Final Report Supplements

CALENDARS Project Hong Kong 2024

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The Global School, Worcester Polytechnic Institute

IQP Term

Professor Brajendra Mishra & Professor Stephen Sturm

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**Tool Development	Nathan	N/A

Online Deliverables

Letter and Link to Visualisation Tool

Link to tool: https://black-desert-04b414b0f.4.azurestaticapps.net/

Letter for Continuing Teams:

Hello teams!

I am a student currently working in the Hong Kong project center and have been the leading the development of the CALENDARS Season tool for my group.

Just as a brief introduction, the tool is a basic web page that records input calendar data (by inserting various bars and textboxes) that is then, in its current state, saved to your browser's local storage, similar to how "cookies" operate. This does mean that data recorded on one computer will not be available on another, but you are able to retrieve saved calendars for later comparison.

To start off, I recommend either downloading or forking the tool from my GitHub and hosting it directly on a cloud platform such as Microsoft Azure. You can do this free of charge if you use your WPI email and stick with the student plan. Once the tool is online, you are free to start recording data as needed with little to no upkeep.

The primary objective of future development for the tool is to have it in a state where it can be hosted on the CALENDARS research team's website with support for a centralized database so that input from all over the world can be stored for comparison. I am planning to leave some comments in the code itself of where I suggest this implementation be placed, but it is completely up to your teams to decide how best this can be achieved. As a smaller thing, I also recommend trying to overhaul the user interface, as currently there are a large number of bugs present with displaying the calendars in regard to different screen sizes.

Please feel free to reach out to me with any questions or concerns you may have with the code and I will try my best to provide assistance!

Additional materials for the tool are housed in CAL Seasons Tool.zip file.

Link to Git: GitHub - AtomiCatalyst/seasons-2024

All the best,

Nat Dynko

WPI Class of 2025

Computer Science

Cyber Security Club President (Away on IQP)

Link to ArcGIS Website

Link to website: https://arcg.is/118mq10

Interview Questions

1. What is a year of beekeeping like for you? Please describe or draw and label your beekeeping activities in relation to time of the year or identify seasons within your practice.

Please add a short description or specifics for each identified activity or season.

2. Please tell us about your experience and background with beekeeping.
3. Where do you source your training and information from as a beekeeper?
4. What kind of beekeeper would you consider yourself to be?
5. How has your practice of beekeeping changed in your memory as a beekeeper? What is the biggest change you've noticed?
6. In your opinion, what are your biggest challenges as a beekeeper in this region?
7. What kind of bees and how many hives do you maintain? Is there any particular reason you chose to keep this type of bee?
8. Are you personally affected by shifts in the weather, mite activity, viruses, or bacteria with your bees? What do you look for to indicate if your bees may be affected by this?
9. Has your beekeeping practice changed as a result of any encounters described in the previous question?
10. Do you treat your hives with chemicals?
11. Do you feed your hives when the bees are in the offseason/low energy state? If so, why?
12. Do you use any tools like weather forecasts to anticipate when and how you will need to care for your bees?
13. How do you know where to put a hive/what do you consider when placing hives?
14. What day-to-day activities or week-to-week activities do you do to maintain your hives?
15. Do you think beekeeping will change in the future?

Cleaned Interview Notes by Date

The following text is cleaned notes from the interviews in our project by date.

Worcester Polytechnic Institute Global School IQP, Hong Kong Project Center C-Term 2024

Project Advisors: Professor Brajendra Mishra, Professor Stephen Sturm

Interviewers: Samantha Arroyas, Sophia Bogartz, Nathan Dynko, Jack O'Connell

Location of Interview: Kwai Chung

Individuals Interviewed: Harry, cofounder of Beetales Ltd.

Date of Interview: January 17, 2024

Q: Can you describe some of the features of your bee boxes?

