Global Bee Declines and Their Local Relevance: A Conservation Framework for Hong Kong

***Figure 1**: Eastern Honey Bee Approaching Spiny Spiderflower (Cleome spinosa) in Chai Wan Park Hong Kong.*

Hong Kong Project Center 2025

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Acknowledgments

We would like to thank the following individuals and organizations:

Our WPI advisors Professor **Jed Lindholm** and Professor **Clare Gillis** for their guidance throughout this project,
Beetales for sponsoring this project,
Harry Wong, founder of Beetales for continued support through our project,
The **WWF Mai Po Nature Reserve** for allowing us to further our research in the wetlands,
The **WPI Global School** for giving us the opportunity to complete our IQP in Hong Kong in 2024.

This project would not be possible without their support.

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Abstract

Despite their long-standing relationship with humans, bees have been facing significant population declines globally due to various factors, such as habitat loss, pesticide use, climate change, and widespread misconceptions about their behaviour. In Hong Kong, these issues are intensified by rapid urban development, pollution, and public fear of insects, including bees, leading to negative perceptions that hinder conservation efforts. Ongoing efforts from groups like Beetales, who aim to raise awareness and provide hands-on education about bees. Ultimately there is a the need for greater efforts to protect bees through public education, policy reforms, and innovative conservation strategies to ensure humans and bees can coexist. This study is a smaller part of the larger effort of many conservation groups on the mission for humans and nature to live seamlessly in parallel.

Figure 2: *Beehive in the Beetales office opened for observation.*

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Chapter 1: Background Research

Introduction

Bees have held a vital role in human civilization for centuries, but due to the consequences of human actions, their populations are in severe decline. In the face of this trend, focused conservation efforts work towards their recovery. Archaeological evidence from China indicates that honey was harvested as early as the seventh millennium BCE, and apiculture is referenced by the third century CE, underscoring how closely connected our histories have become [1]. Bees are a keystone species in global ecosystems as they are involved heavily in agriculture. They are responsible for pollinating 80% of the world's flowering plants, and without them, there would be decreased plant biodiversity, leading to drastic ecosystem changes (Scott, 2023). They are also utilized as livestock by humans for products such as honey and beeswax. Furthermore, “about 75 percent of 115 top global food crops depend on animal pollination”, like the pollination done by honey bees[3].

Figure 3: *Eastern Honey bee approaching Hibiscus rosa sinensis flower at Victoria park.*

Bee populations worldwide have faced severe declines, primarily due to habitat destruction, industrial farming practices, climate shifts, and the widespread use of pesticides, threatening numerous plants essential to human health and economic stability[4]. To counter these issues, groups like Beetales in Hong Kong have emerged as trailblazers in beekeeping, working to raise awareness about bees’ importance through public workshops that reduce stigmas by allowing people to interact directly with bees. In addition to education, they perform bee rescue operations, helping to sustain local pollinator populations.

Figure 4: *Bee collecting pollen on an ornamental cosmos plant.*

Public Perception of Bees

Public misconceptions about bees in Hong Kong have significantly contributed to their decline, as many view them as pests rather than essential pollinators. In China, there are four native honey bee species used in beekeeping, but cultural generalizations often cause bees to be confused with more aggressive species, like wasps and hornets. These are then also often referred to as “bees.”

Figure 5: *"Beware of bees" sign observed at a park.*

While many people fear bee stings, it’s important to note that honey bee venom is evolved to cause pain, not injury, and allergic reactions are rare, affecting only a small percentage of the population [5]. Addressing these misunderstandings is essential for fostering a greater appreciation of bees and their crucial role in biodiversity and food production within Hong Kong’s urban ecosystem. A recent study conducted in Southeast Asian megacities on the diversity and perception of bees found that while most people agree bees are important, there is hesitancy about their presence in urban areas[6]. The complete survey results are included in the following graph, offering valuable insights—even though the study was not conducted in Hong Kong—into public perceptions of bees in a comparable geographic region.

Pesticide Usage

Challenges such as pesticide use still threaten bee populations. In some regions with relaxed pesticide regulations, like parts of Asia, bee exposure to harmful chemicals is more common, as these toxins can contaminate streams and other natural water sources. This increased exposure underscores the need for more rigorous environmental protections to complement existing conservation efforts[7].

Figure 7: *Pesticide usage warning sign.*

***Figure 8**: Harry Wong of Beetales interacting with some of the bees in the Beetales office Apiary.*

Human Impact On Bees

Air pollution interferes with the essential ways plants communicate with pollinators. Normally, plants attract bees through vibrant visual displays and subtle chemical signals. However, pollution diminishes these cues, making flowers less attractive to bees and weakening the effectiveness of these natural signals[8].

