker in the fall and having at least one hour dedicated to outside work in the garden. Additionally, Professor Tumber-Dávila proposed several other avenues for exploration within and outside his classroom. Among these ideas are organizing large-scale service-oriented events tailored to the Dartmouth community. He also suggested the implementation of pollinator gardens specific to different graduating classes (e.g., Class of 2024, 2025) to foster student engagement and cultivate a culture of planting at Dartmouth. If this plan goes well, then we hope to expand to other departments like Geography and Earth Sciences that also run soil labs.

C. Plan for Alumni Engagement

We want to build a strong connection with alumni and encourage their active participation in the campus wildflower initiative. This engagement will foster a sense of community, promote continued involvement with the college, and potentially create new fundraising avenues.

<u>Alumni engagement plan:</u>

- **Digital Engagement**: Leveraging digital platforms to communicate the project's value and create opportunities for virtual participation.

    - **Social Media**
        - Channels: Utilize the primary alumni social media channels and establish a dedicated page or hashtag for the Wildflower project.
        - Content: Share visually engaging content (photos, videos), alumni spotlights, progress updates, educational information, and calls to action (volunteering, donating).
- **On-Campus Presence**: Establishing tangible ways for alumni to connect with the project during campus visits. - Maps
    - Wildflower Map: Develop an online and physical map highlighting wildflower plots, with information on species, sponsors, and historical notes.
    - Alumni-Sponsored Plots: Create a sponsorship program for alumni groups or individuals to support and take pride in designated plots.
- **Community Events**: Designing events that promote hands-on involvement and foster alumni networking - Volunteer days, Planting Days

D. Plan for Campus Plots

The enduring beauty of the wildflower meadows is a cornerstone of the project's success. Each plot will feature informative signage, identifying the resident wildflowers, explaining their ecological roles as pollinators or habitat providers, and highlighting the project's commitment to environmental sustainability.

Looking ahead, we're collaborating with landscaping to expand these vibrant havens strategically. Potential future locations include President Beilock's Lawn for high visibility, Old Dartmouth Cemetery/Tuck Row, Blunt Alumni Building Lawn, Observatory Row, and Bema for a visually appealing gathering space. These strategically chosen sites prioritize both aesthetics and reduced maintenance needs.

While initial establishment might require some volunteer support, the goal is for the meadows to reach an autonomous state within a few years. We envision a future Dartmouth campus adorned with these beautiful landscapes, fostering a vibrant ecosystem and underscoring our commitment to environmental stewardship.

Survey Data

To gauge campus and community interest in wildflower gardens, we will launch a comprehensive Qualtrics survey this week. The survey will be disseminated through the following channels:

- **Campus Distribution**: QR codes directing to the survey will be strategically placed in high-traffic campus areas. Additionally, hyperlinks will be included in emails to relevant student organizations, faculty, and staff.
- **Community Outreach**: The survey link will be shared within popular communication platforms (e.g., GroupMe) and through targeted email campaigns to community groups.

Survey Design

The survey is designed to collect unbiased, representative data. Key considerations include:

- **Participant Anonymity**: The survey will be entirely anonymous to encourage candid responses.
- **Accessibility**: Questions will use clear, non-technical language to ensure broad understanding.
- **Neutrality**: Question-wording will avoid bias and prevent influencing participant responses.

Data Analysis

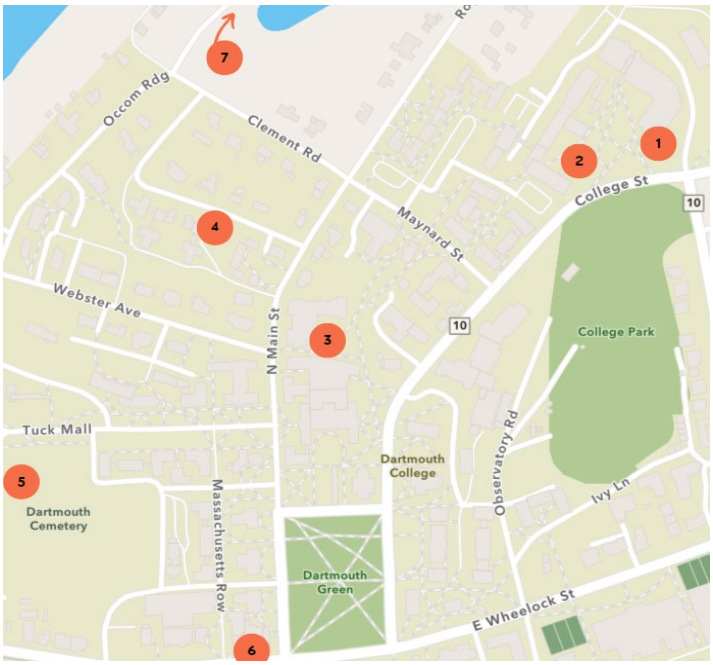
We will analyze qualitative and quantitative survey data to determine the level of support for wildflower gardens. This analysis will inform our recommendations and provide a persuasive tool for securing buy-in from college administration and potential funders.

Site Map

Wildflower meadow locations are marked with green signs. Follow the suggested route for a guided tour or explore independently. Learn more about Creating Habitats for Pollinators (CHP) by visiting creatinghabitats.org or scanning the provided QR code.

The maps are easily created by using Canva and dragging numbers onto a photo of the Dartmouth map using the features. The Google map is located here: LINK OF MAP. This map contains all of the locations currently in the Upper Valley area, and David will update it as the project grows.

This is one of the maps created by a synthesis group for an Instagram post that highlights the spots on campus that are easily walkable.



This map shows all the gardens in the broader area, including places outside of the college, such as the Organic Farm, Dothan Brook Elementary, and West Lebanon Cemetery.

Walking tour Map

David asked our group to supply him with a handout that could be used for the class of 1989 reunion and potentially onward. Below is the more refined draft of that handout:

DARTMOUTH

Campus Pollinator Walking Tour

In Collaboration with the Class of 1989 Pollinator Project and Creating Habitats for Pollinators

LEGEND

- Collis Lawn facing W Wheelock St (#1)
- Sustainable Living Center (#2)
- Anonymous Hall Lawn Under Bridge (#3)
- Life Sciences Center Drainage Circle (#4)
- Baker-Berry Rear Lawn Hillside (#5)
- Baker-Berry Rear Lawn Granite Wall (#6)

Creating Habitats FOR POLLINATORS

Make a donation

Dartmouth College has partnered with alumni-operated nonprofit, Creating Habitats for Pollinators and the alumni class of 1989 to bring beautiful wildflower plantings to campus! Follow the highlighted route to see 6 of the most convenient plantings in ~20 minutes walking. (Look for the green signs!)
CreatingHabitats.org / / DartmouthService.org

GROUP 2: COST BENEFIT ANALYSIS

Message to the Reader

As Creating Habitats for Pollinators (CHP) advances its mission of planting native wildflowers, thereby increasing pollinator habitat and fostering community engagement, our team undertook a cost-benefit analysis to support the organization's pitch to new stakeholders (towns, municipalities, schools, etc.). By quantifying and comparing the environmental and economic costs and benefits of wildflower gardens vs. mowed lawns, we sought to provide CHP with a resource that appeals to the priorities of local town managers, campus facilities departments, and other important stakeholders. Landowners and managers are not only concerned with aesthetic and environmental factors when it comes to landscaping decisions, but also issues of cost-effectiveness and budgetary constraints. Evidenced by the U.S. Department of Agriculture's Conservation Reserve Program CP42-Pollinator Habitat, which provides grants and other financial incentives for landowners and farmers to establish pollinator habitat wildflower plots on agricultural lands, subsidizing the costs of wildflower planting has resulted in the conversion of over 162,000 ha of row crop since 2008 (USDA FSA, 2020). Thus, combining financial and ecological benefits increases the attractiveness of wildflower gardens as an alternative method of management. We hope that our conclusions — located at the intersection of landowners, managers, and communities' values and interests — will provide a strong quantitative foundation for CHP's efforts to expand wildflower gardens and planting activities across North America.

The Importance of Native and Non-Native Species

Native and non-native plants alike support pollinator populations at risk from pesticide use and habitat loss. Replacing grassy areas with wildflower meadows provides additional habitat for these at-risk populations, with varying degrees of effectiveness. Seitz et al. (2020) found that native plants better supported pollinator populations by providing more specialized habitats for native pollinators, increasing both pollinator species richness and effectiveness. The authors found that while bee abundance can sometimes be lower at native flower plots at the start of the growing season, by midseason bee abundance and species richness were equal. The authors do stress that while having non-native plant species benefits pollinators more than no flowers at all, planting exclusively non-native plants can alter bee foraging patterns, community assemblage, and bee-plant network structures, so they suggest a mix of native and non-native plant species to reap the specialized benefits of native plants along with the general benefits of non-native plants.

Habitat loss is a key driver of declining abundance and species richness of wild pollinators, so planting flowers in general can offset habitat destruction to promote healthy pollinator activity. While Seitz et al. (2020) do suggest mixing native and non-native plants based on their two-year

study in Maryland, they do not provide a suggested ratio for how many native and non-native species to plant. Nabors et al. (2022) conducted a similar study in California, but their discussion lays the groundwork for data-driven selection of plant assemblages. While Nabors et al. (2022) found that native pollinators visited native, ornamental, perennials more often than nonnative plants, they also found that native plant species could vary by up to a factor of twelve in their attractiveness to pollinators, based on factors such as floral display (total measured flower area), plant species, and native or non-native identity. As a result, the authors suggest that pollinator abundance, richness, and plant attractiveness data should be collected and analyzed to find the optimal mix for each location. For CHP and Dartmouth, this could mean planting different blends of native and non-native plants at different sites across Dartmouth's campus and the Upper Valley. CHP and Dartmouth could then collect data on plant survivability at different sites and different times of year, pollinator species, which pollinators visit which plants, etc. Analysis could look similar to ENVS 25 during Summer 2022, where groups of students collected similar types of data and developed species accumulation curves. Hopefully, this data will shed some light on which plants attract greater numbers of pollinators or more species of pollinators. Further data collection could include total flower area per plant species in a given location, and whether this affects pollinator visits to that species when controlling for other variables.

A key issue with native and non-native plants and pollinators is determining exactly which species are native and which are not. In the field, native and non-native species often coexist, with non-native species becoming naturalized in their ecosystems over time. If a non-native plant does not out-compete all native plant species, but instead coexists, then it can become naturalized, likewise with pollinator species. The reality that these species often coexist should influence the proportion and selection of native and non-native flowers to support pollinators as best as possible. To that end, Frankie et al. (2019) studied urban gardens in California cities, finding that native bee species were more common on native plants and that non-native bee species were more common on non-native plants. Based on these findings, incorporating a healthy number of non-native plant species can better support non-native pollinators in the region that might otherwise be less likely to visit native plants.

Overall, the literature suggests that pollinator species in a given area will thrive the best if they have access to a mix of native and non-native plants. CHP already practices this, by using a blend of native perennial flowers along with annual, non-native flowers. In the first year, each annual can support a greater range of species, while the native plants will continue to support a higher number of pollinators per plant each year. Currently, CHP's reasoning behind including non-native annuals is aesthetic: CHP adds these plant species to their mix so local stakeholders can appreciate the higher aesthetic value of the annuals.

Botanical Name	Common Name	Life Cycle	Color	Height (in)	Bloom Season
Ammi majus	Bishop's Flower	Annual	White	30	Spring, Summer
Calendula officinalis	Pot Marigold	Annual	Mixed	24	Spring, Summer, Fall
Centaurea cyanus	Cornflower	Annual	Blue	35	Spring, Summer
Clarkia amoena	Godetia	Annual	Pink, White	14	Spring, Summer
Clarkia amoena	Farewell-to-Spring	Annual	Pink, Lavender	30	Spring, Summer
Coreopsis tinctoria	Plains Coreopsis	Annual	Yellow, Red	30	Summer, Fall
Cosmos sulphureus	Sulphur Cosmos	Annual	Mixed	33	Summer, Fall
Cosmos bipinnatus	Wild Cosmos	Annual	Red, White, Pink	47	Summer, Fall
Cynoglossum amabile	Chinese Forget-Me-Not	Annual	Blue	24	Spring, Summer
Delphinium cnsolida	Rocket Larkspur	Annual	White, Pink, Blue	36	Summer
Eschscholzia californica	California Poppy	Annual	Orange	18	Spring, Summer
Gaillarida pulchella	Indian Blanket	Annual	Red, Yellow	24	Summer
Gilia capitata	Globe Gilia	Annual	Blue	24	Spring
Gyposphilia elegans	Baby's Breath	Annual	White	28	Spring, Summer
Helianthus annuus	Dwarf Sunflower Sunspot	Annual	Yellow, Brown Center	16	Summer, Fall
Lavatera trimestris	Rose Mallow	Annual	Mixed	47	Summer, Fall
Linaria maroccana	Baby Snapdragon	Annual	Mixed	20	Spring, Summer
Linum grandiflorum rubrum	Scarlet Flax	Annual	Red	24	Spring, Summer
Lupinus succulentus	Arroyo Lupine	Annual	Blue	48	Spring, Summer
Mirabilis jalapa	Four O'Clock	Annual	Pink	36	Summer, Fall
Nemophila menziesii	Baby Blue Eyes	Annual	Blue	9	Spring, Summer
Papaver rhoeas	Red Poppy	Annual	Mixed	36	Spring, Summer
Silene ameria	None-so-Pretty	Annual	Pink	36	Summer

Table 1: This table details the exact species found in the All Annual Vivid Variety Wildflower Seed Mix used by CHP along with their characteristics.

Because non-native annuals still support pollinators, CHP could consider adding non-native flowering perennials to their seed mix. If CHP continues using American Meadows as their seed supplier, they could use the "Perennial Beauty Wildflower Seed Mix." This mix contains annuals for first year color and perennials for continued blooms year-after-year. It could fill the pollinator niche for generalist pollinators, leaving the native plants open for specialized pollinators.

Botanical Name	Common Name	Life Cycle	Native to	Height (in)	Bloom Season
Asclepias tuberosa	Butterfly Weed	Perennial	North America	12-24	Spring to frost
Aster novae-angliae	New England Aster	Perennial	North America	36-60	Late summer to frost
Centaurea cyanus	Cornflower	Annual	Europe, Western Asia	24-36	Summer
Cheiranthus allionii	Sberian Wallflower	Biennial	Europe	10-18	Spring
Coreopsis lanceolata	Lance-Leafe Coreopsis	Perennial	North America	12-30	Spring to summer
Coreopsis tinctoria	Plains Coreopsis	Annual	North America: Central and Western US	12-24	Summer to fall
Cosmos bipinnatus	Cosmos	Annual	North America	48-72	Mid-summer to frost
Cosmos sulphureus	Sulphur Cosmos	Annual	North America, Central America	36-48	Mid-summer to frost
Dianthus barbatus	Sweet William	Biennial	Western Asia, Eastern Europe	12-24	Spring to Summer
Echinacea purpurea	Purple Coneflower	Perennial	North America	36	Early summer to frost
Eschscholzia californica	California Poppy	Annual	North America	8-16	Spring to late summer
Gaillardia pulchella	Indian Blanket	Annual	North America	24	Summer
Linum lewisii	Wild Blue Flax	Perennial	North America	24	Summer to fall
Lupinus perennis	Perrennial Lupine	Perennial	North America	36	Spring to summer
Mirabilis jalapa	Four O'Clock	Perennial	Central America	36	Mid-to-late summer
Oenothera Lamarckiana	Common Evening Primrose	Biennial	North America, Central America	48	Summer
Papaver rhoeas	Red Poppy	Annual	Europe, Asia	12-30	Spring to summer
Rudbeckia hirta	Black-Eyed Susan	Biennial	North America	12-36	Mid-summer to frost
Silene armeria	Catchfly	Annual	Europe	12-16	Summer

Table 2: This table details the exact species in the Northeast Pollinator Wildflowers Seed Mix used by CHP along with their characteristics.

Future steps for CHP could also include furthering their partnership with Environmental Studies at Dartmouth to collect and analyze data about which seed mixes support the most pollinators.

This study could include changing proportions of native and non-native plants in the seed mix, then collecting data on survivability, pollinator count, and pollinator species richness among other variables, then analyzing for statistically significant differences between seed mixes.

What are pollinators and their importance

Pollinators play an integral role in developing and maintaining the health of ecosystems and agricultural systems. Plants are static organisms and therefore rely on self-pollination or on external vectors (like pollinators, wind, or water) to carry pollen, which contain their male gametes, across multiple different flowers (Ollerton, 2017). The majority of flowering plants rely on animals for pollination. Animal pollinators, which include animals like bees, birds, insects, butterflies, provide ecosystem services including nutrient cycling and fertilization (Toro and Ribbons, 2020). Pollination is essential for the production of many essential crops and foods that are not only important to ecosystems and human food supplies since crop yield processes rely on these animals to transfer pollen from one plant to another (Khalifa et al. 2021). Scholars have estimated that eliminating pollinators would reduce half of flowering plants by 80% and a third of these plants would not produce seeds (Katumo et al., 2022).