A: Each box has a layer of foil or fabric between the inside hive and the box lid which acts to insulate the hives during winter. There are holes in the side of each box that can be plugged or unplugged to better regulate temperature. Each bee box also has a thermometer and heating pad so Harry can monitor and stabilize the conditions of the hives. During weekly hive inspections, Harry removes the frames of each hive and examines the amount of pollen, brood health, strength of the workers, and checks to see if there are new queen cells being built. He also pipes a pollen mixture on top of each frame which is a food supplement for the hives. Harry describes that the food supplement does not last long, but it depends on the activity and overall health of the hive. Bees use different panels in manmade hives for different purposes. Some portions of the frames are dedicated to storing honey, while others are comprised of brood cells where the larvae develop. The primary external food source for Harry's hives is an invasive species of Australian tree in nearby parks. Harry previously did arborist work and says that while these trees are a good food source for the bees, generally, invasive species are not good for the environment of Hong Kong. The honey that his hives produce can also taste different depending on what type of plants the bees are collecting pollen from.

Q: *Harry is closely inspecting certain frames* What are you looking for in this hive?

A: Harry is inspecting for signs of illness in the hive, especially sick egg and larvae cells. Bees will throw dead larvae or infected adult bees out of the hive, and they will be visible on the

ground surrounding the bee boxes. The bees will exert a lot of energy trying to chew through the caps of infected larvae cells to dispose them, so Harry and the other volunteers will remove infected cells with small tweezers. Alternatively, if the hive has a serious illness, Harry describes how some beekeepeers will have to seal the hives shut. Harry also has been experimenting with spraying the hives with other nutrients such as vitamin C.

Q: What are other mechanics of a hive that you would find useful or are interested in?

A: Harry would find it useful if his bee boxes could individually weigh all the frames inside the hive so that he would get an idea of how many bees or how much honey was inside. He had tried working with a group in the past to create a "smart hive," as he was interested in automating temperature sensing, opening and closing of the hive gates, and general data collection inside of the boxes. Harry is interested in exploring remote control of the hive entrance, meaning that he could open and close the hives from a distance. Additionally, temperature sensing inside of the hive is very difficult, as temperature can vary greatly across different portions of the hive. The sensors cannot be too far from or too close to the center of the hive.

Q: Can you describe what "swarming" is and how you manage it while being indoors?

A: Swarming can occur for a variety of reasons. When one hive gets very large or another queen emerges, a portion of the hive will split off and leave to create a new hive in another location. This process of splitting can be stopped or managed by beekeepers as soon as they observe new queen cells being built by the hive. Harry describes how queens can either lay drone eggs or worker eggs. Cells that are fed royal jelly transform into queen larvae, which have a distinctive exterior that beekeepers look out for. If a beekeeper does not want their hive to split or swarm, they will remove the queen cells before a new queen can emerge. Sometimes, for larger hives, Harry will manually cause a split by taking a few frames and placing them in a new box that is directly next to the old hives. When bees exit and return to the frame, some will return to the new box and begin working to build a new, separate hive. Harry states that the Eastern honeybee species is less aggressive than Western bees, therefore, he does not need to use smoke on them.

Q: Where do you source your knowledge of beekeeping?

A: There is a lot of intergenerational stigma against bees in Hong Kong that is passed down from parents to children. For this reason, Harry likes to run workshops where kids can safely view his bee hives and learn how bees are helpful pollinators rather than pests that need to be

exterminated. When he first started having an interest in beekeeping, he tried to research online for information, but there was limited information about Eastern honeybees. Most literature discusses the Apis mellifera or conditions of bees in Western countries, which is very different from the conditions in Hong Kong. He mentions how sources like YouTube can contribute to misinformation, as the videos online are mostly from Europe or the United States which have completely different climates, species, and practices. Harry states that, sometimes, there are negative thoughts of beekeepers, because "natural" bee environments cannot always be perfectly replicated, especially in urban or indoor locations.

Worcester Polytechnic Institute Global School IQP, Hong Kong Project Center C-Term 2024

Project Advisors: Professor Brajendra Mishra, Professor Stephen Sturm

Interviewers: Samantha Arroyas, Sophia Bogartz, Nathan Dynko, Jack O'Connell

Location of Interview: Kadoorie Farm and Botanic Garden, Lam Tsuen

Individuals Interviewed: Harry, cofounder of Beetales Ltd.