Climate change also creates new and unpredictable weather patterns in Hong Kong, leading to a dramatic increase in precipitation. The graph below shows just how drastic the levels of rainfall are due to climate change. These shifts, including prolonged summers and heightened rainfall, affect the timing of blooming seasons and extend the period during which bees face natural predators. “The time for bees to face their natural enemies like wasps also becomes longer,” noted Wong, who also explained that climate change impacts flower blooming times[9]. The loss of natural habitats also threatens bees in the region. Hong Kong’s rapid urban expansion reduces nesting areas, making it harder for bees to find suitable places to build hives. Bees are drawn to specific nesting environments, such as undisturbed soils or old wood, but the clearing of wild spaces and the removal of deadwood mean these sites are becoming scarce. Moreover, the spread of highways and infrastructure creates physical barriers, lengthening bees' travel time between foraging sites. “After the infrastructures are built, the movement of pollinators is constrained. In particular, flying across the highway not only becomes dangerous, it is also not lucrative as the pollinators may not detect strong floral scents from the other side of the highway”[10]. The combined challenges of pollution, climate change, and habitat loss present a dire situation for bees, emphasizing the importance of solutions to support pollinator populations in Hong Kong’s evolving urban landscape.

Conservation Efforts

While several initiatives in Hong Kong are dedicated to raising awareness and supporting bee conservation, data on the local bee population and the effectiveness of these efforts remains limited. Some alumni from the Hong Kong University of Science and Technology (HKUST) have taken meaningful steps to educate their community about the importance of bees, recognizing the essential role they play in local ecosystems. Reflecting this commitment, HKUST has joined the cause by implementing two beehives on campus, which are managed by alumni to foster a hands-on approach to conservation[11]. This spirit of conservation is mirrored in the actions of other local advocates. Conservationist Wong recalled a significant moment when a group of

trainees rescued a swarm resting on a fire hydrant in Sheung Wan, where local authorities would likely have exterminated the bees if they had not dispersed quickly. Despite the challenges, the volunteers were able to relocate the bees safely, thus preserving them from certain harm[9]. Together, these initiatives and obstacles reveal both the potential for effective conservation in Hong Kong and the pressing need for data-driven strategies to ensure long-term sustainability for local bee populations

Figure 9: Eastern honeybee collecting pollen from Invasive weed Shepherds Needles (Bidens alba).

Purpose

The study's Which key environmental and social factors influence bee populations across urban, suburban, and rural areas of Hong Kong, and how conservation efforts be enhanced for greater effectiveness. We aim to evaluate how

place to compare and improve bee conservation efforts in Hong Kong. The relationship between bees and humans has become strained in the past years with urbanization and

***Figure 10**: Eastern Honey bee collecting pollen from Chinese Privet (Ligustrum sinense) in Sai Kung Park.*

influential factors such as plant distribution and weather patterns affect bee populations in Hong Kong's varied landscape. The wild bee population has been suffering for many years, and although apiaries have increased bee numbers, the wild bee population must be investigated. Assessing the population and making suggestions to improve the wild bee habitats are two of the main topics of concern in Hong Kong. Following this, understanding local attitudes in Hong Kong toward bees is a crucial step towards effective conservation efforts; it is essential to gather data on public opinion surrounding bees in the region to accomplish this. Using data on bee conservation efforts across the globe and in Southeast and East Asian megacities, a plan can be put in stigma against insects. This study aims to aid in countering the root cause of some of these misconceptions and offer methods of alleviating them through education about bees

Chapter 2: Data Collection Method

Wild Bee Populations

One of the main objectives of this project was to gather short-term data for seven weeks during the winter season on the status of the wild pollinators and identify which flowering plant species attract the most of them. The data collected will be on the quantity of pollinators and species of pollinators that pass through an area.

	Total Pollinators	Vegetation Proportion	Flowering Plant Proportion	Pollinators Attracted by Flowers Proportion
TuenMun Park	84	75%	20%	10%
Shing Mun Valley Park	74	75%	25%	20-25%
Tin Shui Wai Park	37	75%	15%	30%
Nam Cheong	44	70%	15%	70%
Sai Kung Park	13	70%	25%	95%
Pineapple Dam Trail	23	90%	15%	100%
Lion Rock	11	100%	35%	40%
Sha Tin	26	60%	30%	100%
Chai Wan Park	29	80%	20%	5%
Ma Wan	20	93.00%	7.50%	5-8%
Little Hawaii Trail	13	90%	5%	50%

***Figure 11**: Example of data collected on plants from various parks that were surveyed.*

The primary data collected at the parks were the number of pollinators at a flower. The plants and pollinators were then identified at a later date with photographs as a reference to further inspect each pollinator and plant species with access to online resources. Each data collection session at each park was 50 minutes, between 9:30 AM and 1 PM Hong Kong time. During this time, there is higher pollinator activity because the weather conditions are more favourable for them. The goal was a minimum of five flowering plants at each park but included more depending on the abundance of plants for each location. There were also locations in which there were less than five flowers. For each flowering plant, we observed the time, weather, location, plant species, number of pollinators visited, and the frequency of visits. When evaluating pollinator count, we considered five or more pollinators high, between three and five medium, and less than three to be low. In addition to this, at each location, we recorded the total vegetation proportion and the flowering plant proportion. While collecting data on pollinators within these locations, we also made note of signs that were encountered, as well as the general condition and size of the park. This data was then used to determine the percentage of pollinators of bees, the biodiversity of the local parks, and which species of plants have the highest bee activity to make suggestions on what can be done to aid the local bee population in Hong Kong.