Figure 1. Impact of Eliminating Pollinators. This is a graphic that CHP can use when pitching to audiences to show the importance of pollinators for flowering plants.

This statistic highlights the integral role that pollinators have, as their elimination would drastically reduce flowering plant populations and seed production, which emphasizes their contribution to plant reproduction and overall ecosystem health. There are four different categories on why pollinators are important: economic, agricultural, environmental, and cultural based on existing literature (Khalifa et al. 2021).

Economic Motivations

Pollinators, particularly bees, have a profound effect on the economy. Khalifa et al. (2021) discusses that pollination by animals improves the global crop output by an additional $235-$577 billion annually.

Figure 2. Pollinators' Economic Impact. This graphic illustrates the significant economic impact that pollinators have on the global crop market, which highlights their importance in a cost-benefit analysis on the global scale. CHP can use this graphic to emphasize to its audiences how economically significant pollinators are globally.

This highlights the significant economic impact that pollinators have which therefore shows the importance of building habitats for these pollinators to reside in. Economic valuation of pollinators is a way of showing the benefits of conserving pollinators, ultimately displaying the value of pollinators to general audiences (Hanley et al., 2015). It primarily provides economic

value to the world through crop production through the increase of the quality and quantity of crop yields, which results in a greater economic output which is evaluated by the prices that the market determines (Hanley et al., 2015). Other studies suggest that both municipalities and private land owners can save money in the long-term by replacing roadside grass and shrubs with small wildflower meadows, Mody et al. (2020) found that replacing woody shrubs with wildflowers increased insect count by 212%, including pollinators, and that replacing woody shrubs reduced maintenance costs fivefold. Delphia et al. (2019) performed their own cost-benefit analysis for agricultural land in Montana, finding that their retail seed-sales approach, where landowners purchase live infant plants from wholesale suppliers then collect the seeds from the wildflowers to sell, led to each farm in the study saving money over time and eventually turning a profit. In this paper, we conduct a cost-benefit analysis of the pollinator gardens that CHP has implemented with the Dartmouth community as a microcosm of the general understanding of pollinator gardens amongst the public to hopefully help promote and support future projects.

Agricultural Motivations

As mentioned before, pollinators' main economic market value is its importance in agriculture and crop production. Katumo et al. (2022) described that "87 of the leading global food crops and 35% of global production volumes from crops are dependent upon animal pollination." Ellis et al. (2015) underscores that the loss of pollinators could potentially lead to malnutrition due to the loss in crop production. They are also important for both the quality and quantity of agricultural crops as plants and crops visited by diverse pollinator communities produce higher quality and more abundant seeds (Ellis et al., 2015). Katumo et al. (2022) indicates that animal pollination increases the weight and fruit set in crop yields, including but not limited to coffee, mango, pitayas, almonds, pumpkins, apples, and cotton. This is highly applicable for the CHP plantings in Southeast Michigan which is an area where agriculture is a significant industry. In terms of CHP's plantings in the Northeast, specifically in Vermont and New Hampshire, Tucker and Rehan (2018) conducted a study in New Hampshire with results that pollinator abundance was greatest in organic farm landscapes and lowest in meadow landscapes, which highlights the importance of the mission and efforts of CHP of creating and planting pollinator gardens in order to attract more pollinators in replacement of mowed grass.

Environmental Motivations

Pollinators also play an integral role in maintaining ecosystems through the promotion of biodiversity within each region. "Pollinators are essential to plant reproductive success and therefore play an important role in the maintenance of plant communities" (Katumo et al., 2022) and "they are also important for the reproduction of more than 65% of the world's wild plants (Wratten et al., 2012). Pollinator diversity increases genetic diversity and promotes seeding, which therefore increases the plant diversity which is important for maintaining healthy and abundant ecosystems. In general, there has been an increase in environmental awareness and

positive attitudes towards environmental issues. Young people, in particular, are starting to actively participate in protests and green movements, as they are starting to understand that combating climate change cannot be an individual endeavor but instead a collective effort (Calculli et al., 2021). Older generations would find solace in understanding the economic benefits of a pollinator garden, and younger generations may resonate well with the environmental benefits that pollinator gardens provide, in addition to the economic benefits.

Socio-Cultural Motivations

Pollinators not only bring market economic values but non-market values as well, including aesthetic and cultural reasons. While these benefits are hard to economically quantify, it does not diminish its value for the public. While they play an important role in maintaining the economic, agricultural, and environmental benefits of ecosystems, they also contribute to the aesthetic appeal of these environments through their habitat of abundant, beautiful, diverse wildflowers. A recent survey indicated that 39% of people chose ecotourism opportunities as their number one choice for vacations. Additionally, there has been an increase in interest in a subcategory of ecotourism known as agritourism, where traditional landscapes are restored for tourism and scenic purposes (Katumo et al., 2022). Thus, the preservation of pollinators and implementation of pollinator gardens is not just an environmental concern, but it also has positive socio-cultural value.

Why Planting More Wildflowers Brings More Pollinators

Despite their importance to ecosystems, pollinator populations have been suffering from rapid and increasing decline. Among the leading causes are habitat fragmentation and loss due to human land-use and conversion to mown grass lawns, which cover over 40 million acres of land in the continental U.S. (Burr et al. 2018, Milesi et al. 2005). The creation of pollinator habitats, both in rural and urban areas, is one proposed solution: the (re)establishment of wildflower meadows, especially on those existing acres of lawn, is one of the most important measures to promote pollinator abundance (Blackmore and Goulson 2014, Feltham et al. 2015, Bretzel et al. 2016, Mody et al. 2020). Large wildflower plantings support greater bee density and diversity, as well as improve wildflower pollination (Blaauw and Isaacs, 2014). Indeed, unmown meadow areas “generally contain markedly more arthropod individuals" than mown spots, and the presence of adjacent wildflower strips can support a 25% higher frequency of pollinator visits to crops than those without (Mody et al. 2020, Feltham et al. 2015). The effectiveness of wildflower meadows in attracting pollinators, particularly bumblebees, in agricultural areas has been well established; their importance to the promotion of biodiversity and ecosystem functions in urban contexts is also increasingly supported (Mody et al. 2020).

Given that increasing wildflower garden habitat supports larger and healthier pollinator populations, CHP and similar organizations can raise awareness of their benefits compared to

mown lawns. Although such lawns may be necessary in some situations (e.g. playing fields), many areas are mown regularly for aesthetic reasons only, presenting an opportunity for CHP to demonstrate that these lawns may be converted to more biodiverse habitats that are more attractive to pollinators and communities (Blackmore and Goulson 2014). As the literature demonstrates, a clear positive relationship between wildflower planting and pollinator health and abundance has been identified. Perhaps the most important factor for community decision-makers, however, may be costs: native wildflower meadows not only lead to increased pollinator abundance and diversity, but also lead to reductions in the costs of green space maintenance (Mody et al. 2020). Our team's cost-benefit analysis seeks to quantitatively demonstrate the benefits of such wildflower plantings.

Cost-Benefit Analysis Methodology

In this study, our team sought to quantify the environmental and economic costs and benefits of wildflower gardens vs. mowed lawns to help CHP solicit support for its activities from new stakeholders. This report uses Dartmouth College as a case study, using data collected from Dartmouth groundskeeping operations and community members to conduct this analysis. We hope that our conclusions and identified trends, however, will be helpful in projecting the long-term costs and benefits of wildflower planting regardless of location. For this Dartmouth case study, the following methodology was employed:

Given the difficulty of evaluating the real worth of the crucial ecosystem services that pollinators and wildflower meadows provide, we employed a stated preference technique under Professor Richard Howarth's guidance to incorporate those hidden services. For the economic evaluation of pollinator and wildflower services, we attempted to quantify their values based on people's willingness to pay (WTP) for the service in a contingent value survey (Upadhyaya and Bhandari, 2022). Through a Google Form survey circulated amongst Dartmouth College undergraduates, we garnered 103 responses from undergraduate students. We measured each student's WTP by asking if they would be willing to pay various amounts for the wildflower plots on campus (see Appendix A). This data was then used to construct a demand curve for wildflower gardens. We recognize the potential bias in these responses since the only places this survey was sent out were the Environmental Studies department listserv, Ruckus listserv, the Class of 2024 GroupMe, Kappa Kappa Gamma GroupMe, Sigma Nu GroupMe, Alpha Phi GroupMe, Chi Delta GroupMe, Pyxis Senior Society GroupMe, and Osiris Senior Society GroupMe. These groups include Environmental Studies majors and minors, students interested in environmental causes (Ruckus), students affiliated with sororities and fraternities, and students affiliated with senior societies (social groups for upperclassmen). Thus, based on these groups, we were more likely to receive responses from upperclassmen (especially seniors) and students already passionate about environmental causes. Further, since this survey was only sent to college students that attend an Ivy League university, we do not have the perspective or beliefs of the general population and/or local residents captured in our results.

To analyze the costs of establishing and maintaining wildflower meadows vs. mowed lawns through a Dartmouth College perspective, we interviewed Douglas Cosentino, the Associate Director of Dartmouth Facilities Operations & Management, who oversees the maintenance of the Dartmouth grounds. He explained the entirety of Dartmouth's grounds maintenance process to our group, noting the methods and processes that Dartmouth uses and also the costs associated with those processes. Further, he helped us hone in which variables to include in our cost-benefit analysis. We entered the interview with a preliminary model that we derived from our literature review, but after our discussion with Mr. Cosentino, we discovered our model could be much simpler. For example, we initially included variables for gasoline and equipment costs. However, Mr. Cosentino explained that gasoline prices are captured in the Worker Wage variable and that Dartmouth only rarely needs to update/fix its equipment. Of course, these costs are non-zero, however our group and Mr. Cosentino believe that the equipment maintenance costs would be too insignificant to include in the model. Although, we should note that our model assumes that the landowner will have pre-existing equipment and, thus, our model does not include the cost of purchasing a lawn mower or similar equipment. We also do not consider the entire life-span of the plot, only considering future costs of either maintaining a grass plot or constructing a wildflower plot.

Our cost-benefit analysis was also supported by interviews with David Hammond '89 (the founder and Executive Director of CHP), Professor Theresa Ong, and Marcus Welker (Assistant Director of the Dartmouth Sustainability Office). Through these interviews and other literature (Atkinson and Mourato, 2008; Hanley et al., 2014), we settled on the variables we would like to track and measure for this cost-benefit analysis. In order to accurately assess the costs of each plot type, we created three sections that capture the temporal aspects of each plot: maintenance of a grass plot, the site preparation for a wildflower plot, and the maintenance of a wildflower plot. We assume that this analysis is based in a region similar to Dartmouth, such that the maintenance of both plot types occurs on an annual basis due to the seasonality of the area. As explained by Mr. Cosentino, the temporal aspect exists for the wildflower plot because the first year for preparing a wildflower bed requires much more time and money than following years (if maintained properly). Further, after about four to five years, the wildflower beds require essentially zero maintenance (maybe hand-picking weeds if there are any). Thus, the two sections for the wildflower plots essentially divide the costs into the cost for the first year and the cost for years two through five. Figures 1 and 2 demonstrate a typical timeline for maintaining a grass plot and a wildflower plot, respectively.

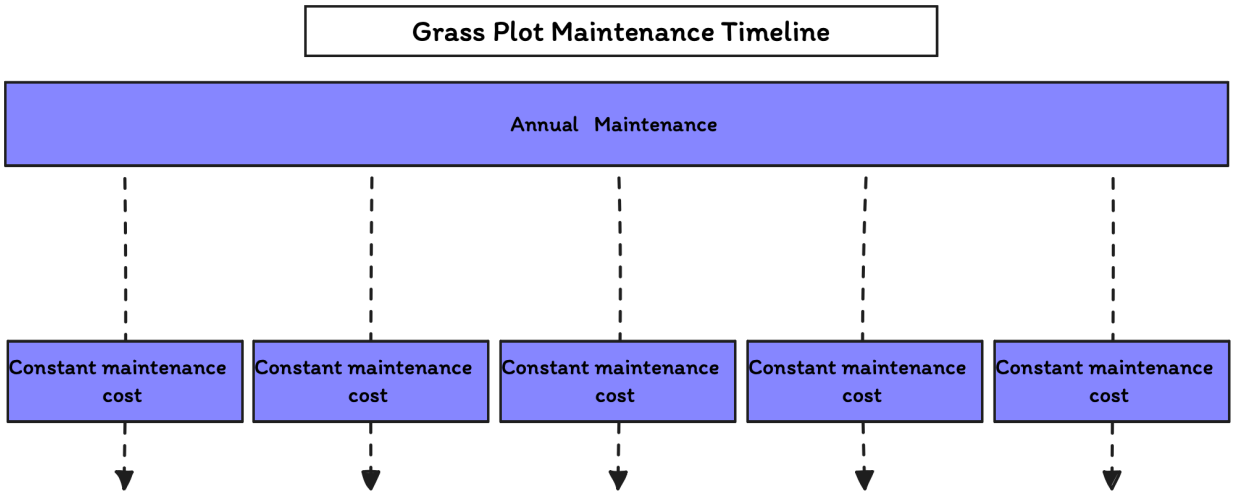


Figure 3. Grass Plot Maintenance Timeline This diagram shows the anticipated costs of maintaining a grass plot, highlighting that the costs will generally remain constant each year.

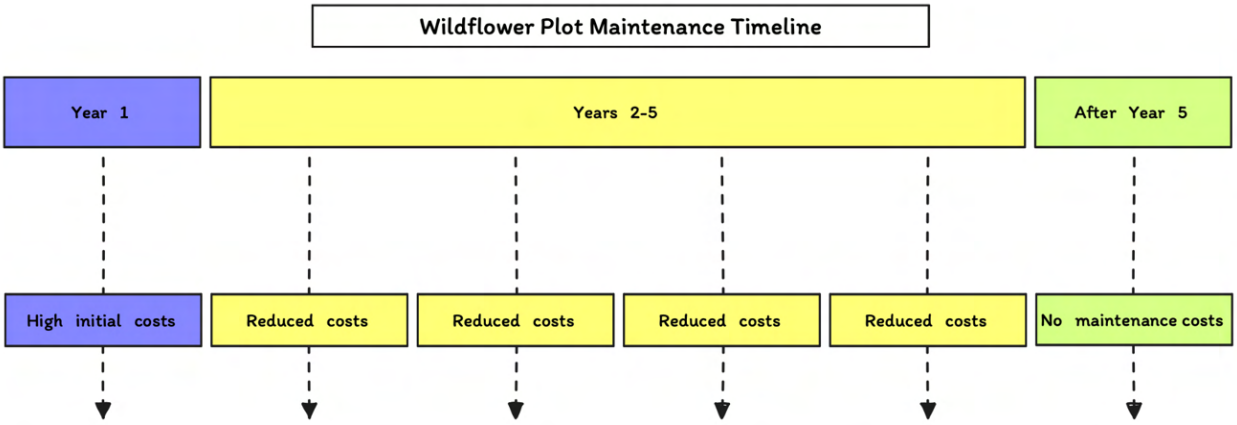


Figure 4. Wildflower Plot Maintenance Timeline This diagram shows the anticipated costs of maintaining a wildflower plot. The timeline of a wildflower plot can be divided into three sections: the first year, years two through five, and after year five. The first year will include high initial costs of preparing the site, while the following years should see a reduced cost of maintenance with the costs completely disappearing after year five.

The variables for the three sections may be shared among them, but each section also includes variables unique to just that section. The variables for the maintenance of a grass plot include: Site Area (sq ac), Mowing Time (min/sq ac), Grass Seed Cost ($/sq ac), Worker Wage ($/hr), Number of Workers, Fertilizer Cost ($/sq ac), Maintenance Frequency (day/month), and Number of Months. The variables for the site preparation for a wildflower plot include: Site Area (sq ac), Maintenance Time (min/sq ac), Wildflower Seed Cost ($/sq ac), Worker Wage ($/hr), Number of Workers, and Pesticide Cost ($/sq ac). The variables for the maintenance of a wildflower plot include: Site Area (sq ac), Maintenance Time (min/sq ac), Worker Wage ($/hr), Number of Workers, Fertilizer Cost ($/sq ac), Maintenance Frequency (day/month), and Number of Months. In order to decrease potential bias in our costs, we used the low ends of estimated ranges for calculating the grass plot costs and the high ends for the wildflower costs.