Date of Interview: January 24, 2024

Q: Can you describe your perceptions of how beekeepers are being affected by shifts in climate?

A: Shifts in the climate of Hong Kong are felt most directly in locations where it is already difficult to keep bees. In these locations, such as the indoor, urban, Beetales property, beekeepers would really feel all the seasons and any small shifts in seasonal timings. Harry observed that as climate conditions worsen, climate change effects are being felt by more rural beekeepers. Harry's master, who has been keeping bees in one rural location for over 20 years is beginning to have some of the same issues that Harry deals with. Harry has tried to keep bees in various locations, both urban and rural, so he has seen climate change spread in terms of beekeeping

practices. It is difficult to measure the effects of climate change for beekeeping, as there are many complex environmental relationships and data at play that are often hard to describe. Most conditions of the bees are directly related to food source availability.

Q: Can you describe what your typical yearly practices are?

A: Spring – In the spring, external nectar and pollen supplies are sufficient for sustaining the hives, and activity is focused on collecting food outside of the hive and building up larger amounts of eggs inside the hive. In this season, beekeepers must be the most mindful about potential splitting as hive populations grow. Beekeepers must continuously check the volume of honey inside of the hive so there is still room for the queen to lay eggs towards the bottom of the frames. Wild hives are usually self-sustaining in this way, but manmade bee boxes have space constraints and need to be monitored with weekly hive inspections. In this season, Harry harvests the honey for vocational purposes and starts to do general hygiene checks. In the wild, this season might be influenced by the presence of predators, but moths and wasps are not very common for Harry's urban location.

Summer – In the summer, blooming flowers turn into fruit, therefore, there is a general decrease in external food resources for the hives. Beekeepers need to make sure there is enough honey in the hive to sustain the bees through the summer months. Parasites and disease appear most strongly in this season, so beekeepers need to be vigilant in examining the health of the bees during weekly inspections. Harry needs to make sure his hives are not too hot or wet throughout the summer months and into the fall. Defense season from disease and parasites also lasts through summer and into the fall.

Fall – In this season, Harry must supplement his hives with honey or a mixture of pollen and sugar water to prepare for winter. The two main honey production seasons are in the Winter and Spring. Throughout the fall, Harry focuses on trying to increase his hive populations by stabilizing conditions as much as possible so that the queen will feel comfortable and lay more eggs.

Winter – In the winter, Harry must make sure that temperatures are warm enough for the queen to lay eggs. For vocational purposes, he prepares the hives to gather winter honey. This season is relatively comfortable for beekeepers, as predators like wasps have usually died off due to the colder temperatures. Harry must ensure there is enough pollen and honey stored in the hives to

sustain the bees until the main spring blooming season. In the fall and winter months, it is easiest for hives to contract disease, therefore, Harry must make sure all frames are healthy and fully covered by bees.

Q: Can you describe your perspectives on the environmental relationships that affect beekeeping practices?

A: Harry says that the difficulty is that so many conditions are happening all at once, but conditions are always dependent on the resources that are available for hives. Conditions also vary across the different districts of Hong Kong. Hong Kong is very biodiverse and is split into many districts, each with unique plant blooming schedules. Some locations have small blooms in summer that can support bees, however, others are sparse or have no blooms. Harry says that the relationship between plants and pollinators relates to the larger topic of carbon capture. He also states that robust datasets on climate and variation in seasonal timings may take years to gather properly.

Q: What do you think the future of Beetales and your personal beekeeping will look like?

A: Harry anticipates that Beetales will continue to focus on all pollinators, not only bees, throughout any future projects or initiatives that they develop. While honeybees are good for agriculture, solitary bees are better for urban areas, as they will go to any flowering plant they can find and are constantly searching for more pollen sources. He says popular honeybee conservation stories make for good publicity, but it is important to focus on all bees and other pollinators such as butterflies. It is dangerous for the ecosystem if support is only focused on bees. Hary believes that this is a good start in terms of doing public outreach and destigmatizing bees, but the scope must be expanded to all pollinators. One future project that Harry describes is to make pollinator oases inside of very urban sectors of Hong Kong. These spaces would ideally be away from human pathways, maybe on rooftops, to not bother people. Urban bee oases would provide a safe place for bees to lay eggs, gather clean water, and contain floral food resources for urban pollinators.