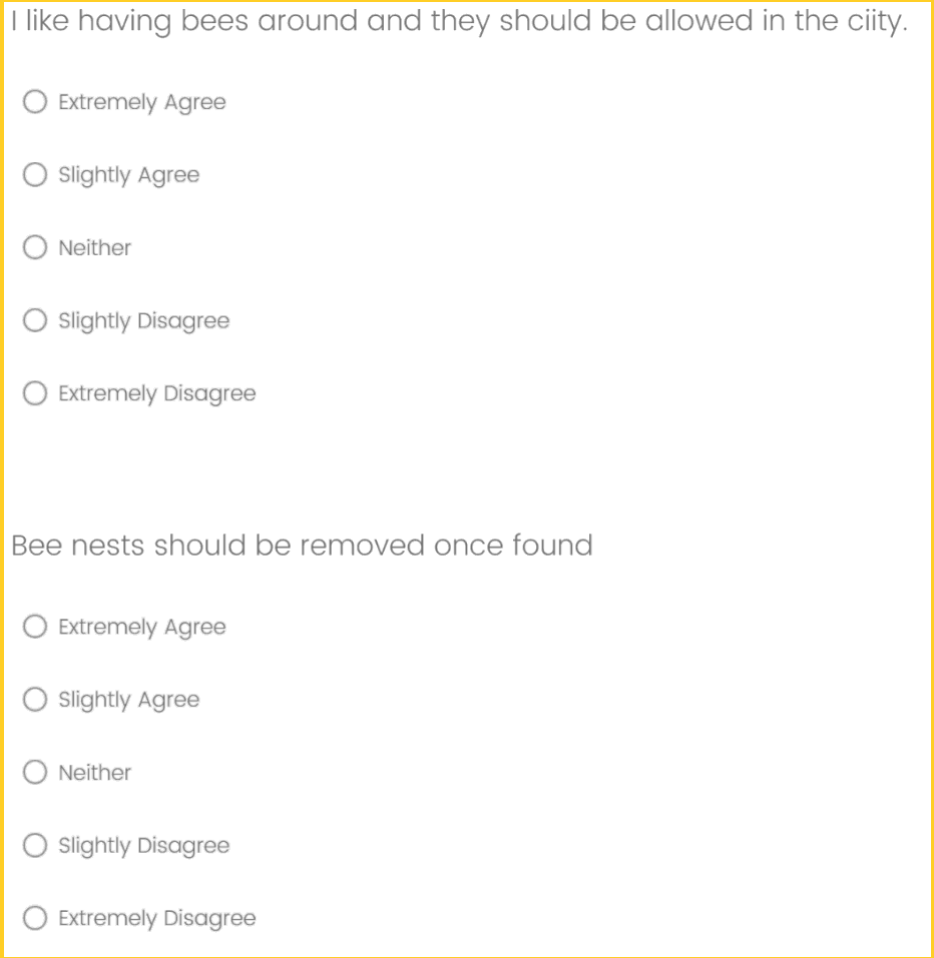

Figure 12: *An example of our survey questions created on Qualtrics.*

Public Perception of Bees

The second objective of this project was to survey the general public and identify reasons why there is a stigma against bees in Hong Kong. To collect data on the public's perception of bees, we first planned to interview people firsthand and ask them questions about their opinions on bees from a list of questions. To the left in Figure 12 shows two questions asked on the online version of our survey to gauge the impression locals have on bees. However, after asking people in parks and on trails we have visited to take our survey on the public perception of bees, it became apparent that people were not willing to participate. This may have been due to the language barrier our group faced, as members of this project are not proficient in Cantonese or Mandarin and proved to be an obstacle when communicating with locals during surveys about bee perception. Another factor that may have played into this is that we presented a QR code to locals to take our survey, which may have turned people away due to it appearing as a "scam".

Due to these issues, the survey became an online survey. This survey was then spread via word of mouth, leading to a majority of respondents being part of the younger age groups. Beetales also posted the survey on their social media to foster responses. As a result, there were a total of 42 responses. Although the responses provide valuable insight on the perception of bees, there were not enough participants to be conclusive.

Chapter 3: Data Analysis and Findings

Wild Bee Data

Throughout Hong Kong, we collected data at a combined total of 32 various parks and hiking trails; we observed a total of 526 pollinators. The vegetation proportions show a strong correlation between the number of pollinators and vegetation proportion up to about 80%. This is likely because areas with 80-100% vegetation proportion tended to be hiking trails or other dense areas that had fewer flowering plants near the trails and led to less pollinators being observed. This may also be because parks are maintained with higher amounts of flowering vegetation than typically seen in the wild.