Total Cost Equation for Grass Plot:
Site Area × (*Grass Seed Cost* + *Fertilizer Cost* + (*Mowing Time* / 60) × *Worker Wage* × *Number of Workers* × *Maintenance Frequency* × *Number of Months*)

Total Cost Equation for Wildflower Plot Site Preparation:
Site Area × (*Wildflower Seed Cost* + *Pesticide Cost* + (*Maintenance Time* / 60) × *Worker Wage* × *Number of Workers*)

Total Cost Equation for Wildflower Plot Maintenance:
Site Area × (*Maintenance Time* / 60) × *Worker Wage* × *Number of Workers* × *Maintenance Frequency* × *Number of Months*

Since we are using Dartmouth as a case study, the numbers we input into these equations all come from our interview with Mr. Cosentino. However, many of the values should be similar regardless of location. For example, Mr. Cosentino estimated that he buys a 2.5 gallon jug of Roundup for $50 (or $20 for one gallon), and hardware stores, such as Home Depot and Lowes, carry a one gallon jug of Roundup for $15-20. We should note that, while Roundup may act as an extremely effective pesticide, its negative effects on both the environment and humans should encourage one to consider less harsh or more organic alternatives (Novotny 2022). Further, again from our interview, we used a price of $100/lb or $100/sq. ft. for the wildflower seed mix, which falls toward the upper side of the possible average price for this seed mix, which could be from $30/lb to $130/lb (Cruz et al. 2016). Therefore, while we use Dartmouth-specific numbers for the case study, our values should not be too abnormal either.

Results

Based on our cost equations, we calculated the costs of maintaining the plowed grassland, which totaled an annual cost of $1,715.60. Using information gathered from the interview with Mr. Cosentino, we calculated the cost of the alternative land use form – the wildflower plots. The

plots have higher fixed costs than the mowed grass, totaling $4,520.52 in the first year they are planted. However, they have a much lower maintenance cost of $1,200.00 per year.

Using this data, we created Figure 5, which plots the total costs of grass maintenance (shown in blue) and wildflower gardens (shown in red) over time. Figure 3 shows that, for 1 acre of land, wildflower gardens become more cost effective than grass maintenance after the fifth year of planting.

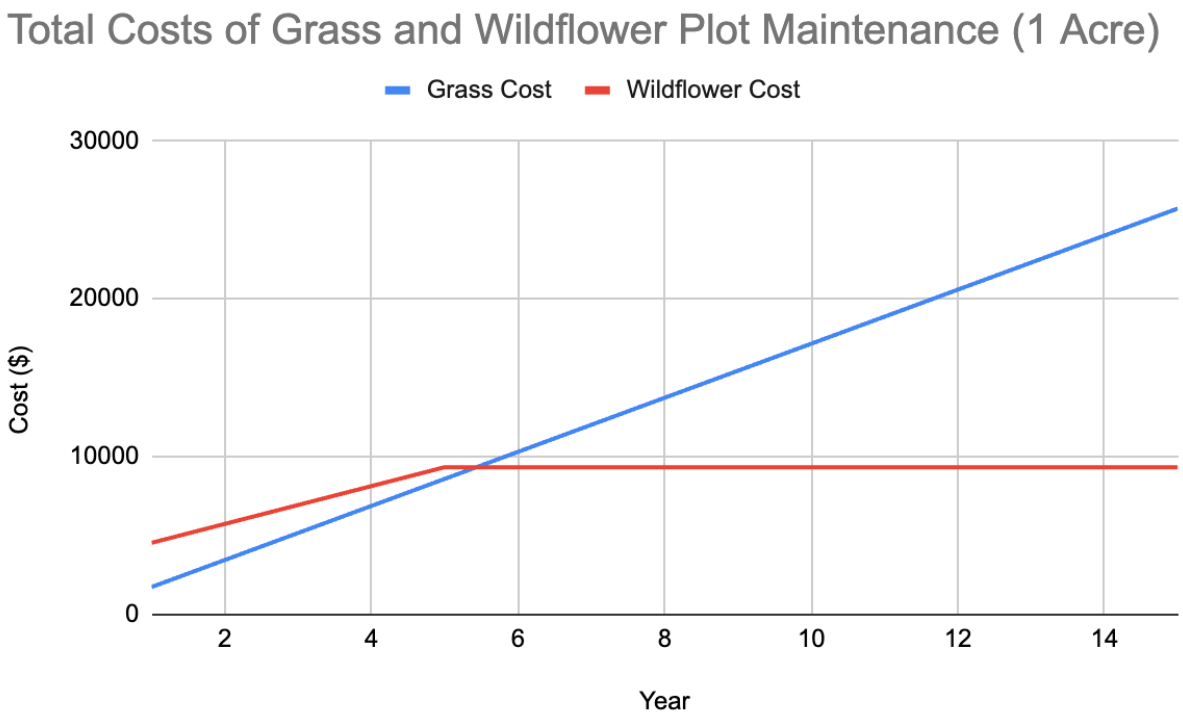


Figure 5. Cost Comparison of Alternative Land Uses. This diagram plots the total costs of wildflower gardens (in red) and plowed grass fields (in blue). The intersection between the two curves show when both alternative land uses achieve cost parity.

In addition to the market value costs of the wildflower gardens, we also conducted a contingent valuation survey to determine the demand for non-market benefits provided by the wildflower gardens. Contingent valuation surveys are widely used in environmental economic analyses (Carson 2012, Hanemann 1994, Loureiro et al. 2009) to measure people's valuation of environmental resources. While many environmental resources improve people's welfare, they may not have a market price since they are not directly sold on the market. Contingent valuation is one method of quantifying these values.

The survey asked respondents if they would be willing to pay $5 a year to maintain the wildflower gardens. Based on their response, the willingness to pay value was incrementally

raised up to $10 or down to $0 in order to ascertain respondents' maximum willingness to pay. The results are shown in Figure 6.

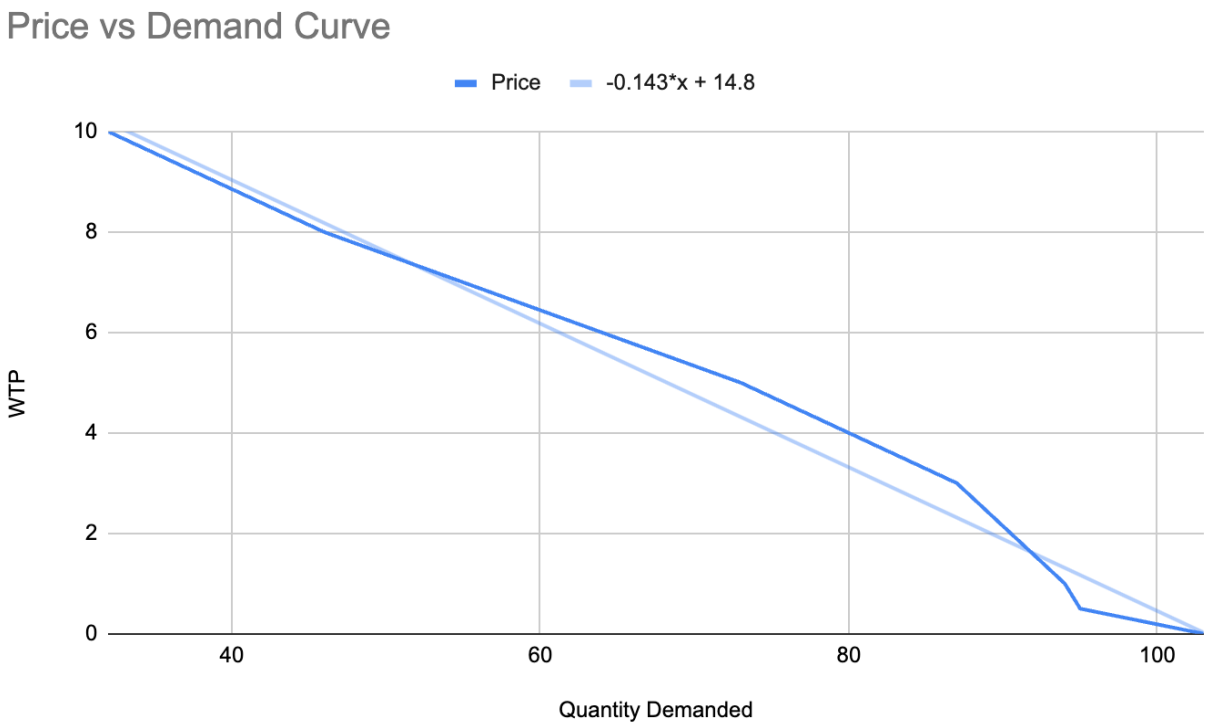


Figure 6: Contingent Valuation Survey. Using WTP (willingness to pay) data from the contingent valuation survey, a demand curve for wildflower gardens was constructed. The price line shows the exact amount of students who were willing to pay a certain price to maintain the pollinator garden for one year. The equation shows a smoothed version of these findings in order to create a demand curve for pollinator gardens.

Based on these findings, the median willingness to pay to maintain the wildflower gardens is $7.44 per year per student. When multiplied by the entire undergraduate student body, this provides a total willingness to pay of $47,244 per year, suggesting that the non-market value of the flower gardens far outweigh the costs. This can be seen in Figure 7 below.

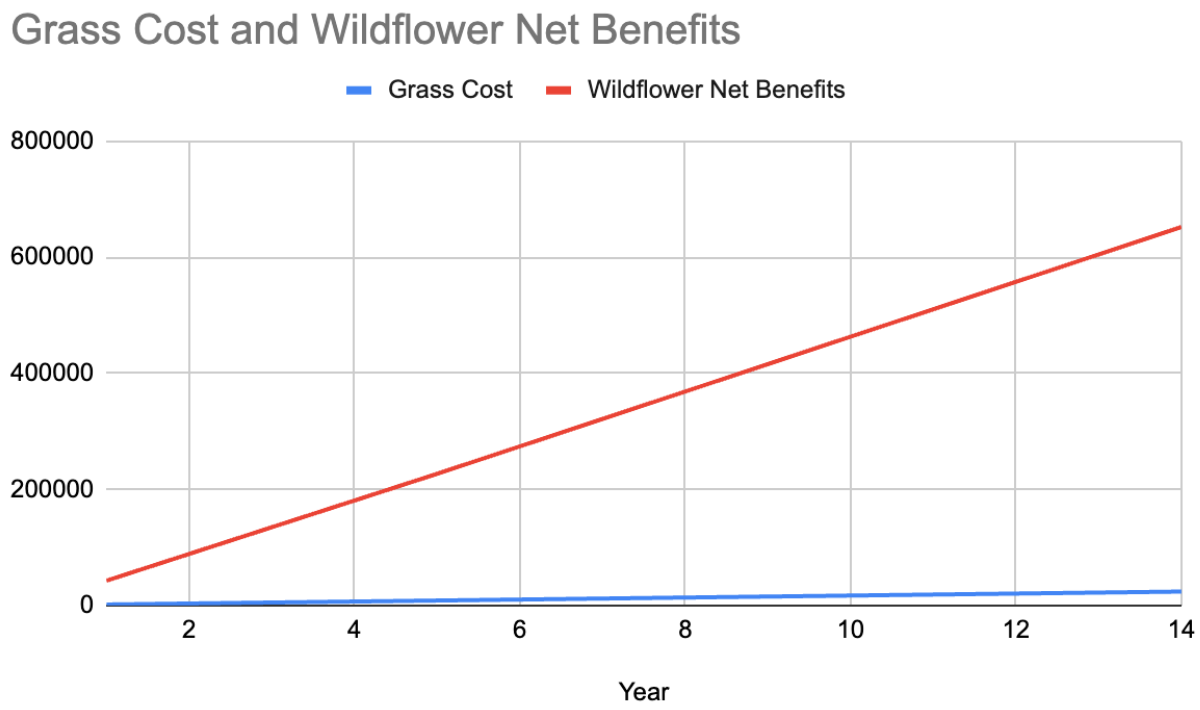


Figure 7. Wildflower Net Benefits. This diagram shows the net benefits of wildflower gardens compared to the total costs of grass plots. The wildflower garden net benefits were calculated by subtracting annual wildflower planting and maintenance costs from total annual willingness to pay.

Discussion

Our analysis shows that the benefits of planting a wildflower garden outweigh the costs over the lifetime of the plot. In the short run, wildflower gardens have high fixed costs in the form of seed costs and maintenance costs. However, in the long run, these plots require less upkeep than traditional grass surfaces, which ultimately results in lower costs after the fifth year of planting. This presents a similar trend to many sustainable alternatives to traditional practices, in which the practice requires high initial costs but will ultimately be the cheaper option over time (SaveMoneyCutCarbon 2022). We recognize that not everyone may have the upfront resources to implement wildflower gardens; thus, we do not recommend this option as a universal solution that everyone must adopt. Rather, someone who has the funds and also the dedication in the first year to properly prepare the site should consider constructing a wildflower plot in order to not only save money but also to impact the local environment.

We should also note that these costs (both the grass and wildflower costs) are likely greater than average since Dartmouth College pays its grounds people at least double the hourly rate than the average New Hampshire landscaper. The estimation for Worker Wage at Dartmouth is around

$40-50 per hour, while the average hourly wage for a landscaper in New Hampshire is around $20 (indeed, n.d.). However, the possibility also exists that the advanced experience of Dartmouth landscapers may decrease the maintenance time as compared to the time it may take the average New Hampshire landscaper. The impact of wage on our findings is likely to have a larger impact on grass plots given that labor costs are a much larger fraction of total costs. Thus, labor costs are an important factor to consider when determining CHP locations.

In addition to market-based costs, wildflowers also create additional benefits by providing ecosystem services. Wildflower gardens promote pollinator diversity by providing food and shelter for pollinators. They also improve soil health, prevent erosion, and increase carbon sequestration (Bretzel et al. 2016). While these values are not captured in conventional cost benefit analyses, they represent important benefits that wildflower gardens provide, and therefore should be accounted for. Our analysis attempted to capture these values by conducting a contingent valuation survey, which found that once the ecosystem services of the wildflower gardens are included in the analysis, the benefits outweigh the costs from the beginning.

In light of these findings, we recommend planting more wildflower gardens since the benefits outweigh the costs. However, it is important to note that these findings are Dartmouth-specific, given that the numbers used to conduct the cost-benefit analysis are based on maintenance costs provided by the College, as well as the stated preferences of Dartmouth undergraduate students. These values may vary regionally based on labor costs and individual's preferences for the ecosystem services that the wildflower gardens provide. Given the high fixed costs associated with wildflower plots, it may not be cost effective in areas with high labor costs or where people's valuations of wildflowers are low. This Dartmouth-centric approach is a key limitation of this report.

Another area for further research is understanding how the surrounding physical landscape affects this analysis. For example, high traffic areas may impede the growth of wildflower gardens and limit their ability to attract and support pollinators. On the other hand, high trafficked areas increase human exposure to the gardens, and therefore may raise the community's valuation of the plots. Thus, future studies should focus on CHP plots located in different areas. In the future, these exact equations can be reused at different sites (including on prospective sites) in order to model projected cost savings at different sites across the country.

Appendix A

ENVS 50 Pollinator Garden Planting Survey

ENVS 50 Pollinator Garden Planting Survey

This project is being conducted as a part of the Environmental Studies Culminating Experience course (ENVS 50). Our group's primary goal is to perform an environmental cost-benefit analysis focused on pollinator gardens and their local implementation. This research is designed to more closely examine hov the Dartmouth community values the pollinator garden planting around campus and the ecosystem services it provides.

While the research is hypothetical and no actual money will be exchanged, it serves as a way to gather insights from the student community to help us with our cost-benefit analysis. This survey will take 2 minutes and thank you so much for your help!

1. Have you noticed the Class of '89 Pollinator Project planting at Kemeny Courtyard (behind the library) or at the LSC?

   Mark only one oval.

   - ◯ Yes
   - ◯ No

Take a look at these two images below and answer the following question

Option A

Option B

2. Do you find Option A or Option B more aesthetically pleasing?

Mark only one oval.

- ◯ Option A
- ◯ Option B

3. Would you be willing to pay $5 to maintain this pollinator garden each year?

Mark only one oval.

- ◯ Yes *Skip to question 5*
- ◯ No *Skip to question 4*

$3 WTP Question

4. Would you be willing to pay $3 to maintain the Kemeny Courtyard pollinator garden each year'

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to question 7*

$8

5. Would you be willing to pay $8 to maintain the Kemeny Courtyard pollinator garden each year'

Mark only one oval.

- ◯ Yes *Skip to question 6*
- ◯ No

$10

6. Would you be willing to pay $10 to maintain the Kemeny Courtyard pollinator garden each yea

Mark only one oval.

- ◯ Yes
- ◯ No

$1

7. Would you be willing to pay $1 to maintain the Kemeny Courtyard pollinator garden each year'

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to question 8*

less than $1

8. Are you willing to pay any amount under $1 to maintain the Kemeny Courtyard pollinator garde each year?

Mark only one oval.