Q: *Harry is interested in some of the other site visits we looked in to* Do you have any insights on the practices of other beekeepers in Hong Kong?

A: Harry says that the practices of each beekeeper that we interview in Hong Kong will be unique, as their practices are not only dependent upon their individual locations, but also on their sources of information. For example, the Beetales location is not in the normal route for bees, therefore, he does not have many cases of wild bees attacking his hives. In Harry's master's district, they are closer to the mountains, meaning the hives have more external resources, but wasps and hornets are a larger issue as well. His master is experiencing similar struggles with disease as viruses are spreading across the mountain areas and infecting bee larvae. Harry believes that the spirit of beekeeping is to experiment with what conditions will be best for the bees and independent environments that beekeepers are operating in. With that being said, Harry does believe that there needs to be some sort of good foundation of information for new beekeepers. There is a lot of misinformation with online beekeeping resources, and he has found that new beekeepers with no master or credible source of information often cause more harm than good. Harry says that in his opinion, the information online is interesting to experiment with, but beekeepers must do firsthand learning, and having a mentor is very valuable. Mentors can help with safely learning how to properly pick up a farm or do minimally invasive hive inspections.

Q: Are there any other components that you would like to see in an online educational beekeeping resource?

A: Harry thinks that the relationship between humidity, temperature, and beekeeping is not easily accessible online, so some sort of visualization of these relationships would be helpful. He will be working in the future on researching innovative treatments such as vitamin C sprays, and ways of helping bees through more extreme winters, so a section on the adaptations of beekeepers would be interesting to include.

So Yuen Farm

Worcester Polytechnic Institute Global School IQP, Hong Kong Project Center C-Term 2024

Project Advisors: Professor Brajendra Mishra, Professor Stephen Sturm

Interviewers: Samantha Arroyas, Sophia Bogartz, Nathan Dynko, Jack O'Connell

Location of Interview: So Yuen Farm, Fanling

Individuals Interviewed: Owners of So Yuen Farm

Date of Interview: January 22, 2024

The owners of So Yuen Farm contacted a friend who spoke some English and was present during the site visit and aided in translation.

Q: Why did you start beekeeping?

A: The husband started to keep bees around 4 years ago and now has around 70 hives. He initially purchased a hive and received beginner instruction from an individual in Hong Kong, and then further searched online on Chinese web pages for information. The couple emigrated from mainland China and has owned their property in Fanling for 5 years. The husband keeps hives as a hobby and describes it as a therapeutic practice for him. He stings himself with a bee and mentions how in ancient Chinese medicine, bee stings are good for your joints, bones, and can generally reduce inflammation. He keeps the Eastern honeybee, Apis cerana, but also refers to it as the "Chinese" or "Asian" bee. He refers to the Western honeybee as the "Italian" bee.

Q: How would you describe your yearly schedule or regular practices here?

A: He does weekly inspections of the apiary, and it takes him around 4 days to inspect and maintain all 70 beehives. He states that the Eastern honeybee easily reproduces, and he anticipates that the apiary will have over a hundred hives by next year. Populations are highly dependent upon the abundance of resources in their surrounding environment. The couple has observed instances where some wild bees will try to steal honey from the apiary hives, and the bees end up fighting one another. Ordinarily, they do not need to feed the bees, as there is plenty of flora around, However, during the summer months when floral resources begin to decrease,

they may feed them a mixture of honey and yellow bean. They also extract honey from the hives and sell some at small pop-up shops and farmers market events. If the bees are particularly unstable, the beekeeper will use smoke or air spray to calm down hives when extracting honey or doing inspections. They do not interfere in hive activities and do not use chemicals, prefering an "all-natural" approach.

Q: Are there any special or unusual years for the apiary that you remember?