Across all locations, it was observed that weather conditions like a cloudy sky, wind speeds, and temperature all play a role in how active pollinators tend to be. At Tuen Mun Park, we recorded the highest number of pollinators, 84, despite having observed just five flowers. At this location, temperatures were recorded to be warmer at 21°C, and it was a sunny day. Comparatively, at Kowloon Park Bird Lake, there were only 37 pollinators recorded when there were 15 flowers observed - three times more than that at Tuen Mun Park. One cause for this is that many of the species of plants were not as attractive to pollinators, with 6 of the flowering plants having 0 bees present, leaving 9 flowering plants that had pollinators. The main cause for this, however, is that the weather conditions at Kowloon Bird Lake Park were not optimal, with the temperature being 18°C and overall cloudy weather. This reinforces the idea that pollinators tend to be less active since the poor conditions mean that pollinators have to spend more energy gathering resources.

Within parks, it was also noted that some had signs to warn of pesticide usage on the plants. In these areas, it could also be seen that there were fewer pollinators than typically expected, even if conditions were favorable. Another observation is the constant maintenance most parks have, with workers watering and maintaining plants every day throughout the day. With the workers making small adjustments to care for the plants based on the species' specific needs, it would not be difficult to switch the flowers that are already in place with one's native species to enhance biodiversity.

Observations on Flower Species

44.17% of the flowers observed had no pollinators at all. There were also only 25.76% of flowers that had a high count of pollinators per flower with 5 or more pollinators per flower. One theme observed through data collection was the lack of floral biodiversity in certain

parks. Our sponsor and independent research determined that parks can be more easily maintained with fewer flowers compared to those with more flowering vegetation. Because of this, the majority of parks that have less green space do not attract many bees or have non-native species that can hurt local biodiversity in the area. An example of a flower that doesn't attract bees and is purely ornamental but is in several parks is the paper flower *(bougainvillea glabra)*, which was in at least 9 parks we observed and had only one insect seen between all of them.

Figure 13: *Spanish flag flower observed at Ng Tung Chai.*

Another two plants that had significant results were invasive weeds present in almost every corner of Hong Kong. The first were the Shepherd's needles *(Bidens Pilosa or Bidens Alba)* shown in Figure 9*,* which attracted an average of ~5 bees per plant observed. This plant was recorded 9 times, contributing to the average pollinator per flower given above. However, it is important to note that for most parks, the goal was to observe five flowers. However, at some locations, there were less than 5 flowers, while others had some drastically more flowers, causing variations in the number of flowers recorded at each site. This caused there to be instances where the Shepherds' Needles were seen, but no data was taken on it. The second invasive weed was the Spanish Flag *(Lantana camara)*; this flower was more present in areas with thicker vegetation as opposed to in parks with well-maintained flower beds and bushes and did not attract any pollinators. It was seen in many areas and recorded in three parks. From these two flower species, a contrast can be seen in their effect on pollinators. One does attract pollinators but is an invasive weed, while the other one is invasive while also not providing any use to pollinators. Shepherds needles weeds

Figure 14: *Paper Flower (Bougainvillea glabra) observed at Garden Hill Park.*

are not any better for supporting the pollinators as it results in pollinators being taken away from local plant species, but it provides insights on the type of flowers bees prefer and find local alternatives to replace them in the process of removing the weeds from the landscape of Hong Kong.

Some popular species of non-native flowers include Garden Cosmos (*cosmos bipinnatus*), which had 10 pollinators per flower on average, the

Strawflower (*xerochrysum bracteatum*) with 6 pollinators per flower on average, and the Swan River Daisy (*Brachyscome iberidifolia*) with 13 insects at the flower observed. Each of these had a pollinator per flower count of above 6, which signifies how much bees and other insects prefer these over other flowers present in parks. It is also worth mentioning that these 3 species are also ornamental in many parks throughout Hong Kong. Each of these has a common trait, which is that they have a clear center disc where there is pollen for bees to land on, surrounded by one or multiple layers of ray florets surrounding it. This structural feature of the flowers is correlated to an increase in pollinator count as the invasive weed species shepherd's needles (*bidens alba*) also shares the same structure and holds a high pollinator per flower average.

The native flower species with the highest pollinator per flower averages were the Hong Kong Orchid (*bauhinia blakeana*) with approximately 4, the Chinese Privet *(ligustrum sinense)* with roughly 6, and Orange Trumpet Vine (*pyrostegia ignea*), which was observed only once but had 5 bees logged. Each of these flower species does not follow a common trend in shape and only share the fact that they are native species. One notable fact is that the Hong Kong Orchid is mainly ornamental and is planted throughout the parks of Hong Kong, while the Chinese Privet was only found in areas that had more dense vegetation and less manicured flower beds and park space. The Orange Trumpet Vine, on the other hand, was found just outside one trail and not in any other location that was a part of this project. What this says about the native plants throughout Hong Kong is that there are not enough of them in urban areas and that they are outperformed in terms of pollinator per flower counts compared to non-native ornamental and invasive species.