- ◯ Yes
- ◯ No

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GROUP 3: POLLINATOR ECOLOGY

Bee Hotel Abundance and Identification Analysis at Dartmouth Pollinator Garden Plots

Our primary aim with this study was to gain as much insight as we could into the efficacy of the 17 bee hotels, and with that information provide recommendations as to the future sites of the hotels. In order to achieve this we wanted to collect as much relevant data as possible, both quantitative and qualitative (due to the fact that we found so few samples, were unable to find some of the hotels & had trouble distinguishing the areas of the flower meadow plots). So,we decided that our best shot to find conclusive data was by measuring occupancy of tubes, as well as the abundance and species of bees and other arthropods emerging from the tubes, we hope to inform CHP's future applications of this method of conservation and provide baseline data for future classes and researchers to use.

Pollinator Research

Animal pollinators mediate reproduction in over 87% of flowering plants, including many important crop species (Ollerton et al. 2011; Ashman et al. 2004). While animal pollinators are a highly diverse functional group, insects, particularly bees provide the greatest degree of pollination services across most of the world's biomes. While human-cultivated honeybees have long been the focus of popular culture and conservation (Stout et al. 2022), native wild bees like bumblebees and solitary bees as well as non-bee wild insect pollinators have been found to be highly important for sustaining the world's terrestrial ecosystems, including many crops (Mathiasson and Rehan, 2020; Piers and Maués, 2020; Rader et al. 2015). These pollinators also tend to have narrower latitudinal ranges, and are more likely to be floral specialists and sensitive to relative abundance of multiple species, traits correlated with vulnerability to anthropogenic change, including habitat degradation, pesticide use, and global warming (Bartomeus et al. 2013; Potts et al. 2010; Burkle et al. 2013). As a result wild insect pollinators have been declining worldwide (Potts et al. 2010).

The Northeast United States is no exception to this rule. Wild pollinators, such as native bees and butterflies, play an important role in Northeast / New England natural cycles. However, there are significant problems with habitat loss and pesticides. Wild bees in the Bombus genus i.e. the bumblebees are the most significant wild pollinator in this region, and have been undergoing significant decline over the past three decades (Bartomeus et al. 2013; Cameron et al. 2011).

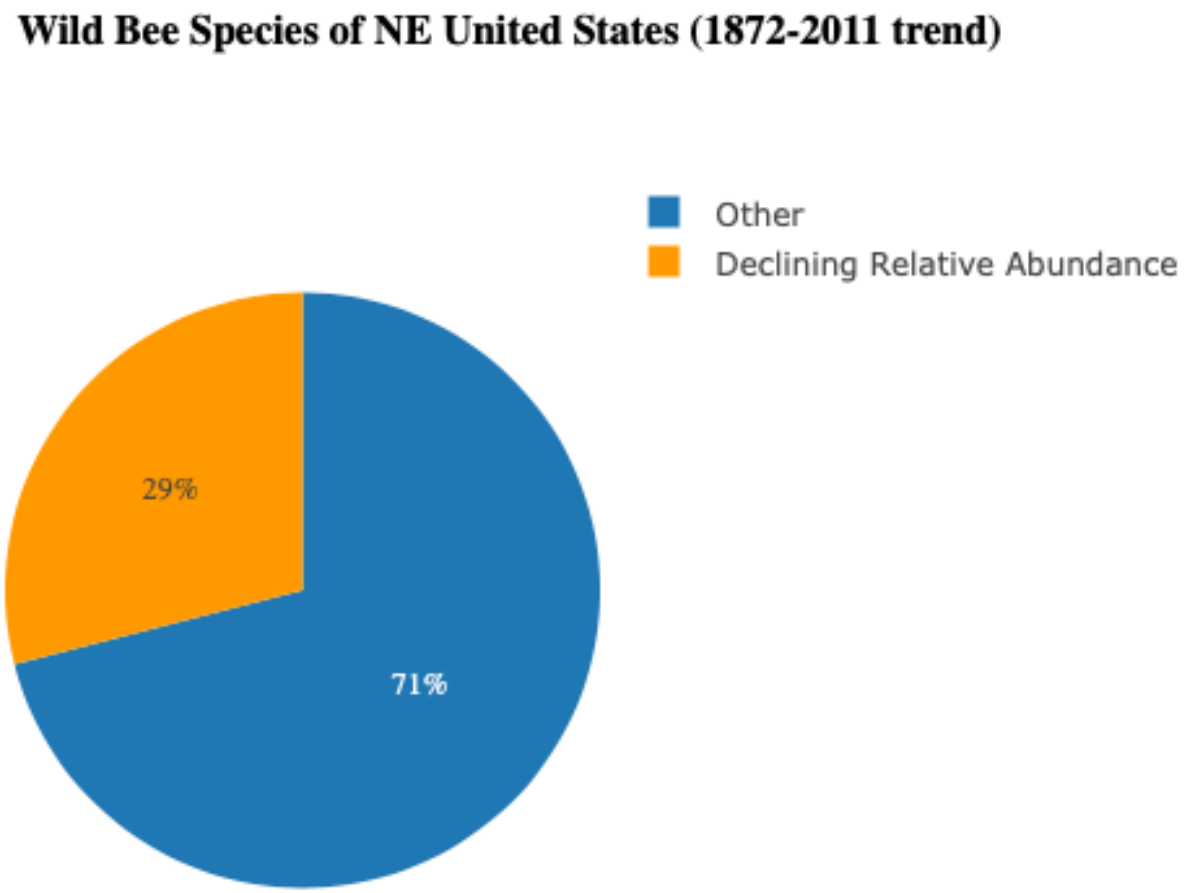


Fig 1. Proportion of wild bee species having experienced significant relative population declines between 1872 and 2011 using data from Bartomeus et al. (2013).

Overall, 29% of wild bee species in the northeast US have undergone significant relative population declines between 1872 and 2011 (Bartomeus et al. 2013).

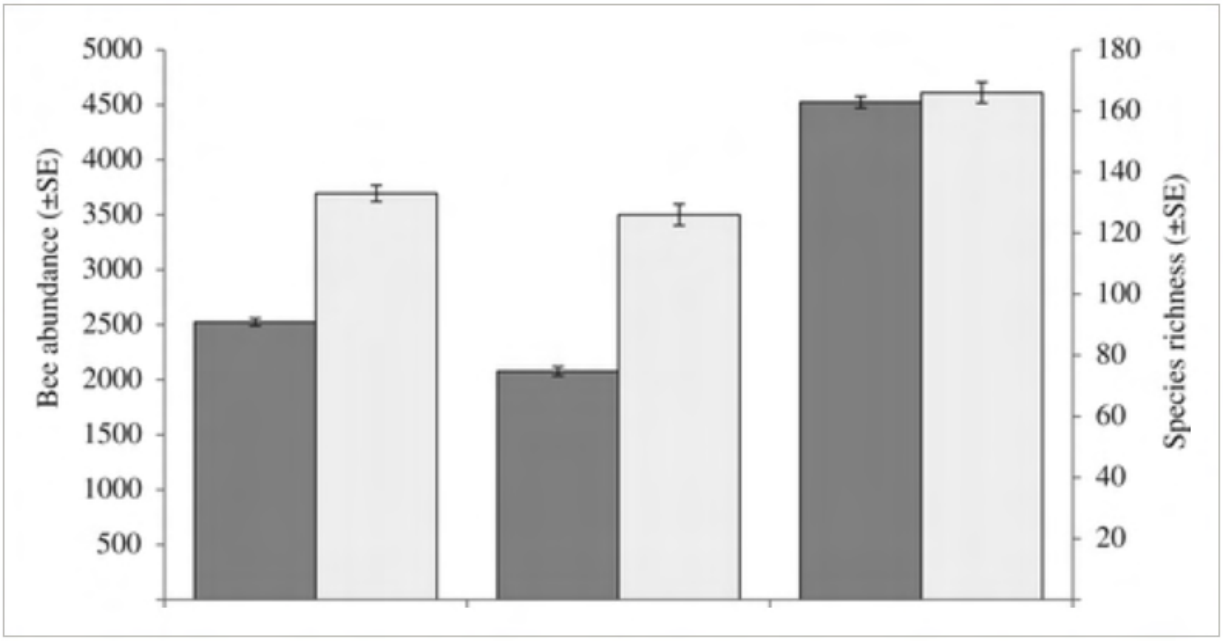
Given the importance of wild insect pollinators for ecological health and maintenance, and their vulnerability to anthropogenic change, it is important to consider conservation measures for these pollinators. One such measure is wild pollinator gardens, which allows for crowd-sourcing pollinator habitat in a wide array of environments with varying levels of human disturbance (Majewska and Altizer, 2018). New England, however, has ran into troubles implementing such gardens on a large scale. Poor integration of revegetation strategies, lack of cooperation and information sharing between state agencies, and the use of cheaper, less local species have hindered the reestablishment of native flowers. Additionally, New England has critically underdeveloped commercial infrastructure for the production of native seeds. While organizations like the Connecticut Northeast Organic Farmers Association and the Wild Seed Project of Maine have sought to remedy this, neither produces seed in volumes large enough to meet the needs of these government agencies (Campanelli, 2023). Hurdles like this, a complete

lack of coordination between New England states, and difficulties in raising this issue's profile on governmental agendas has contributed to a decline in New England bee populations. While it is encouraging that segments of state governments like various Departments of Transportation have been working together on projects such as the aforementioned roadside flower planting, bureaucracy and lack of commercial seeds has hindered progress greatly.

Considerations for Protecting Pollinators

Enhancing Floral Resources for Diverse Pollinators:

A cornerstone of successful pollinator habitat creation is the selection of flowering plants. A diverse assemblage of native plant species, offering blooms throughout the growing season, is crucial. This floral variety caters to a wide range of pollinator fauna with varying nectar and pollen requirements. Referencing studies such as those by Tucker et al. (2016) and Fowler (2016) can guide the selection of regionally appropriate native plants. Furthermore, incorporating a variety of flower shapes and sizes within the meadow can significantly enhance its value. This caters to the diverse feeding mechanisms employed by different pollinator groups, such as the long tongues of butterflies and the short mouthparts of some bee species. As such, CHP should continue attempting to make the flower meadows/gardens as diverse as possible.



Graph, from Tucker & Rehan (2016) paper, showing bee abundance and richness relative to landscape (n = 12 samples per landscape). Landscape significantly affected bee abundance based on generalized linear model (GLM) results (dark grey bars) with a post-hoc analysis showing that abundance was significantly greatest in the organic farm landscape. Species richness was also significantly affected by landscape based on GLM results (light grey bars) and followed the

same trend as abundance with a post-hoc analysis showing that richness was significantly greatest in the organic farm landscape.

The Role of Trees in Pollinator Landscapes:

While flowering plants are undoubtedly the primary source of sustenance for pollinators, incorporating trees into the meadow design offers additional benefits. Certain tree species flower in early spring, providing a vital source of nectar and pollen at a time when herbaceous wildflowers are scarce. Additionally, trees offer shade and protection from predators for foraging pollinators. Therefore, the ideal meadow landscape should strive for a balanced composition, encompassing both flowering plants and strategically placed trees. So, a possible consideration for new locations could be the abundance or species of tree.

Importance of Locality in Plant Selection:

The selection of native plant species is critical for the long-term success of the meadows. Native plants have coevolved with local pollinator populations and are adapted to the specific climatic and soil conditions of the region. This ensures their ability to thrive with minimal maintenance and provide optimal sustenance for the local pollinator fauna. Utilizing native plant species fosters a self-sustaining ecosystem within the meadows, reducing the need for external inputs and promoting a healthy habitat for resident pollinators, whether the nativeness of the plants needs to be hyper-local or not did not appear much in the literature we reviewed so we cannot comment on that.

CHP's Advantage: Aligning Practices with Pollinator Health:

The presence of parasites identified in the pollinator ecology group's data suggests minimal pesticide use within the CHP meadows. This is a positive indicator, as pesticides can have a detrimental impact on pollinator populations. CHP's existing practices appear to be well-aligned with creating a healthy pollinator habitat. However, tilling practices can be further optimized to minimize disruption to nesting sites. Exploring alternative tilling methods, such as no-till planting, or limiting tilling to specific depths and times of year when pollinators are less active, can further enhance the nesting suitability of the meadows.

Long-Term Success Through Collaborative Monitoring:

Regular monitoring of the meadows is essential for CHP to assess the effectiveness of their practices and identify areas for improvement. This monitoring program could encompass tracking pollinator populations, observing plant growth and species composition, and evaluating the overall health of the meadows. By establishing a collaborative partnership, the pollinator ecology group can provide expertise in ecological monitoring techniques, while CHP can offer

their practical experience in meadow management. This collaborative approach will ensure the continued development and optimization of the meadows as a haven for pollinators on the Dartmouth campus.

Methodology

To accomplish our analysis, we investigated bee hotel use and the types of insects emerging in early spring. We collected nine bee hotels from five locations in Hanover, NH. In the lab, we wanted to simulate the natural progression from winter to spring.

First, we documented the total number of nesting tubes in each bee hotel and recorded how many were already occupied. We then placed the bee hotels in a room-temperature environment to mimic the warming temperatures that signal the end of hibernation for many insects.

Over a two-week period, we checked the bee hotels regularly for signs of waking activity. At the one-week mark, any bee hotels showing activity of any arthropods were placed in a very cold refrigerator overnight. This brief period at a low temperature (-2˚C) safely slowed down the arthropods' metabolism, making them less dangerous to handle. After chilling, we carefully collected the arthropods from the bee hotels using individual containers.

These arthropods were then humanely euthanized and prepared for microscopic analysis using a research methodology from the Bee Informed Partnership (Snyder, 2011). This methodology was as follows.

We humanely euthanized them by placing the containers in a freezer for one week. This freezer was set to a temperature low enough to guarantee their neutralization. Following this, the insects were allowed to thaw by being removed from their containers and placed on a paper sheet for fifteen minutes. We then rolled each specimen in the sheet to remove excess moisture.

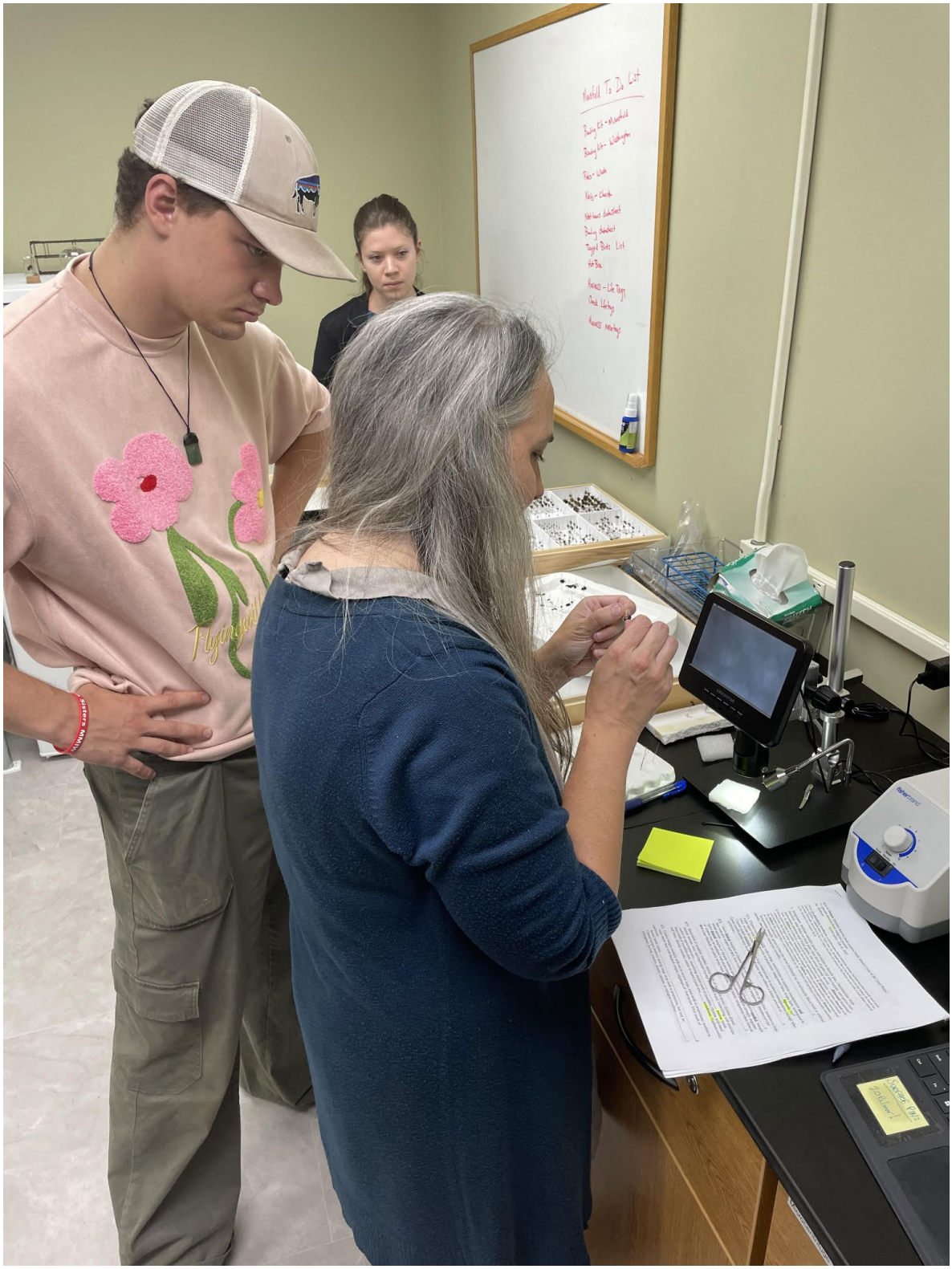
Each individual organism was then placed on a styrofoam platform and pierced with a stainless steel mounting pin close to the center of the insect’s body to be mounted. The specimens were then allowed to air dry for 48 hours. This process prepares the specimens for detailed examination and identification under a microscope.