A: The hives are affected by extreme weather conditions such as typhoons. One of the most recent typhoons wrecked some of their hives, and the boxes had to be rebuilt. Additionally, last year, their honey production was not very good due to warm weather. The beekeeper planted several banana trees and taller plants throughout the apiary to provide natural shade and keep hives cooler during the summer months. A large challenge for the beekeeper has been dealing with wasps and moths praying upon the hives. During the site visit, the beekeeper captures a Black Shield wasp, stating that it will attack the hive and bring honeybees back to the wasp nest to feed its babies. Similarly, moths invade hives and lay eggs in the brood cells of the hive. The moth larvae will then kill the bee larvae. Sometimes, the beekeeper will use salt to prevent moths, but he says mainly that keeping good hygiene around the ground near the hives helps to lessen the presence of moths.

Kadoorie Farm and Botanic Garden

Worcester Polytechnic Institute Global School IQP, Hong Kong Project Center C-Term 2024

Project Advisors: Professor Brajendra Mishra, Professor Stephen Sturm

Interviewers: Samantha Arroyas, Sophia Bogartz, Nathan Dynko, Jack O'Connell

Location of Interview: Kadoorie Farm and Botanic Garden, Lam Tsuen

Individuals Interviewed: Master Lee and Master Raymond

Date of Interview: February 5, 2024

A volunteer from Beetales Ltd., Siu, was present and helped to provide translation. A contact from Kadoorie Farm and Botanic Garden, Laurie Lo, was also presented and aided in translating.

Kadoorie Farm and Botanic Garden employs two individuals, Master Lee and Master Raymond, to maintain the apiary. Master Raymond has worked at Kadoorie for 1 year and has 35 years of prior experience with beekeeping. Master Lee has between 30 and 40 years of experience with beekeeping and will be retiring this year. The Kadoorie apiary has been operating for around 16 years.

Q: Will you relocate bees from other parts of the farm to bring here (the apiary)?

A: Yes, but they are not common to find. There are techniques to attract wild bees. Masters Lee and Raymond are planning to put some empty bee boxes on the mountain to attract wild bees. Some traditional beekeepers use hormones to mimic pheromones and attract wild bees, but the masters at Kadoorie do not do this.

Q: Why collect wild bees in the mountain? Why not leave them be?

A: In the surrounding environment, it is hard for the bees to survive. Most of their food sources in the area have been lost. There are other factors that Masters Lee and Raymond consider when deciding whether to relocate bees. If the bees are too difficult to reach or continue to swarm rather than settle, the masters will choose not to collect them.

Q: How would you describe your yearly schedule at the apiary?

Masters Lee and Raymond use the Chinese 24 solar term calendar to mark seasons. They are only very busy in the 2 breeding seasons for bees. It is getting extremely hot in the summer months (June, July, and August). Weather shifts that are less gradual such as 10 to 20 degree Celsius fluctuations in temperature affect trees and flowers where bees get their pollen or nectar. Temperature is the main factor in affecting the food source of bees at Kadoorie. Master Raymond is not sure wether heating pads would be effective in supporting hives during colder months, as he thinks it could make the bees lose sensitiveity to the temperatures outside. Both masters state that it is more difficult to maintain hives now than years ago, but they are still trying to pinpoint exactly why this is.

Q: Is the environment surrounding Kadoorie generally good for sustaining your hives?

A: The water source is good, but the stability of food source is not very good. The main food source for bees are fruit trees. Winter temperatures are becoming too warm, affecting the blooming periods of winter fruit tree species, further affecting winter honey. In certain temperatures or humidity, there will be droplets of nectar on flowers and fruit trees. The flower nectar and honey acts as a high-quality food source for the bees. If the wind, temperature, or humidity conditions are not suitable, there will not be much flower nectar present.

Q: Are there any special or unusual years for the apiary that you remember?