Flowers that had less than two pollinators shared the common trait of being nectar flowers that did not have exposed pollen. One example of this is the Chinese ixora (*Ixora chinensis),* which, although being native, is not a flower species that can attract bees because of this quality. Another example is when a flower is non-native and does not attract any pollinators is the paper flower discussed above and this is also because of the structure of the flower having a long stem more suited to pollinators such as butterflies that use a probiscis to drink nectar from the base of a long and narrow tube like flowers.

Public Perception Of Bees Data Analysis

To further examine the public perception of bees, we compiled the data taken from all surveys and created charts representing the responses from each question. There could have been more analysis on what each age or district demographic responded for each, but there were not enough participants to make a significant conclusion.
From the survey data, locals in the younger population acknowledge the importance of bees but find them to be a nuisance if encountered. When asked how bees have been annoying to participants, the majority of the participants made negative statements about the “buzzing” or “stinging” being obnoxious. An example is one participant saying, “Whenever I am hiking, running, biking or doing anything outdoors, bees buzz around me and make me lose focus on the thing I'm doing.” Another response to the same question was, “Not really, it's only the more dangerous ones like wasps or hornets that are scary, regular bees just do their own thing.” Another surprise was when asked, “Have you been stung by a bee? If so, are you scared of them now?” Many participants answered that they had never been stung. Of the participants who have been stung, the majority are still not scared of them. Another agreed-upon statement is that bees are extremely important to the environment. Of the responses received, the majority agreed that bees were important for plants in the city. Some participants said they are top pollinators, showing prior knowledge on the subject. In terms of how often bees were encountered, there was only one response more frequent than “weekly.” This shows that