Microscopic analysis allowed us to capture images of the insects, which (along with specimens themselves) were compared to a reference collection at the Vermont Center for Ecostudies for more precise identification of pollinator genera in consultation with Dr. Desiree Narango.

Finally, we returned to the bee hotels themselves. We examined each nesting tube to see if it was occupied and, if so, by what. We documented whether or not the tube was occupied, the number and types of insects found in the tubes, including adult bees, wasps, and immature stages like

larvae and pupae (cocoons) of various hymenoptera (insects with membranous wings, like bees and wasps).

Methodology In Action (Shots)




Pollinators
Native Bees

Statistical Methods

We separated our sites into three habitat types based on their location relative to the forest, the likely source habitat of these wild pollinators. These habitat types were forested (sites located in the forest), edge (sites located in close proximity to the forest), and urban (sites located deep within human habitation). As the organic farm bee hotels were in poor condition when they were obtained, these were excluded from statistical analysis of occupancy.

The forested habitat type included the bee hotel from the pine park wildflower plots, the edge habitat type included the bee hotels from the wildflower plots near Anonymous Hall and the Life Sciences Center (both less than 200 feet from the forest edge, measured via google maps), and the urban habitat type included the bee hotels from the Hanover parking lot behind CVS (which were isolated within a more urban area).

Each tube was entered into the data sheet as a separate row. We created a variable called “occupancy,” which we noted as 1 if the tube was occupied and 0 if it was not. Using occupancy

as a continuous variable, we compared occupancy by site type using ANOVA analysis in JMP Pro 17.

Results

Baseline Data and Bee Abundance Results

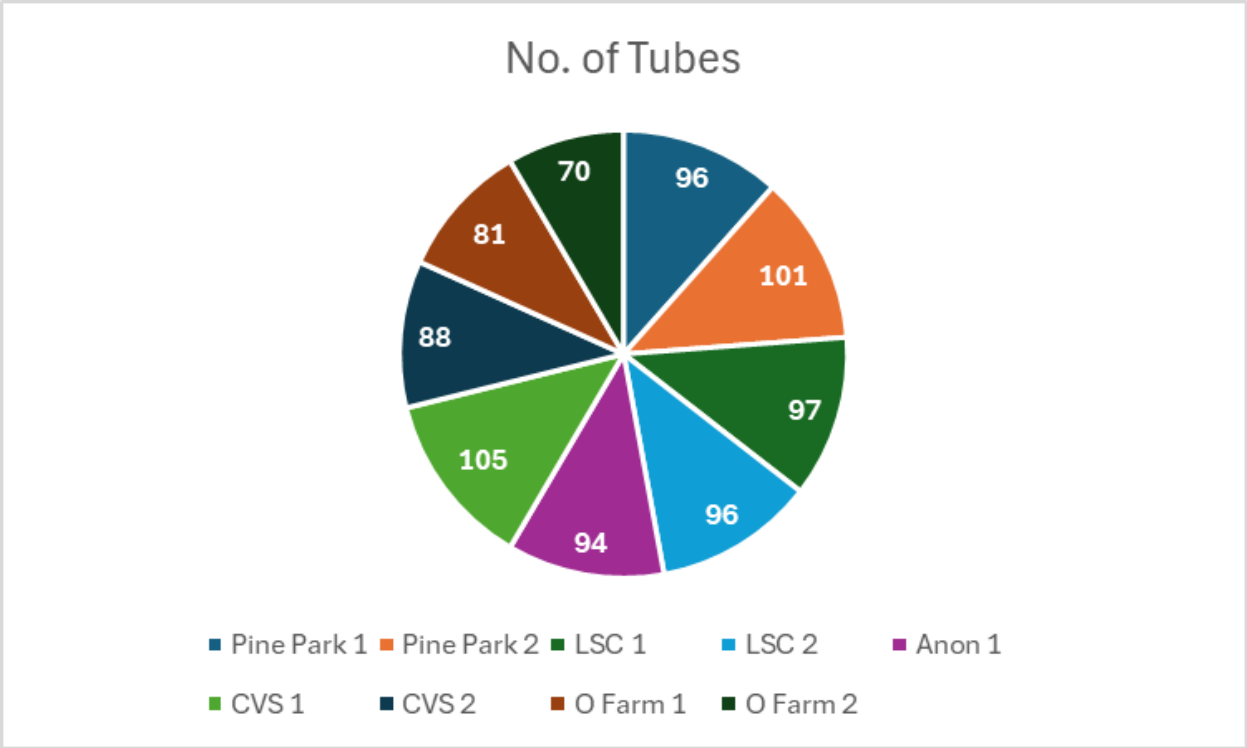


Fig. 3. Number of tubes by bee hotels.

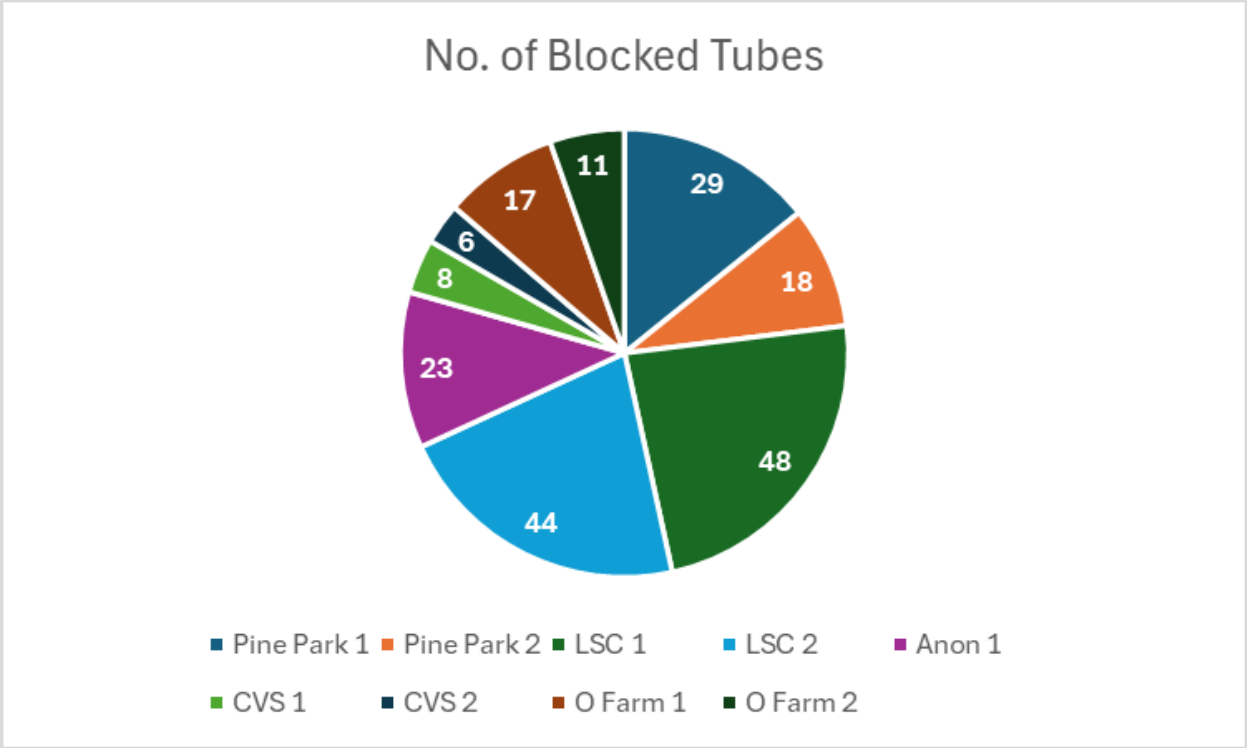


Fig. 4. Number of blocked (i.e. occupied tubes) by bee hotel.

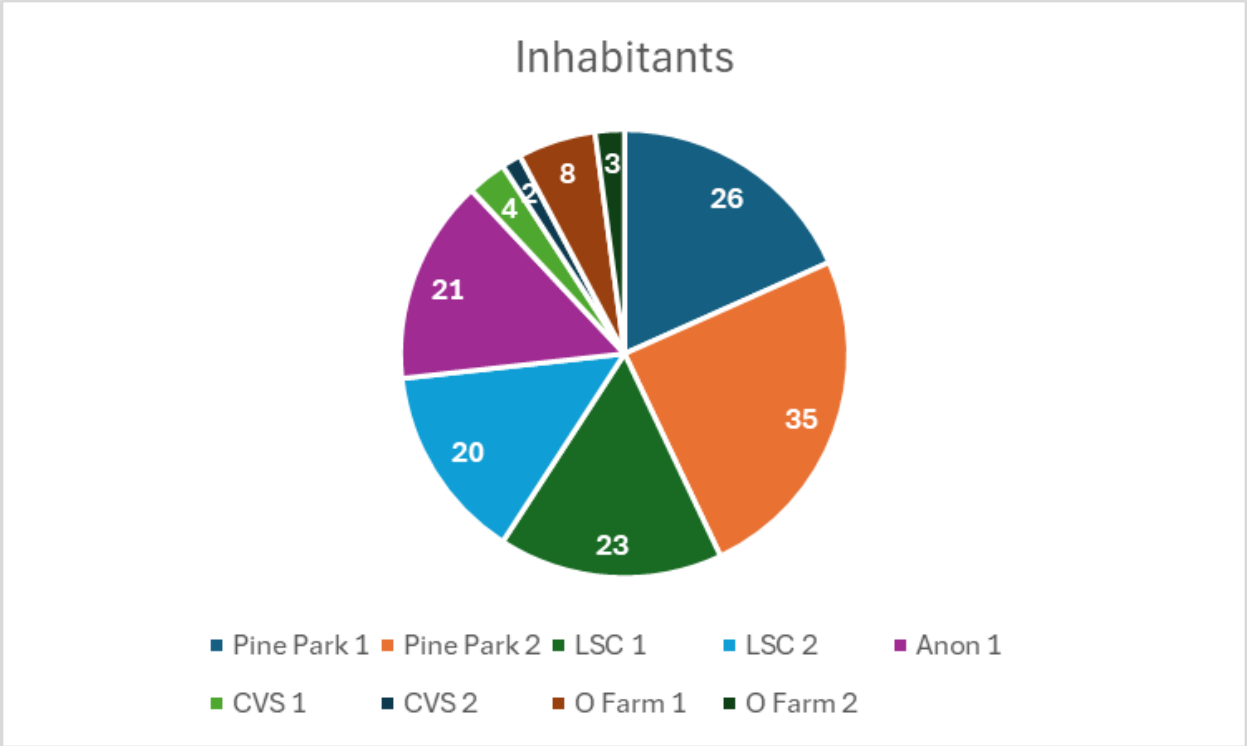


Fig. 5. Number of inhabitants (inclusive of live and deceased specimens found in tubes) by bee hotel.

Interpretation of Baseline Data and Bee Abundance Results

Data on occupation, inhabitants, and pollinator abundance (Figs. 1-5) were cross referenced with the characteristics of each hotel, including location, elevation, exposure to sun, and the development of the area. Qualitatively, pollinator usage was observed to be positively correlated with bee hotels located further away from human development, those mounted at an elevation from the ground, and placed at locations which received several hours of morning sunlight. Bee hotels in anthropogenically developed areas appeared to have the lowest levels of pollinator activity and usage. Additionally, we recorded a relatively low number of individual species across all bee hotels. Recorded species had high relative population numbers, with multiple members for each species of bee, although all live bee specimens

Occupancy Results

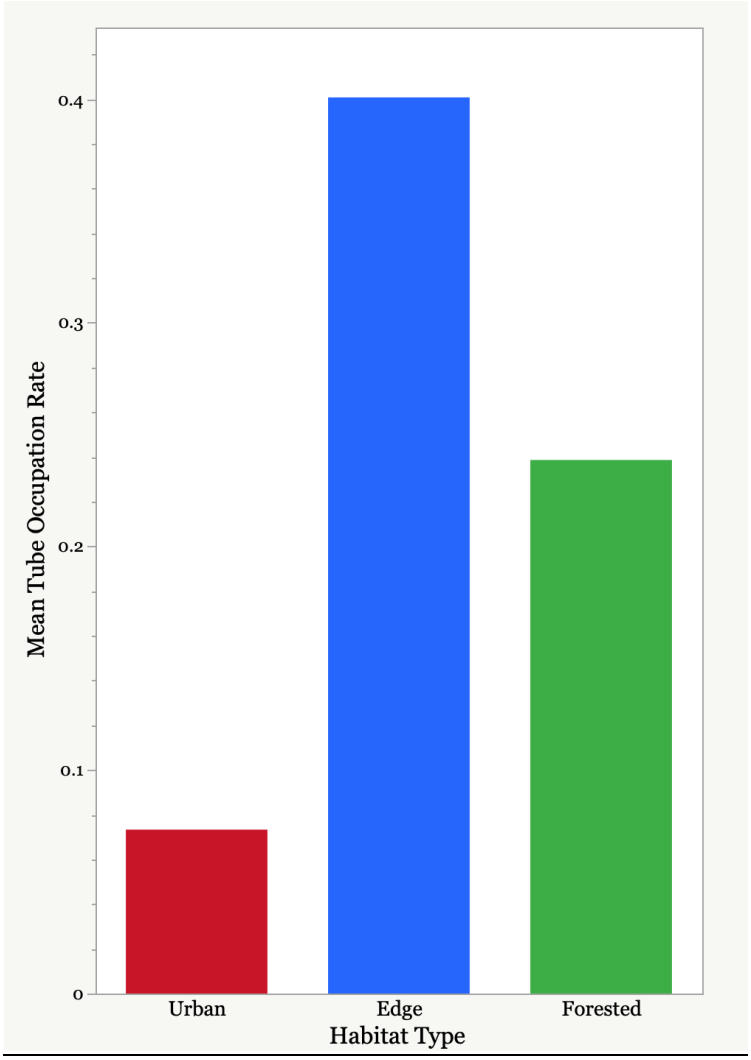


Figure 1: Mean tube occupancy rate by habitat type.

ANOVA analysis found rates of occupancy varied significantly by habitat type ($F_{2,674} = 35.49$, $P < 0.0001$). A post-hoc comparison of all pairs using Tukey-Kramer HSD found that the edge habitat had significantly higher rates of occupancy than either the urban habitat (0.33 ± 0.04, $P < 0.0001$) or the forested habitat (0.16 ± 0.04, $P < 0.0001$). In addition, the forested habitat was found to have significantly higher rates of occupancy than the urban habitat type (0.17 ± 0.04, $P = 0.0003$).