A: The masters do not remember anything extremely special, as Master Lee has many years of experience with beekeeping. The masters did notice something unusual last year around the time where they usually collect honey to sell during a large festival. Usually, they can extract honey 2 to 4 times, but they could only extract once last year. The bees began to fight back after the first extraction because they knew they would need to keep honey stored inside the hive due to insufficient external food supply. The masters extract honey before feeding the hives to ensure the collected honey is higher quality and made from nectar or pollen rather than the sugar that is used to supplement the hives. The masters will mix sugar and pollen to feed the hives in exchange for the honey they collect. Mainland China has higher production of vegetables, such as Cabbage, that are a very good food source for bees, therefore beekeepers there do not need to supplement hives often. In Hong Kong, there is not enough space for largescale vegetable

A:
production, therefore, beekeeping masters usually purchase pollen from other places. Masters Lee and Raymond purchase pollen in bulk from mainland China.

Q: When hives are sick, will you transfer frames to other, stronger hives to heal them?

A: If they have disease, the masters will not move them, but if there is a weaker hive, they will try to combine it with a stronger hive. At Kadoorie, the use of chemical treatment is prohibited, and the masters do not like to use such treatments, so they leave sick bees in their boxes. The masters shared a story of someone in the area who imported plum blossoms from mainland China that had been sprayed with pesticides. Once the bees collected pollen from these blossoms, they began to get sick and die. The masters also share that wasps are not very common in their area.

Q: Why did you start beekeeping?

A: Master lee has been beekeeping since he was around 10 years old. He started because he liked to eat honey, and his family grew many lychee trees at home. His father would use a bamboo basket to collect swarms of wild bees. Master Lee does not currently use a bamboo basket to collect bees, as it is too hard to manage. The masters state that beekeeping is not a particularly popular activity in Hong Kong. Master Raymond does not have a family history of beekeeping. Master Lee used to keep bees in a clay pot left outside and not interfered with to let the bees maintain themselves naturally. Master Raymond says that we will see if he can get us in contact with other beekeepers through a WhatsApp group chat that he is in, as there is a small community in Hong Kong. He states that some master beekeepers are hesitant to make posts or respond in Facebook forums in fear of having their methods judged by other masters. Master Lee's master, Master Wong, lives near Kadoorie. Master Lee calls him to introduce us and explain our project. Masters Lee and Wong met through work as they were both in construction together. Master Wong is very good at catching wild bees. He originally had 60 hives but now has 20 after an accident where salt had mixed into the sugar water food supplement for his hives following a large storm. None of the three masters use the bees for physical health benefit such as sting therapy. Groups interested in sting therapy have visited Kadoorie in the past, but the therapy results in the death of the bees used, therefore, the farm supervisor stopped this activity.

Q: *The masters point to a hive with two queens in it* Are they separate hives, and do they fight?

No, the two queens coexist and share worker bees. Both masters describe that they keep losing bees. They do not know the reason why beekeeping has become harder these days. Some extreme weather events in the past, such as typhoons, caused boxes to be knocked over and resulted in the loss of some hives. Usually, every ten days, bees should be mating and producing more bees, but the hives at Kadoorie are not reproducing this quickly. The masters are trying to produce more flowering greens as a food source or combining 2 weaker hives to form a stronger one.

A:
Master Wong

Worcester Polytechnic Institute Global School IQP, Hong Kong Project Center C-Term 2024

Project Advisors: Professor Brajendra Mishra, Professor Stephen Sturm

Interviewers: Samantha Arroyas, Sophia Bogartz, Nathan Dynko, Jack O'Connell

Location of Interview: Interviewee's home apiary in Lam Tsuen, Hong Kong

Individuals Interviewed: Master Wong

Date of Interview: February 5, 2024

A volunteer from Beetales Ltd., Siu, was present and helped to provide translation. A previous interviewee, Master Lee, also was present during the site visit following his interview conducted at Kadoorie Farm and Botanic Garden.

Q: Why did you start beekeeping? What is the history of your home apiary?