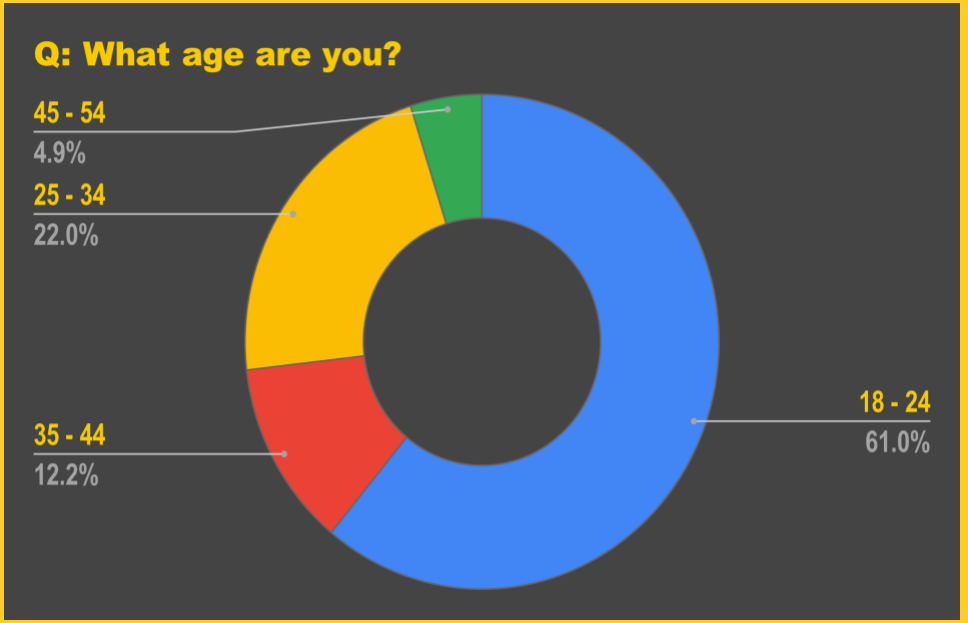

Figure 16: *Demographic of ages that participated in the survey*

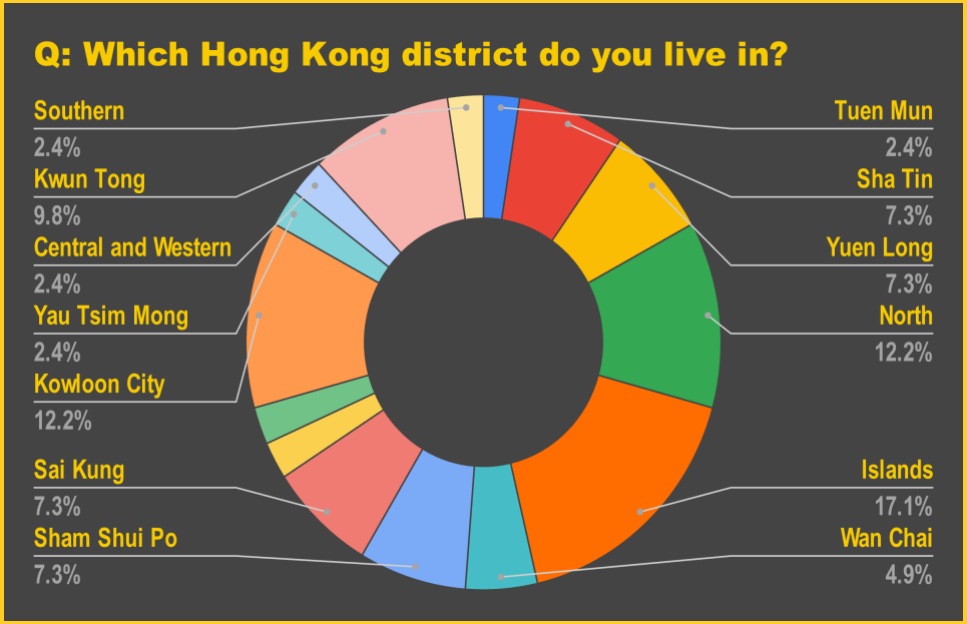

Figure 15: *Demographic of areas the participants live in.*

in the diverse group of areas, we got responses from participants who infrequently encountered bees.
As shown in the pie charts, most people in Hong Kong are aware of how important bees are and don't mind their presence. Only 17.1% of respondents believed that bees should not be allowed in the city; most people don't mind bees coexisting in the same area as them. There is also 14.6% of responders stating they would neither agree or disagree with this statement. From this data alone, most residents of Hong Kong would be accepting or have a positive response to the idea of putting plants in parks that would allow bees to thrive more. With respondents residing in every district in Hong Kong, it further proves the point that the population as a whole would be supportive of increasing the amount of blooming flowers to strengthen the bee population.

Chapter 4: Deliverables

Website and Interactive Map

As a part of our deliverables, a website was also created using our data to serve as another form of presenting our findings and data to the general public.

The initial homepage of the website exists to draw the attention of the user, encouraging them to interact and explore the website to see our findings. This is done by presenting the issue with pesticides on the homepage; to make the user hooked and wonder about the real causes and effects it has on not just people, but our environment. Following this, it brings the user to an interactive map page, in which the website displays all 32 locations we visited to gather data on. Providing an interactive way to view our data, it encourages the user to view and explore it. Each marker on the map is interactive, and clicking a marker will expand a pop-up that includes the park's name, pictures, and other useful statistics, such as the total number of pollinators, number of flowers observed, date, and weather conditions.