Live Specimen and Qualitative Findings

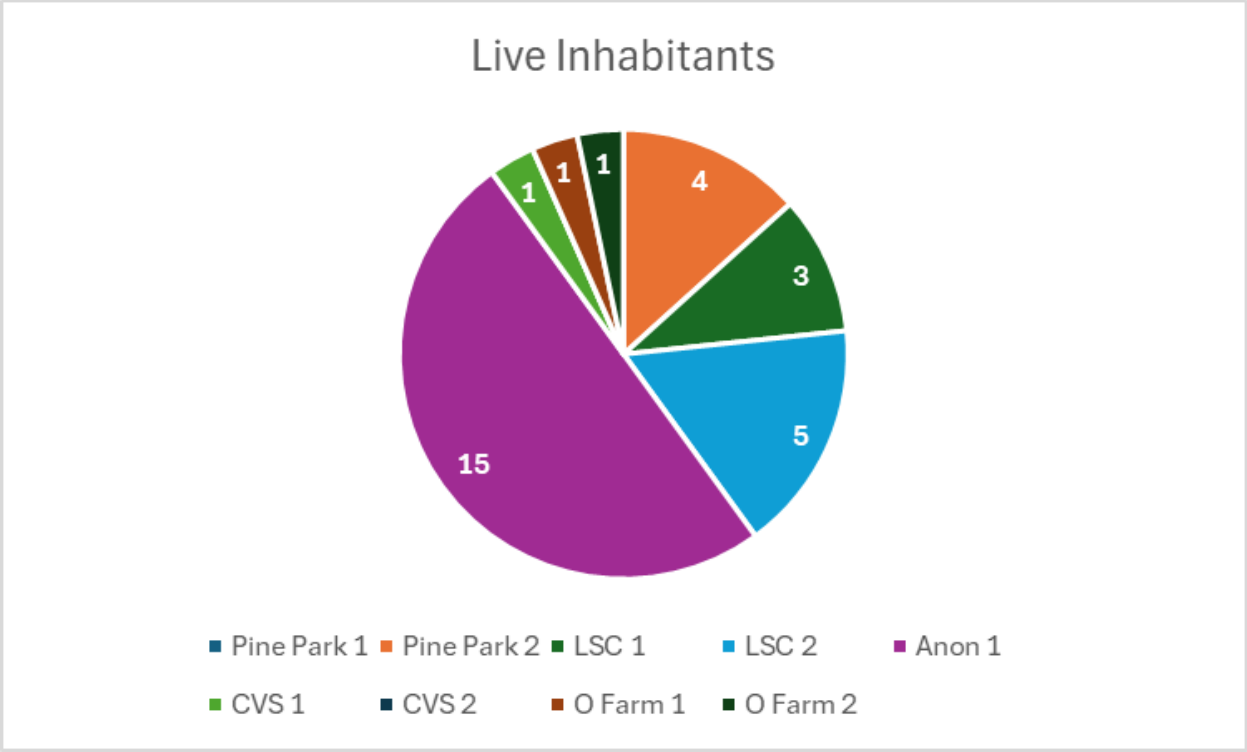


Figure 2: Number of live specimens by bee hotel.

We collected a total of 30 live specimens across our 7 bee hotels. 20 of these specimens were found in the edge habitat bee hotels, 15 of which came from one bee hotel, the one obtained from the wildflower plot by Anonymous Hall (termed Anon 1 in our dataset).

Qualitatively, we also observed that while wasps, spiders and other arthropods were found across several bee hotels, the only site where live bee specimens were collected came from Anon 1.

Bee Identification Results

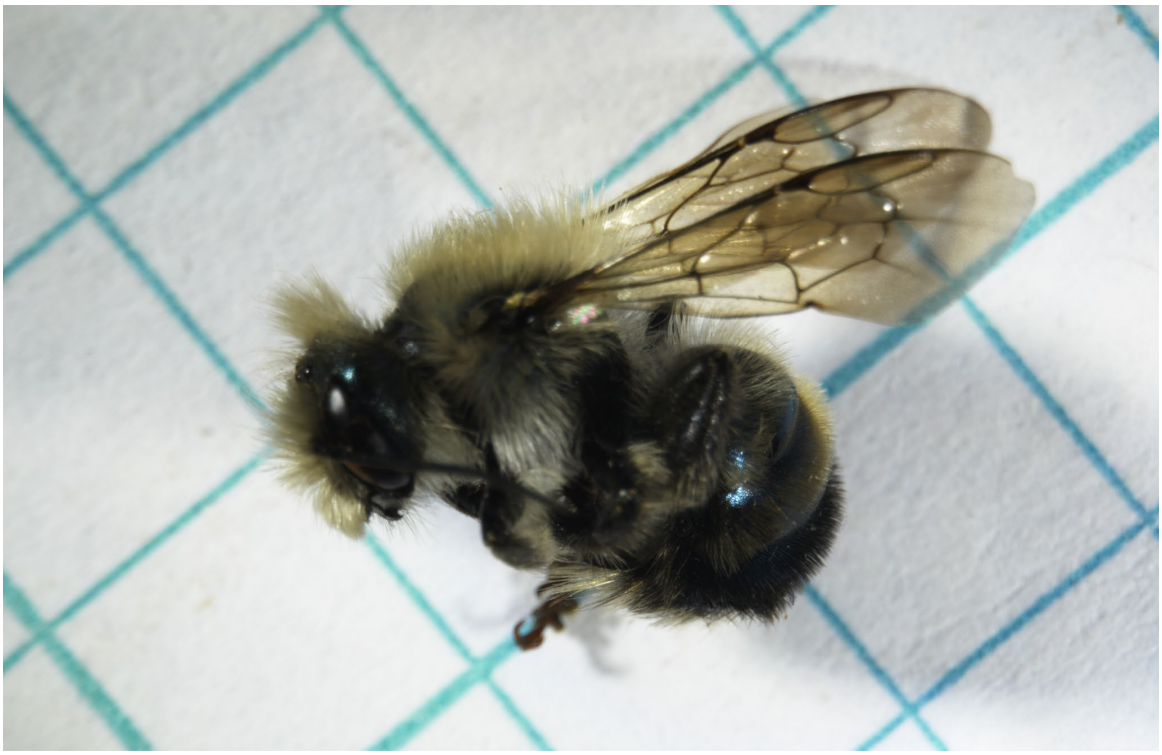


Image 1: Sample photo of *Osmia cornifrons* (Bufflehead Mason Bee) specimen we collected from Anon 1

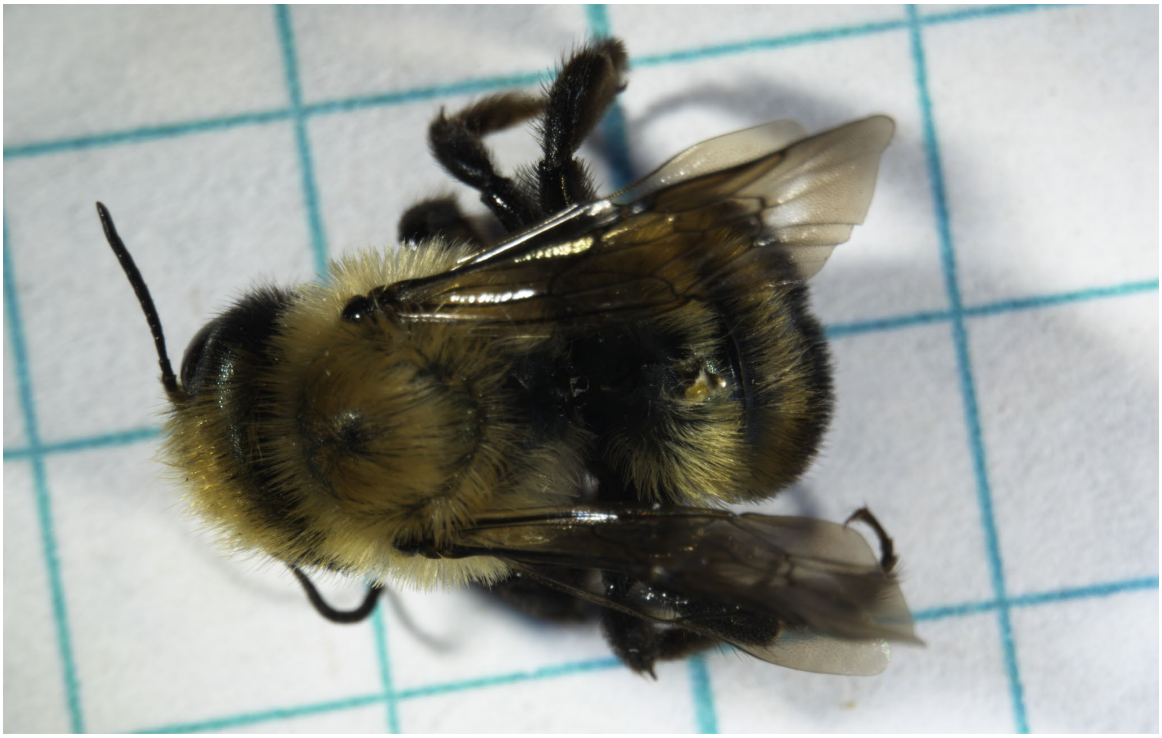


Image 2: Sample photo of *Osmia bucephala* (Horned Face Bee) specimen we collected from Anon 1.

We were only able to confirm bee occupation and inhabitation of Anon 1 out of all the bee hotels collected. At Anon 1 there were 6 bees of the species *Osmia cornifrons* (Bufflehead Mason Bee) (Img. 1), and 4 bees of the species *Osmia bucephala* (Horned Face Bee) (Img. 2). The *O. buchephala* species is a native bee to North America but not to New Hampshire and the *O. cornifrons* species is native to North Asia.

Of the non-bee species found, we were unable to identify all wasps to the species levels, but we observed 1*Vespula vulgaris* (Vesper Wasp) each at Anon 1 and 1 at LSC 2. We also identified a *Chrysididae* (Cuckoo Wasp) at the Pine Park 2 site.

Interpretation of Bee Identification Results

The results of bee occupancy throughout the bee hotels in the study show that only one hotel successfully attracted bees. This hotel was located next to Anonymous Hall on campus. At Anonymous Hall 10 non-Native bees were found. The literature indicates that bee hotels have been found to be significantly more successful at attracting bees the farther away from residential areas that they are (Prendergast 2023). Our data supports this literature as the hotels that attracted bees or any insects at all tended to be farther away from both commercial and residential areas.

We do not believe that our results should be taken as a direct indication of bee population or bee population growth within the area as bee hotels have been found to be under-representative of known population numbers, and thus are helpful for following general trends but not determining actual rates of abundance (Harris et al 2021). Studies have shown that as ecosystem and bee population health and stabilization increases, numbers at bee hotels typically stay consistent (Harris et al. 2021). Meta studies of bee hotels have shown that the average occupancy rate is 20% with the maximum occupancy found being 40% (Rahimi et al. 2021).

We are unable to know if bees nested at other bee hotels before potentially being predated by wasps, as only wasps were found at other sites. Specifically both Vesper Wasps and Cuckoo Wasps, both wasp species found in other boxes, are predators of both native and non-native bees. Our results indicate the use of bee hotels are potentially problematic for allowing the predation of specifically native bees. This is supported by the literature which indicates that native bees are more likely to be parasitized at bee hotels than introduced bees, and over multiple years the only species to increase in abundance after implementation of the bee hotels was introduced wasps (MacIvor and Packer 2015). Some studies have shown that up to 20% of bee nests in hotels are parasitized by wasps or other predators (Prendergast 2023). Thus we conclude that specifically for native bees, bee hotels can provide an attractive location for predators, even as they provide a potential home for non-native bees.

Recommendations for Future use of Bee Hotels at CHP Pollinator Gardens

Placement Matters: The location of a bee hotel significantly impacts its success rate. Here are some key factors that we discovered in our study:

- **Habitat:** Studies like "How effective are artificial nests in attracting bees?" (Rahimi et al. 2021) back up our results and show that bee hotels near flowering plants, especially natives, are more likely to be used. This creates a more attractive habitat for pollinators by providing a food source close to nesting sites.
- **Sun and Shelter:** Ideally, bee hotels should receive morning sun for several hours and have some protection from rain and wind. East or southeast facing locations are good options. Avoid placing them in full shade or exposed areas.
- **Height:** Mounting bee hotels between 3-6 feet above the ground is ideal. This matches the typical nesting height of many solitary bee species and aids in preventing the presence of mites and other parasites, and also spiders (which we found a fair amount of).
- **Avoid Disturbance:** Locate bee hotels away from high foot traffic or areas with frequent activity – although this is difficult in urban areas. Solitary bees prefer calmer environments.
- **Effectiveness:** The effectiveness of bee hotels can vary depending on these placement factors and the local bee communities. Studies have not established a definitive success rate (Rahimi et al. 2021).

How placement affected the species composition of the bee hotels we collected was clearly observed in the difference between the Anonymous Hall site and the other sites. The bee hotel collected from Anonymous Hall was the only site to contain bees, whereas the others were inhabited by spiders and parasites. Anonymous Hall has a combination of ideal factors, including its level of sun exposure, height, and disturbance level. We recommend placing new bee hotels in similar locations where they face east or southeast, are attached to a tree or other structure that is off the ground, and are away from as much noise and direct traffic as possible. Another suggestion is placing bee hotels near pollinator plots that contain wildflower species which native, specialized bee species prefer, therefore further limiting the space and ability for parasites and non-native species to encroach upon the hotels.

Dr. Narango from the Vermont Center for Ecostudies suggested that we implement a new bee hotel model that allows for occupant observation without entirely dismantling the entire hotel and its interior tubes. She was able to reconstruct this model based off of a bee hotel sold on Etsy.com, and even suggested that these new models be produced and set up by an annual ENVS

25 course, Agroecology, which is offered during each Dartmouth summer term.

Image 3: Photo of Dr. Narango's recommended new bee hotel design, from the Etsy shop Rivajam.

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GROUP 4: GRANT DEVELOPMENT

Executive Summary

Creating Habitats for Pollinators (CHP) is a non profit organization founded by David Hammond (Dartmouth '89) in an effort to restore, create, and conserve pollinator habitats. CHP has planted numerous native wildflower plots across Michigan in New Hampshire. At Dartmouth College, CHP partners with the Class of '89 Pollinator Project (also founded by David) to plant native wildflower gardens around campus. David hopes to grow and develop CHP to allow him to tackle CHP's mission full time. CHP is seeking funding via grants, individual donations, and corporate sponsorships. Community engagement through in person events, and a strong social media presence will be integral to CHP's growth.

The following document aims to understand CHP's current funding model and associated literature on non-profit funding models. Using this understanding, our group presents David and CHP with four major expansions to the current funding model that can be easily implemented within the next two years. The document will begin with an industry and customer analysis focusing on the environmental NGO space and the people who are connected and passionate about CHP's mission. We will further contextualize CHP within relevant literature and CHP's current funding sources.

Finally, our Funding Expansions Recommendations are as follows:

- Tiered Donations and Membership:
    - Implement a tiered donation system with thank-you cards, stress balls, and merchandise for larger contributions.
    - Introduce *Sponsor a Pollinator!* membership program with tiers offering various engagement levels and benefits.
    - Publish a subscribable newsletter with annual or monthly CHP updates.
- Grant Proposal Development and Funding Vault:
    - Introduce CHP's Funding Vault as a dynamic and living document of consolidated grant opportunities.
    - Sample proposals, from small-scale native seed grants to large state government grants, are provided to bolster CHP's grant development materials.
    - Scalability and community engagement focus to enhance competitiveness in securing funds.
- Crowdsourcing and Social Media Strategy:
    - Implement comprehensive social media identity through engaging content and strategic posting
    - Ultimately implement Instagram's fundraising feature.
- Corporate Sponsorships and Relationships:

- Develop partnerships with local businesses and institutions for community service workdays and collaborative marketing efforts.
- Expand partnerships with Dartmouth-affiliated local businesses to secure resources and expand visibility.

Our report will conclude with an illustrative timeline for our expansion recommendations divided into short-term and long-term timelines. Through the end of 2024, we hope CHP will expand its social media presence and prepare grant application materials by utilizing the Funding Vault. In 2025 and beyond, we hope CHP will continue preparing and submitting grant applications, introduce the tiered donation structure, and eventually experiment with social media fundraising features and collaborations, such as annual World Bee Day fundraisers.

CHP Industry and Customer Analysis

CHP Industry Positioning

This section analyzes the environmental non-profit industry, focusing on the sub-sector dedicated to pollinator health. Understanding the broader industry trends and the specific needs of pollinator-focused organizations is crucial for the strategic development of CHP.

Since the first Earth Day in 1972, environmental NGOs have seen steady growth fueled by increasing awareness of environmental issues, in particular, climate change (Straughand & Pollock 2007). However, they still only receive 2% of all charitable donations (Thomas 2020). Their missions often involve raising awareness, conducting research, implementing conservation projects, and influencing policy. Environmental NGOs receive funding primarily through donations and grants (Foster et al. 2009). Climate mitigation and sustainable resource management remain the top priorities of the industry meaning CHP can maximize on the open niche of pollinator protection (Straughand & Pollock 2007). However, CHP may compete for attention and resources against organizations focused on issues the public finds more pressing.

Despite the relative lack of awareness regarding the decline of pollinators, their importance cannot be understated. Pollinators are integral for global food production, and are estimated to contribute over 3 trillion dollars annually in worldwide ecosystem services. While the industry is growing, grant and donation competition remains fierce, requiring strategic fundraising efforts. Collaborations with larger, more well-known organizations like the Audubon Society or the Nature Conservancy could be an effective strategy for growing CHP and spreading pollinator conservation awareness. Additionally, continual technology advancements such as social media are crucial for growth, and increasing pollinator decline awareness.

CHP Customer Analysis

This section looks at the diverse range of CHP supporters. CHP's primary audiences include its donors and strong community volunteer base. Understanding these communities are crucial for customer engagement and informs potential future audiences.