A: Master Wong has kept bees since he was 11 years old (he is now 80) because his father also kept bees. He began his home apiary in 1983. At the time, he was still working full time in construction and would bring leftover supplies home at the end of the day to make structures for the hives. When he first moved into the neighborhood in 1971, some neighbors were keeping bees and sharing knowledge with each other. The government owns the land, and neighbors were selling bees and honey. Before a storm-related accident last year, Master Wong had approximately 60 hives. He is confident that he will recover his number of hives and hopes to be keeping around 60 hives again in the coming 2 years. Master Wong keeps the Eastern honeybee, Apis cerana, which usually has a smaller hive size compared to Western honeybees. Master Wong shows us several bee boxes that are much larger than most Eastern hives we have seen, and he describes that large colonies are possible if the queen is very strong. He has

approximately 30 suspended baskets set up throughout his property to catch swarms of wild bees with the hopes of building up his hive number again.

Q: How does beekeeping today compare to years ago from your perspective?

Master Wong uses a specific flower on his property as an example. The bloom that he shows us has completely dried up. Master Wong says that the issue for bees is a lack of stable food sources. Wasps are also not much of an issue for his hives because even the wasps and other related predators do not have sufficient food. He used to use chemical treatment to prevent weeds on his property but transitioned to using salt water as the chemicals were too strong. Master Wong states that it was much easier to keep bees around 10 years ago compared to the conditions now. He states that even the rainfall has been lacking in his area in addition to climate change affecting the bees' main food source, flowering plants. Master Wong believes the problems with temperature, flowering plants, weather patterns, and general climate change are related and interconnected.

Q: How would you describe your yearly schedule at your apiary?

A: Master Wong does all hive inspections, maintenance, and construction by himself, though his wife also observes his practices. He uses the Chinese 24 solar term calendar to mark points in seasons, but bases his tasks on regular hive inspections and the day-to-day behavior of his bees. He tapes small notes on each hive after inspecting them to remember specific details or important tasks to complete for the boxes. We ask him what one of his notes says, and it translates to, "In December, need to keep bees warm...just started with new frame, no eggs, and no honey, will check on 23 February." His main seasons for collecting honey are during the winter (ivy tree) and summer (lychee tree) honey production periods. The hive boxes are covered in a Styrofoam shell layer which Master Wong says acts as insulation for the colder winter months and gets removed once temperatures rise again in spring. When extracting honey, he does not want the queen to get scared and flee the hive, so he checks which frame the queen is on and treats it carefully. If the honey extraction is high and not watery, you can dilute it without it having a sour taste. Master Wong collects the honey in a bucket and stores it for around a year. Masters Lee and Wong both state that they do not believe it is necessary to steam the honey before selling it, but this is policy at Kadoorie Farms and Botanic Garden.

A:

Q: Are there any special or unusual years that you remember?

A: Master Wong says there are no specific or special years that come to mind. He just is observing a continuous increase in the difficulty of keeping bees due to a decrease in food supply in the surrounding environment. Each year, he continuously observes the flowering of surrounding plants and the amount of pollen present.

Q: How did you beginn teaching Master Lee about beekeeping?

A: Masters Lee and Wong met during mutual construction work on projects such as a bridge to the airport and a secondary school being built in Tai Po. They mutually began discussing an interest in bees. Master Wong invited Master Lee to his home to show him the hives and describe his personal experiences with beekeeping. Master Lee learned from Master Wong for 2 years, then Master Lee started to work at the Kadoorie Farm and Botanic Garden Apiary. Initially, Kadoorie hired a beekeeping expert from mainland China to maintain the apiary, but the number of hives decreased from around 60 to 8. The expert left and Master Lee took over caring for the remaining 8 hives. Both masters have an appreciation for each other's skill and hard work.

Herbs Country

Worcester Polytechnic Institute Global School IQP, Hong Kong Project Center C-Term 2024

Project Advisors: Professor Brajendra Mishra, Professor Stephen Sturm

Interviewers: Samantha Arroyas, Sophia Bogartz, Nathan Dynko, Jack O'Connell

Location of Interview: Herbs Country, Lam Tsuen

Individuals Interviewed: Master KK, Phillip, Edmond, Zachary

Date of Interview: February 8, 2024

A volunteer from Beetales Ltd., Siu, was present and helped to provide translation. A previous interviewee, Master Raymond of Kadoorie Farm and Botanic Garden, also was present during the site visit.

Q: How did you learn beekeeping? How much experience do you have?