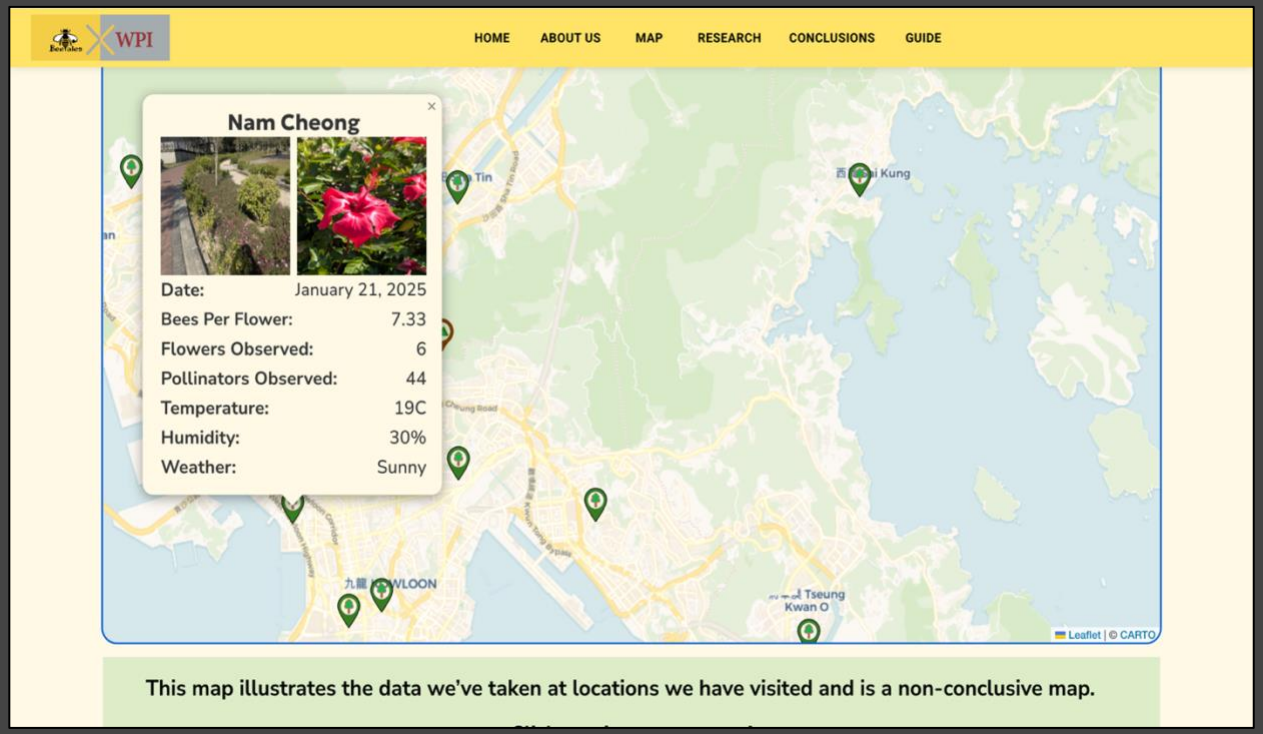

Figure 17: *Screenshot showing the interactive map and what its functionality is.*

The remainder of our website includes details about us, a research page in which we present the same findings in a condensed manner, a conclusions page, a page for our infographic, and another for our booklet. This website aims to be an alternative method to present our findings, and by including all of our data and resources, we hope that others will be intrigued to learn more about it.

Infographic

In addition to the website, an infographic was made, with the intent to inform people about bees and wasps and how to properly interact with them

.

Figure 18: *Image of infographic deliverable_3*

Chapter 5: Conclusions and Recommendations

Wild Bee Populations

The leading factor of the lack of pollinators in urban areas is the floral diversity in green areas around Hong Kong. From observations, the majority of parks are filled with aesthetically pleasing plants and shrubs that lack flowers with pollen, leading to bees finding it difficult to acquire resources in the urban environment. By choosing flowers that contain pollen and also require low maintenance, Hong Kong has the potential to thrive in the pollinator department due to the year-round overall high temperatures and climate.

Public Perception of Pollinators

After survey analysis, many surprising trends were found. All participants acknowledged that bees are necessary and beneficial to the environment. However, when it came to having bees around them, the data began to differ. Across all age groups, some participants would rather not have bees around due to their reputation of being “annoying” and the “buzzing,” sound they make while flying, as well as the fear of being stung. It does not appear that many are aware of the fact that if unprovoked, bees are quite docile. Due to the fear of being stung, many who confuse bees and wasps (which are more aggressive) may be unaware of how to identify the difference. These issues of perception of bees could be solved easily if children were taught that bees are not as dangerous as they may seem and are not to be confused with wasps or hornets.

Lacking Biodiversity in Hong Kong’s Parks

The plant species present in the majority of parks in Hong Kong do not reflect the natural biodiversity of the surrounding region. There is a variety of ornamental plants as well as invasive weeds that populate the urban green spaces along with the native species. This becomes an issue to these surrounding regions. Many of the Ornamental species, while also having the ability to improve the situation for pollinators, can leach themselves into the local ecosystems whether or not they attract pollinators.

In the case that the ornamental species don't attract any pollinators, there presents an issue where pollinators lack a space to find flowers throughout

the city even though there are flowers present. When there is an ornamental flower species that pollinators prefer, it must be ensured that there is no risk of that species becoming invasive in Hong Kong before usage in parks. This leaves only two circumstances where a plant should be allowed in parks: if they are a native species or if it is an ornamental species that is non-invasive and pollinators are attracted to it. Our research will contribute towards future projects identifying what plants bees prefer and whether or not they are local species for reference in future research about each species. The future research will evaluate the plants on their risk to the surrounding environment if they are ornamental and how well of a fit they are in parks based on how well they attract pollinators.

Pesticide Usage And Other Warnings

One major concern regarding pollinators has been the repeated use of signs with pesticide warnings and “beware of bees” warnings. Although it's not the intent, both of these signs and the pesticide usage not only have a physical effect on pollinators but also skew the public's opinion of them. Although it was found that the majority of people agree that bees should have a place to live in the city, respondents have found bees to be annoying. To enhance public understanding in Hong Kong regarding the harmless nature of bees when unprovoked, intensified efforts in education could prove advantageous for both the pollinators and the local flora. The use of pesticides also eliminates some of the population of pollinators due to the harm it causes to them. Pesticides in areas such as enclosed farms could still prove to be very beneficial to farmers and gardeners. However, in public areas such as parks or hiking trails, they cause more harm than benefit to the environment.

Conclusions

In urban environments with uncommon biodiversity, a third party must step in for additional support to ensure sustainability. While effort is important, it must be smart as some actions can have no effects, but some might even be detrimental to the environment. Our perspectives and thoughts on the environment have transformed because of this project, and we deeply appreciate the effort that conservation groups make towards a more sustainable future.

In evaluating the status of pollinators in Hong Kong, we set out to look for improvements to be made to enhance coexistence. This involves collaboration between the government and floral biodiversity organizations to plant species that benefit the environment. Additionally, there was a realization that the public could be informed more about the importance of pollinators and how to handle bee hives responsibly in the older generation.