Volunteers are central to CHP's success. Often local community members, these volunteers bring their passion for conservation through hands-on plantings of native wildflower plots. Their involvement allows for meaningful collaboration and opportunities for community-building while beautifying their neighborhoods. Volunteers and their generous time give life to CHP's initiatives. Donors, both individual and organizational, play an immense role in CHP's growth and sustainability. Those who donate are often environmentally conscious and believe in CHP's mission to restore pollinator habitats. Donors may be drawn from the local area, alumni networks, and environmental communities. Additionally, CHP's tight-knit community, goals, and the people they impact create donor opportunities from friends and family of current supporters. CHP's donors also present themselves through grants from organizations who prioritize environmental causes, allowing well-resourced financial sustainability for CHP.

Engagement through in-person events like planting days and educational workshops gain a tremendous amount of support from the local community. Furthermore, CHP's growing social media presence will allow for support from individuals throughout the country, further creating opportunities for CHP to expand planting sites and locations. The dedication of volunteers and supporters will allow CHP to continue its mission of conservation and creating vital pollinator habitats.

Contextualizing CHP's Non-Profit Funding Model

This section will focus on CHP's funding model and related literature. The literature is wide but this section will be grounded in an article published in the Stanford Social Innovation Review by William Landes Foster, Peter Kim, and Barbara Christiansen. Our understanding of CHP's funding model is as follows:

- **Monetary Donations:** These donations are given by individuals with a personal tie to the organization. These donations are also tax-exempt under CHP's 501(c)(3) status which improved the attractiveness of these donations to the donor.
- **In-Kind Donations:** These donations are not monetary-based but instead are gifts of goods or services. Examples include the landscaping company's in-kind donation to CHP.
- **Community Funds:** These sources, often focused on a specific geographic area, were mentioned as an interesting area of expansion. However, the primary challenge in taking full advantage of these funds were communication and knowing where to focus efforts.

- **Institutional Relationships:** Understood in greater detail by the College Relations team, CHP's relationships with institutions like Dartmouth are crucial in establishing CHP's history and kick-starting the institutionalization of pollinator habitats on larger scales.
- **Recurring Donations:** While CHP may have returning donors, the certainty of timing and amount varies. As such, this is the next step for bolstering CHP's funding structure.
- **Grant Development:** As our group name suggests, large grant funding should be CHP's next step. While applications may be rejected more frequently than accepted as CHP develops, the application process will provide valuable information and experience.

Ten Nonprofit Funding Models

Based on the above, our team's recommendations for expanding CHP's funding structure will be grounded in the paper "Ten Nonprofit Funding Models" by William Landes Foster, Peter Kim, and Barbara Christiansen. The authors tackle the question of how nonprofits can consistently secure funding. The authors propose ten distinct funding models to help nonprofit leaders better understand and communicate their funding strategies. These models include the Heartfelt Connector, which relies on individual donations driven by emotional connections, and the Beneficiary Builder, which gets support from people who have directly benefited from the nonprofit's services, like universities and hospitals. Other models include the Big Bettor, which attracts significant funding from a few major donors, and the Public Provider, which works with government agencies to deliver essential services. By identifying these models, the paper aims to provide a clear framework that nonprofits can use to align their financial strategies with their missions.

The authors emphasize that especially during tough economic times, it's crucial for nonprofits to focus on the funding model that works best for them rather than chasing every funding opportunity that comes their way. By having a clear and intentional funding strategy, nonprofits can secure more sustainable financial support and achieve greater program success. Philanthropists are also looking for nonprofits with well-defined funding models to invest in. This framework may help CHP navigate the complexities of funding, leading to better financial stability and success in achieving its missions.

Below is a recreation of the Foster, Kim, and Christiansen chart summarizing the ten funding models. The key pieces of information here are the source and motivation columns. Note how the Heartfelt Connector and Big Bettor are based on altruism whereas the Resource Recycler is based on self-interest. Regarding CHP, the Heartfelt Connector is the funding model most aligned with CHP currently. There are some aspects of Big Bettor with the use of community funds and Resource Recycler with the in-kind donation from the landscaping community and the potential donation of two acres from the Michigan government, but these funding models do not comprise a large percentage of the CHP's overall funding model. The Big Bettor is the model that most aligns with the mission of the Grant Development team but the Resource Recyler model also presents greater opportunities for community development and relationship building.

Funding Model	Source	Decision Maker	Motivation	Example
Heartfelt Connector	Individual Donations	Many individuals	Altruism	Susan G. Komen Foundation or CHP
Beneficiary Builder	Individuals benefiting from services	Many individuals	Self-interest followed by altruism	Princeton University
Member Motivator	Membership dues and individual donations	Many individuals	Collective interest	National Wild Turkey Federation
Big Bettor	Major grants from a few individuals or foundations	Few individuals	Altruism	Conservation International
Public Provider	Government contracts	Government administrators	Collective interest	Texas Migrant Council
Policy Innovator	Government funding for new approaches	Policymakers	Collective interest	HELP USA
Beneficiary Broker	Government reimbursements	Beneficiaries	Self-interest	Metropolitan Boston Housing Partnership
Resource Recycler	In-kind corporate donations	Few individuals	Self-interest	Greater Boston Food Bank
Market Maker	Mixed (fees and donations)	Many individuals and few individuals	Altruism and self-interest	American Kidney Fund
Local Nationalizer	Local donations and events	Few individuals	Altruism	Teach for America

CHP Funding Expansion Recommendations

Tiered Donations and Membership

We recommend CHP incorporates a tiered donation system catering to varying levels of support. For one-time donations, we will encourage higher donations through prominently displayed buttons of $25, $50, and $100 while also providing flexibility for smaller contributions via the "custom" button. Studies have shown that providing default options increases the likelihood of these amounts being chosen (Goswami & Urminsky 2016). As a token of appreciation, donors contributing $15 or more will receive a thank-you card that includes dried flowers (however, these may be omitted if they become too time or labor-intensive). For exceptional generosity exceeding $1,000, donors will have a garden plot named after them with a custom metal sign, along with a bee, butterfly, and flower stress balls, a t-shirt, a hat, and a mug.

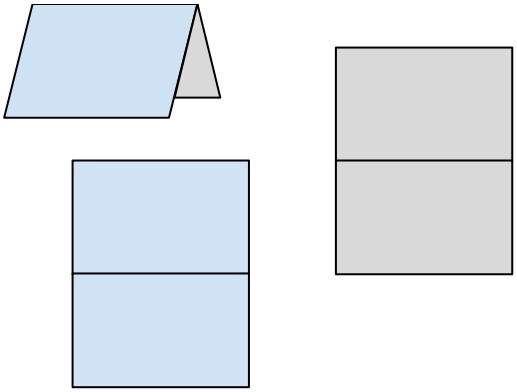
Additionally, supporters can opt for the "Sponsor a Pollinator!" membership program which offers ongoing engagement and benefits. Studies have shown that participatory member-donors are an effective way to increase donations (McCardle et al. 2009). All members will automatically receive the newsletter (with options to opt-out at any time). The program offers three tiers: Bee Sponsor for $100/year (includes the bee stress ball free gift), Butterfly Sponsor for $250/ year (includes the butterfly stress ball and CHP t-shirt gifts), and the wildflower sponsor for $500/year (includes the wildflower stress ball, CHP t-shirt, travel mug, and hat gifts). Supporters will have the option to opt out of receiving gifts if they prefer.

Whenever someone donates, they must include an email, and (if applicable) t-shirt size. All donors will receive a one-time thank you email, regardless of donation amount. This email template should be autofilled with donor information and include links to recent plantings and Instagram to keep donors connected and involved. There should also be a check box for donors to opt-in to a monthly/ quarterly (depending on David's preference) newsletter containing updates on planning initiatives and progress. The web page explaining the donation options should emphasize that all donations are tax-deductible to further encourage donations. If required, the fine print regarding this should be included at the bottom of the thank you email. Additionally, photos on this page should consist of both people and wildlife enjoying wildflowers to highlight the positive impacts of donations.

Important and Editable Canva Links:

- Thank-You Card
- Thank-You Email
- Newsletter

Thank-You Card



Card Format: Pictures Below Numbered Clockwise

Thank-You Email

Dear [Donor's Name],

I hope this message finds you well. On behalf of Creating Habitats for Pollinators (CHP), I want to thank you for your recent donation of [AMOUNT]. Your contribution plays a vital role in our mission to protect and conserve pollinator populations by planting native wildflower gardens.

With your support, we can continue our efforts to create sustainable, biodiverse ecosystems that support healthy pollinator populations and contribute to the resilience of our natural environment.

Donation Receipt:

Name:	[DONOR NAME]
CHP Tax ID:	[TAX ID]
Date:	[DATE]
Donation Amount:	[AMOUNT]
Payment Type:	[TYPE]

Once again, thank you for your support of Creating Habitats for Pollinators. Together, we are making a difference for pollinators and the planet.

Warm regards,

David Hammond
CHP

Creating Habitats FOR POLLINATORS

Follow us on Instagram!
@creatinghabitats

CHP Newsletter (Trifold Brochure)

WHAT YOU SUPPORT

- Help threatened, pollinating insects & animals by planting new native habitat
- Assist important high-profile "indicator" species
- Engage schools & communities with meaningful service projects
- Bring different people together for a common goal
- Allow for education of native ecosystems, habitat restoration, and land use management

WANT TO VOLUNTEER?

STAY UPDATED

creatinghabitats.org

@creatinghabitats

SPRING 2024

Creating Habitats FOR POLLINATORS

TRANSFORMING SPACES

How your generous donation has impacted local communities

NEWSLETTER

RECENT PLANTINGS

On May 2nd, Creating Habitats for Pollinators teamed up with Dartmouth College students enrolled in ENVS 50 to plant wildflowers around campus, including a **brand new** site in front of the Sustainable Living Center. This joins existing native wildflower gardens at the Life Science Center, Kemeny Courtyard, the Organic Farm, Collis Center, Anonymous Hall, and the Old Dartmouth Cemetery.

YOU'VE HELPED US ACHIEVE...

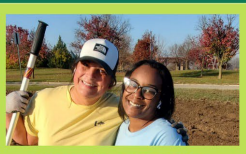
257,174+ square ft planted

34+ active planting sites

4 states with plantings

34 native species planted

CONTINUE YOUR SUPPORT



EVERY DOLLAR INCREASES OUR IMPACT

Make a tax-deductible donation to support wildflower planting projects. Every donation increases the amount of land we can seed with pollinator-friendly wildflowers.

CHP is a fully accredited 501(c)(3) under the IRS tax code making all donations to us tax-deductible. Our donations are processed through the secure online portal of the Canton Community Foundation / Local Impact Alliance.

CHP Merchandise Samples

This section provides links to merchandise for ease of ordering or customization.

Clothing and Drinkware

[Customize T-Shirt Link]

[Customize Hat Link]

[Customize Mug Link]

[Customize Water Bottle Link]

Stress Balls

[Customize Bee Stress Ball Link]

[Customize Butterfly Stress Ball Link]

[Customize Wildflower Stress Ball Link]

Grant Proposal Development and Funding Vault

This section will focus on CHP's use of grant funding. Based on expressed needs, CHP should look to expand their funding beyond small donations. This expansion coincides with CHPs overall operational expansion through increased projects, increased geographic reach, and social media presence. As such, the survival of CHP will be a function of its financial stability, of which successful grant proposals will be crucial. To best serve CHP's funding needs, we have determined that a consolidated location of funding opportunities would best aid CHP's grant proposal development needs. This deliverable, called the Funding Vault, will serve as a one-stop location for grant program information. In addition to the Funding Vault, we will also present CHP three sample grant proposals for a variety of grant programs, from state government to small pollinator specific grants.

Funding Vault Overview

The Funding Vault is divided into various tabs. The first tab is a cover image, the second the instructions on how to use the Funding Vault, the third the "Inner Vault", and the fourth through sixth are expanded information regarding the sample proposals. The "Inner Vault" is a filterable (by column) of selected grant opportunities.

This list is not meant to be final but instead dynamic and updatable as CHP finds funding opportunities we may have missed. The first two columns organize the grants into primary and secondary types which aid the proposal writing process and the specific positioning of CHP. The next section is a high-level overview of the grant programs including eligibility, funding amount, deadlines, and website links. The final three columns are specific to this group's work and understanding of CHP's organizational evolution. The CHP Success column determines which grant programs are within reach to CHP currently with government funding (which requires more strict criteria and documentation) being the more unlikely grant funding source for CHP currently. The final three columns are meant to be updated with time and as CHP begins to apply for grants.

The Sample Proposal tabs are organized much like the inner vault but are more so focused on CHP's application process with the status as the first column. These tabs are meant to be duplicated with each grant CHP submits and can eventually be organized by year or type. A recommended way to do this would be to assign the tabs a specific color, whether by year or by primary or secondary grant type, and/or rename the tabs.

Below are important links along with screenshots of Vault tabs

- Funding Vault
- Sample Proposal Folder (With PDF and Editable Doc Versions)

Funding Vault: Sample Proposals

To bring the Funding Vault to life, we have selected three grant programs and created sample proposals for CHP. This selection of grants captures a wide range of possible funding sources for CHP from state government to individual philanthropic funds. These grant programs also range in funding amounts allowing CHP to flex different aspects of its projects or even fund a single project from multiple sources.

Sample Proposal #1: Neil and Louise Tillotson Fund: Dash Grants Program

This first sample proposal is for the Dash Grants Program under the broader Neil and Louise Tillotson Fund. This fund is part of the New Hampshire Charitable Foundations Organization. Established in 2006, The Neil and Louise Tillotson Fund is one the largest rural philanthropies in the US and is driven by a mission of enhancing community well-being, environmental stewardship, cultural preservation, and economic opportunities.

The Dash Grants Program funds rapid grants ranging from $250 to $2,000 that fit the specific geographic focus. Eligible applicants include government agencies, grassroots groups with financial sponsors, and tax-exempt organizations like CHP. While a sample proposal provided here is specific to the Dash Grants program, CHP is well-positioned to take advantage of the other Neil and Louise Tillotson Fund programs.

Below are important and useful links:

- Funding Vault - Sample Proposal Sheet
- Sample Proposal: PDF and Editable Doc
- Neil and Louise Tillotson - Dash Gants Program Website

Sample Proposal #2: Native Seed Grants by Pollinator Partnership

This second sample proposal is for the Pollinator Partnership Native Wildflower Seed Grant. Pollinator Partnership is a non-profit organization dedicated to promoting the health of essential ecosystems and food pollinators through research, conservation, and education. The organization works with a range of stakeholders, from landowners to scientists to gardeners, to develop methods and opportunities to address issues of climate change, habitat destruction, and increased harmful chemical use.

The Native Wildflower Seed Grant is a collaboration between Pollinator Partnership and Toyota Motor North America. The Grant provides free supplemental native wildflower seeds for large-scale habitat projects. The mission is to enhance 26,000 acres of pollinator habitat by 2025 while also improving community education and support for wildlife protection.

Below are important and useful links:

- Funding Vault - Sample Proposal Sheet
- Sample Proposal: PDF and Editable Doc
- Native Wildflower Seed Grant Website

Sample Proposal #3: Michigan Invasive Species Grant Program (MISGP)

This third sample proposal is for a specific Michigan state government grant focussing on invasive species across the state. The Grant Program supports projects that aim to prevent, detect, and

control invasive species in Michigan. Grants focus on restoring native biodiversity and enhancing ecological health by mitigating the impact of invasive species.

Below are important and useful links:

- Funding Vault - Sample Proposal Sheet
- Sample Proposal: PDF and Editable Doc
- Michigan Invasive Species Grant Program Website

Sample Proposal Analysis

Having presented three separate sample proposals, analyzing similarities and differences will showcase how CHP's positioning changes and provide insights into what defines a successful application. We acknowledge that the similarities across the three proposals are likely a function of our group picking grant programs that largely overlap in their environment-focus, pollinator-specific, and community engagement aspect or locality.

An important concept in CHP's application success is scalability. For general environment-focused grants, CHP's pollinator focus will enhance its competitiveness. For pollinator-specific funds, CHP should leverage community engagement and short project timelines to highlight the immediacy of project impacts. The table below highlights features with similarities highlighted in green and differences in red. The greater number of differences is not a concern but instead a representation of CHP's flexibility in securing funding sources. These distinctions are important to tailor proposals to respective funding program's objectives and demonstrate a clear understanding of local needs and resources.

Program Features	**Dash Grants Program Proposal**	**Native Wildflower Seed Grant Proposal**	**Michigan Invasive Species Grant Proposal**
Fund Objective	Create new native wildflower plots	Expand pollinator habitats with additional planting	Eradicate and control invasive species
CHP Project Justification	Pollinator habitats combat habitat loss and support agriculture	Supplement existing habitats to support imperiled wildlife	Threat of invasive species to pollinator habitats
CHP Project Activities	Site preparation, planting, community engagement	Fall seeding, community involvement, habitat monitoring	Public education, mechanical and chemical eradication, monitoring
Community Involvement	Engaging local volunteers, with focus on students	Engaging community via volunteering	Educational campaigns, specifically in prevention
Environmental Impact	Enhance biodiversity to support local crop yields	Enhance biodiversity to increase local ecosystem resilience	Restore native biodiversity and prevent further invasive species spread

Education Focus	Pollinators and native plants	Increased awareness	Invasive species prevention and management
Funding Request and Duration	Requests $2,000; short-term, rapid implementation	Requests supplemental seed mixes; medium-term project	Requests $250,000; large-scale, long-term project
CHP and Fund Alignment	Revitalize communities, support ecosystems	Promote pollinator health, enhance habitats	Prevent invasive species introduction, manage established species
CHP Marketing Focus	Community benefits and quick project results	Long-term ecological benefits and community education	Comprehensive management of invasive species control via pollinator populations

Crowdsourcing and Social Media

This section aims to underscore the importance of CHP's social media strategy in the eventual addition of crowdsourcing as a funding source. The below strategy is tailored to engage and educate a widespread audience on the importance of pollinator habitats. This strategy highlights the simultaneous passive expansion of CHP's following and an increase in the accessibility of pollinator information to the public.

Social Media Strategy: Engagement, Outreach, and Education

Key aspects of the strategy include:

- Content Creation:
    - Instagram Posts: Informative posts on the role of pollinators and habitat creation. Examples include the negative impacts of pesticide use and the positive impact of new wildflower plots. These posts are crafted to be engaging but accessible through simple language and concise explanations of complex scientific content.
    - Instagram Stories: Stories provide project updates on new plots or community planting days to stories engage followers and encourage online involvement. While not in-person, online involvement enhances community and one's sense of place in that community.
- Strategic Posting and Hashtags:
    - Optimized Posting Schedule: Posts are strategically published to coincide with relevant environmental dates and projects to maximize visibility and audience engagement.
    - Effective Hashtag Use: Hashtags help to extend CHP's reach beyond project locations or community ties by engaging with already interested communities. These communities may include those focused on gardening, wildlife conservation, and sustainability.

- Interactive Features:
    - Collaborations and Tags: Partnering with educational, ecological, or other local community organizations increases CHP's visibility and network. By tagging and collaborating in posts and stories, CHP leverages its audiences for organic growth.

Instagram Fundraising and Donation Feature: Brand Identity

Through continual posting and engagement, CHP will be able to create a unique and recognizable brand identity that will allow CHP to utilize Instagram's fundraising feature. This feature is a PayPal Giving Fund and Instagram collaboration that began in late fall of 2023. The feature allows account owners to raise money through their followers and associated networks. The fundraiser exists in your account biography for 30 days, with options to end early or extend, and is advertised through standard Instagram features (posts, stories, or live videos). Since CHP is a public account, anyone with a personal account can see and donate to the fundraiser. The link to the full Instagram Feature is provided here for further information: Link.

To do this, CHP must make sure these points are clear to any potential donor:

- Mission Clarity: Define clear and powerful statements about CHP's mission and its broader environmental importance. This mission should be central to CHP's brand identity and consistently reinforced.
- Visual Uniformity: Develop a consistent visual style including color scheme, logo, and graphic elements (such as bees, butterflies, and flowers) to reflect CHP's focus on pollinator habitats.
- Content Creation Diversification: Create diverse content to highlight CHP's impact, educate the public in fun and innovative ways, and demonstrate the tangible benefit of continued donations.

To Create a Fundraiser, Please See Instructions Below:

1. Tap the ⊕ button
2. Choose the image(s) for the fundraiser post and tap **Next**
3. Edit the picture as desired and tap **Next**
4. From the options tap **Add Fundraiser**
5. Select CHP as the nonprofit you'd like to fundraise for and tap **Edit Fundraiser** to go to an "Fundraiser Details" page.
6. Complete the details of the fundraiser and then tap **Done**.
7. Tap **Share** or **Post** to begin the fundraiser

To Extend a Fundraiser, Please See Instructions Below:

1. In your account home page, tap on the post with the fundraiser
2. Tap of the three dots in the top right corner
3. Tap **Extend Fundraiser** twice

Corporate Sponsorships and Relationships

CHP can leverage corporate sponsorships and relationships to help fulfill its mission to support pollinator health. By establishing strategic partnerships with local businesses and institutions, CHP can secure necessary resources, enhance community visibility, and foster sense of community involvement. This section outlines the potential avenues for developing corporate sponsorships and relationships.

One way to develop corporate sponsorships is through community service workdays. Community service workdays are a powerful tool for engaging corporate partners while directly benefiting the environment. These events allow businesses to demonstrate their commitment to corporate social responsibility and team-building while supporting local pollinator habitats. Brands can have their logo on signs or t-shirts to make their contribution visible. A second way to build corporate relationships is through collaborative marketing and promotions. Collaborating with local businesses on marketing campaigns can amplify CHP's message. Joint promotions, such as special discounts for customers who donate to CHP or participate in volunteer events, can drive community engagement and support. Businesses can also feature CHP information in their newsletters, websites, and social media channels, broadening the reach of CHP's initiatives.

Dartmouth Affiliated: Sustainability Office and Irving Institute

CHP can collaborate with the Dartmouth Sustainability Office and the Irving Institute for Energy and Society at Dartmouth. These institutions are dedicated to environmental sustainability and can mobilize students, faculty, and staff for community service work days focused on creating and maintaining pollinator habitats. Aligning these service days with academic schedules and sustainability initiatives will ensure high participation and ongoing support from the Dartmouth community.

Non-Dartmouth Affiliated: Local Businesses in Hanover, NH

- **FatFace**: This clothing store, known for its commitment to quality and community, can provide volunteers and promote CHP's mission via in-store campaigns and social media.
- **Lou's Restaurant & Bakery**: Lou's has been a community staple since 1947, with a history of supporting local initiatives. They can support CHP by sponsoring planting days, providing refreshments, and increasing pollinator and food system awareness.
- **My Brigadeiro**: Founded in 2012, My Brigadeiro is committed to selling high-quality chocolates made with the best natural ingredients. They can engage their customer base through joint events with CHP, such as fundraising activities or educational workshops on the importance of pollinators.
- **Dartmouth Co-Op**: This store, which sells Dartmouth College gear, is a popular spot for first-year students looking to purchase Dartmouth swag. They can support CHP through

marketing efforts, and partnering with the co-op will allow CHP to reach first-year students.

- **Still North Books and Bar**: This book-store/bar shop can host fundraising events, pollinator lessons, and education talks to promote pollinator awareness. CHP can also partner with the store through in-store campaigns and partnerships.

CHP Expansion and Development Timeline

This section will shift focus to the implementation of our above recommendations and literature. We will divide this section into short-term and long-term goals with the recommended time frames being through the end of 2024 for short-term and within the next five years for long-term. This timeline is illustrative and not exhaustive but rather a guide for future decision-making.

Short-Term Timeline

Through the end of 2024, we recommend that David focus on the following goals:

- CHP Social Media Expansion
    - Preparation of materials, images, posts relating to any CHP events, new plots, or pollinator related events.
    - Curation of a cohesive CHP identity via content creation (refer to Synthesis Handoff Document, Section Next Steps)
- Grant Application Material Preparation
    - Work through Funding Vault deliverables and determine which existing funds may suit CHP's most pressing needs.
    - Prepare additional grant proposal materials based on sample proposals, including but not limited to CHP overview materials, CHP success stories or existing pollinator plots, CHP administrative budget, and CHP illustrative project budget.

These goals are not numbered to allow for flexibility with timing and introduction but will instead prepare CHP for the implementation of our funding recommendations.

Long-Term Timeline

Moving into 2025, we hope David is able to achieve and focus on the following goals:

- Grant Application and Grant Material Preparation
    - Continue with preparation of grant proposal applications based on upcoming deadlines.
    - Submit applications and become familiar with the grant application process.
    - Expand Funding Vault, Inner Vault tab as additional funding opportunities are identified.
- Tiered Donation Structure Implementation

    - Publication of Newsletter and determination of publication timing (annual vs monthly).
    - Implementation of Tiered Donation Structure through reworking Donation Page on CHP website to include discrete donation amounts.
    - Determine if CHP merchandise fits with current organization costs and if merchandise is a desired aspect of tiered donation structure.
- Social Media Fundraising and Collaboration
    - Start experimenting with Instagram post collaborations and fundraising features.
    - Some ideas for fundraiser timing include annual World Bee Day fundraiser on May 20th or fundraiser collaboration with Dartmouth accounts for any new pollinator plots.

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ENVS 50 Synthesis Products:

Promoting CHP at Dartmouth & Beyond

Handoff Document 24S

Last Updated 5/16/2024

About

In ENVS 50, students showcased their culminating knowledge of environmental studies by creating synthesis products for Creating Habitat for Pollinators (CHP). These products focused on publicizing and elevating the mission of CHP through social media and other outreach materials, like posters, news articles, and blogs. Social media is a powerful, interactive tool that can help organizations reach a broad audience. By leveraging these platforms, organizations can share summaries, impactful visuals, QR codes, and links to more in-depth information to help spread the word about what CHP does and why it is important.

Social media products and outreach materials were designed to be colorful and eye-catching and to spark further interest by the interactor to explore the account and website. They were also designed to be informative, using accessible language and attractive design features to make often-dense scientific or logistical information easily understandable, accessible, and enjoyable.

The products covered a range of topics such as CHP, the Class of '89 Pollinator Project at Dartmouth College, general ecology information, and more! The timeline below outlines the release date for these products, many of which were released by the students during the term after approval from CHP.

Throughout the process, students worked directly with David Hammond, CHP Executive Director, receiving feedback and adapting products as they were developed.

Useful Links

CHP: https://creatinghabitats.org/
CHP Instagram: https://www.instagram.com/creatinghabitats/
Canva: https://www.canva.com/
Class Canva folder: https://www.canva.com/folder/FAFD69KOapg
USDA Statement on the importance of pollinators
Search Engine Optimization: https://searchengineland.com/guide/what-is-seo

Progress this Term

Document	**Purpose**
Instagram Post: Introducing SLC Garden	Introduces the new wildflower plot at SLC; acknowledges efforts of Dartmouth FO&M and Sustainability Office in this collaboration.
Instagram Post: Harmful Effects of Pesticides on Pollinators	Explains how pesticides harm pollinator biology and populations and why supporting them with wildflower plots is essential. Highlights that CHP's wildflower gardens provide new habitats for pollinators affected by commercial pesticides. It contains citations to scientific literature, lending credibility to the information contained in the post.
Instagram Post: What is a Pollinator?	Educates the public on why CHP's work is essential and why they should care.
Instagram Story: Breaking new ground at Dartmouth College	Updates followers about progress in real-time and makes them feel involved in the plantings, even if they weren't present.
Instagram Story: Tilling the Cemetery	Updates followers about events and informs them of ways they can help.

Recommended Submission Order

Deliverable	**Submission Date**
Instagram Post: Introducing CHP	ASAP → This week? 4/30/24
Instagram Story: Tilling the Cemetery	Wednesday, May 1st
Planting Day!	Thursday, May 2nd
Instagram Post: What is a Pollinator	Next week →5/6/2024
Meet the CHP Team	Next week →5/6/2024
Instagram Post: Introducing SLC Garden	Next week →5/6/2024
Instagram Post: CHP Plot Map	A few days before the reunion (not sure when that is)
Instagram Post: Harmful Effects of Pesticides on Pollinators	Time with Common Ground film full release?

World Bee Day Poster / Post	World Bee Day → 5/20/24
Bees are Friendly! Post	On World Bee Day
Earth Day Poster / Post	Earth Day 2025 →4/22/25

Using Instagram

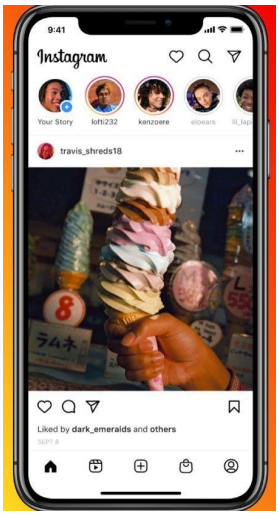
Login Info:

- CHP account username: **creatinghabitats**
- CHP account password: **Habitats!1**

Instagram Features

- Posts
    - Photo: Classic single-image post that stays on your profile.
    - Video: Can be short clips or up to an hour long. Appears on your profile grid.
    - Carousel: A series of up to 10 photos/videos in a single swipeable post.
    - Collaboration: Posts can be a collaboration across multiple accounts
        - Example Collaborators:
            - Dartmouth Sustainability Office (@sustainabledartmouth)
            - Dartmouth College (@dartmouthcollege)
    - Tagging: You can be tagged or tag other accounts in posts, an alternative to a collaboration
- Stories**:** Photos or videos that disappear after 24 hours. Great for casual, of-the-moment content.
    - Highlights: Stories will remain on your profile page
        - To post this, go to the three lines at the top right corner of your profile, go to archive, and then click the three dots at the top right corner of the page and create a highlight
            - Then, you select all of the stories that you would like to display in this highlight
            - Once you've chosen and created the highlight, it will be displayed permanently on your profile for your followers to see
        - Potential Ideas: Workdays, Earth Day, etc.
    - Tag people who are in the photos or @dartmouthcollege so that they can repost. This allows CHP to be more exposed to a broader audience and gain more followers!
- Reels: Short-form (up to 90 seconds), engaging videos often set to music. Like Tik Tok
    - Can be used to display work days or post informational videos about pollinators
    - Can be used to highlight different seed mixes or tilling processes during the workday
- Bio: A short description of the account should include a link to the company website

Buttons and their functions!



- You create This button to make a new post, story, or reel!
- It can be found on the bottom center of the screen
  From here, it will allow you to select pictures and write an Instagram 'caption' for the post that your followers will see

- This button will take you to your profile, which gives you an overview of your posts, stories, reels, and followers.

Instagram Norms and Etiquette

- Business/organization accounts typically do not follow or request the personal accounts of people with whom they are not personally connected; it is not recommended to follow every account that pops up on the "recommended" section. Instead, try only to follow people/accounts directly related to and/or involved in your organization.
- Following other business/organization accounts that share similarities with your organization's mission can be helpful.
  - Can also follow specific scientists/activists/social media presences that align with CHP's mission.
  - Dartmouth-related accounts to follow could include: @dartmouthcollege, @sustainabledartmouth, @dartmouthoutingclub, @dartmouthoutdoors, @dartmouth_geog, @doc_esd
- Add a link to the Instagram account on the CHP website.

Hashtags

- Relevant hashtags on posts can help CHP posts reach larger audiences (ex: CHP posts could include hashtags such as #wildflowers #planting #garden #pollinators etc.)

Other Outreach (Posters, maps, etc.)

- Posters posted around campus for visibility.
  - Posted around campus - Collis and Novack
  - Bright, sharp colors of wildflowers
- Maps
  - Use the map that is being created in ENVS 50
  - Create a handheld map
  - Adapt the map for different audiences, such as alumni and families.
- Email
  - Get added to a Dartmouth-wide listserv that sends out emails. This could help spread the word around campus about CHP's events, such as volunteer opportunities to assist with planting.

Design Choices

- Design Tools: We utilized Canva for its user-friendly interface and access to graphics and templates.
    - Color Palette: Primary: Green, symbolizing nature and growth.
        - Secondary Color Palette: green, purple, blue, and yellow (exact match to logo colors!)
    - Accents: White and dark green for text contrast and readability.
    - Pops of Color: Baby yellow and pink, especially highlighting pink wildflowers for visual interest.

- Imagery: We included bees and flowers to emphasize the relationship between wildflowers and pollinators.
    - Broader nature imagery (i.e. leaves, landscapes) to create a cohesive aesthetic

- Overall Style: Inspired by Canva templates, we aimed for a clean, modern look with a touch of whimsy to appeal to a broad audience.

Our synthesis products often depict flowers due to their close relationship with pollinators. Despite insects like bees, which may draw fears of stings, flowers are an entirely peaceful symbol that is aesthetically pleasing and can help introduce the theme of the intricate relationship between the two.

Next Steps

1. Teach David how to post and make stories on Instagram with our templates.
2. Plan a long-term vision for the Instagram account (pivot from Dartmouth-only to Dartmouth + Midwest, etc. - this could be achieved through highlighted stories)
    a. Explore the types of photos to post, how to get more engagement, and how to work with CHP's partners to extend reach as far as possible
    b. Dual account posts with Dartmouth Social Media accounts to spread outreach and awareness to stakeholders
3. Ensure David has access to the Canva templates of some posts we produce to act as a framework for future posts (like the posts introducing new planting sites)
4. Partner with other green organizations on campus to have regular events, grow presence on campus, and create a culture of maintaining and enjoying pollinator gardens
5. Establish a story/post template to ensure cohesion on the page
6. Establish a social media brand identity
    a. Creating specific templates that can be used for future posts would help CHP create a social media presence

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