The research findings aligned with expectations, showing that Hong Kong's urban environment limits bee habitats and suitable plants. The Beetales project revealed the need for greater quantities of local flowering plants and increased awareness about pollinators and biodiversity conservation in urban areas. The relationship between pollinators and flower species in parks should be

emphasized as the number of pollinators relies not just on the quantity but also the species of flowers found in parks.

Recommendations

Regarding the survey data, there was a lack of response and clear sampling bias, with most survey takers being in the same age group as the team members. This survey could be pitched again in the future to create a viable dataset and more accurately evaluate the public perception of bees in Hong Kong. One way this could be accomplished is by having more focus on survey taking as the rate of success was low, but the overall count of participants could have reached a substantial number if it was the main focus of our study.

With the wild bee data collected throughout these eight weeks, Beetales can compile a list of plants that best attract bees as well as how local and non-local plant species vary in attracting pollinators. This data can then be used to advise government offices that manage park landscaping to benefit pollinators while also furnishing parks with flowers. Regarding data collection, it would be more beneficial to collect data on all flowers, or as many as possible, to ensure that the data is more complete. With this, it becomes possible to compare the scale of locations easier and get a more complete picture of averages throughout each site. Another recommendation would be to evaluate what non-local species would be helpful as ornamental species that have little risk of becoming invasive while still attracting a large number of pollinators to include in such a report.

For future project groups that work with Beetales or any other group researching the current status of bees, it would make a significant contribution to the data if more wild bee data was collected in a different season than we collected data in. This would diversify the data collected on flowers with different blooming periods as well as gauge how much temperature and other factors related to seasons and weather affect pollinator activity in Hong Kong. Future groups of students can also make direct contributions to the work by doing in-depth research on different plant species. For the plants we collected data on, they could research the invasive risk of each ornamental plant to identify species that can still be beneficial to pollinators without harming other local environments around them. This type of research would not only solidify risks about using certain ornamental plants, but it would also support reasoning for government agencies managing park vegetation to make more environmentally conscious choices about plants used in the city’s green spaces.

References

1. Lau, C. W. (2012). Ancient Chinese Apiculture. *Bee World*, *89*(4), 78–81. https://doi.org/10.1080/0005772X.2012.11417496
2. Scott, E. (2023, March 28). Indicator species and keystone species explained: Honey bees and 18 other examples. Best Bees.https://bestbees.com/2023/03/28/indicator-species-keystone-species/
3. Bedada, A. H. (2020, August 6). CAHFS Weekly Topic: Bee decline – A great concern for US food security. *Center for Animal Health and Food Safety*. https://cahfs.umn.edu/news/cahfs-weekly-topic-bee-decline-great-concern-us-food-security
4. UN Environment Programme. (2019, May 20). *Why bees are essential to people and planet*. UN Environment Programme. https://www.unep.org/news-and-stories/story/why-bees-are-essential-people-and-planet
5. Sponsler, D. B., & Bratman, E. Z. (2021). Beekeeping in, of or for the city? A socioecological perspective on urban apiculture. *People and Nature*, *3*(3), 550–559. https://doi.org/10.1002/pan3.10206
6. Sing, K.-W., Wang, W.-Z., Wan, T., Lee, P.-S., Li, Z.-X., Chen, X., Wang, Y.-Y., & Wilson, J.-J. (2016). Diversity and human perceptions of bees (Hymenoptera: Apoidea) in Southeast Asian megacities. *Genome*, *59*(10), 827–839. https://doi.org/10.1139/gen-2015-0159
7. Oldroyd, B. P., & Nanork, P. (2009). Conservation of Asian honey bees. *Apidologie*, *40*(3), 296–312. https://doi.org/10.1051/apido/2009021
8. Duque, L., & Steffan-Dewenter, I. (2024). Air pollution: A threat to insect pollination. Frontiers in Ecology and the Environment, 22, e2701. https://doi.org/10.1002/fee.2701
9. Fung, K. (2023, December 10). *Beekeepers' mission to convince Hong Kong that bees are our neighbours*. Young Post. https://www.scmp.com/yp/discover/lifestyle/features/article/3244418/bees-are-neighbours-beekeepers-mission-convince-hong-kong-vital-pollinators-shouldnt-be-exterminated
10. Wang, Y., Jia, S., Wang, Z., Chen, Y., Mo, S., & Sze, N. N. (2021). Planning considerations of green corridors for the improvement of biodiversity resilience in suburban areas. *Journal of Infrastructure Preservation and Resilience*, *2*(1), 6. https://doi.org/10.1186/s43065-021-00023-4
11. The Hong Kong University of Science and Technology (2021, September 2). *Buzzing our way towards sustainability.* https://sust.hkust.edu.hk/news/buzzing-our-way-towards-sustainability-6