Zachary: Originally became interested while attending university in Edmonton Canada. Learned from bees kept at the university. The bees would be stored in shelter during the winter months. Still interested in beekeeping when came back to Hong Kong after university. Now has approximately 20 years of experience with beekeeping.

Phillip: 4 years of experience. Recently went to South America for Chinese Beekeeping Association field trip.

Edmonton: Found nearby beekeeper as mentor. Lived in Hong Kong twenty-five years before moving here. Started farm 7 years ago and invited friends and volunteers.

KK: Started 30-something years ago. Beekeeping and bee products are also good for health. The honey bought in supermarkets is not the same...doesn't heal the same.

Q: What practices and technologies do you use to bee keep?

KK: For most hives use typical bee box in Hong Kong (frames hanging instead of different compartments). Have provided shade, and planted plants nearby as food source. Area naturally has good water source. Recently been testing new bee box. The concept is to mimic nature/the

structure of a tree trunk (cylindrical design). This design is inspired from bee boxes found in an Egypt or Israel archaeology site. Variations of this design date back to the Silk Road. There are also references to pollen and olive trees of that region in the Bible. Some countries of that region now have major exports of honey.

Q: What kind of bees do you keep and do you face difficulty caring for them?

KK: We keep the Eastern Bee. We do not keep the Italian Bee because we cannot keep them stable here. The Eastern/Chinese bee we can sustain. Eastern bees are generally more difficult to keep in the hive than Western Bee. With the new hive design, we would like to transfer the bees to these new hives and keep them in the forest. We think that going back to a traditional method will be easier and the honey will be better.

Q: Why does your farm keep bees?

Group: Apart from beekeeping for honey in some seasons, we do bee conservation as well as bee rescue. For example, in rural areas we will collect swarm and try to get there before people call Prest control/use chemicals to exterminate. We also run a conservation program where the local school and international school in the past year could visit and learn about bees and conservation. In our program, the students can also hear, touch, and taste the bees/honey through an observation hive (temporary box) for safety.

Q: Do you ever have issues where wild bees will attack your hives?

Group: This is not a serious issue for us, but we do sometimes have problems caused by a commercial farm that keeps Italian Bees nearby. The Italian Bees will sometimes come and attack our bees, or steal their honey. The commercial bee farm has over 100 boxes. We will put herbs on the entrance of our hives to deter Italian bees as they are larger than our bees. Usually, the Eastern Honeybee is more hardworking: they go to many flower source to collect pollen and nectar. The commercial farm also cannot produce honey year-round. In the off-season they will reduce their populations.

Q: Does your farm do other things than keeping bees?

Group: Yes, we animals like goats, rabbits, in addition to farming and hydroponics.

Q: What threats/struggles do you bees have?

Group: Lately, we have noticed more viruses, but we do not consider this a serious issue. In our case we do not have issues with mites because the Eastern Bee is more resilient. The weather fluctuations have also been affecting our bees. Currently, we will help regulate hive temperature by wrapping our hives like a windbreaker. In the future we think that returning to more natural method and keeping the hives in the forest will also help with temperature. We also currently inspect our hives every day. With our hives in the open, we have to put up canopies in the summer to protect our bee boxes from getting too hot.

Q: Are there any other problems with weather or predators that you have noticed?

Group: Last year there was a typhoon, but fortunately our bees were OK. Extreme weather like this can be destructive to our hives. Another problem can be ants or wasps.

Q: When is the most difficult season for beekeeping?

Group: Summer is the most difficult beekeeping season in Hong Kong. The temperature and climate have changed a lot in the last ten years. Beekeeping friends have also noticed that 20 years ago the climate was still not bad. Also in the rainy season, if it rains too much, bees cannot go out and will also struggle. Spring to summer is also difficult because the transition from fruit tree to fruit blossom are not the same.

Q: What do you do when food sources in the surrounding environment is limited?

Group: We buy pollen from mainland China and supplement their diet.

Q: What do you think about the sentiment of bees with people in Hong Kong?

No parents will ask children to do beekeeping. Bees are often thought of as pests. Our conservation program helps to educate the younger generation.

Master Chun Kwong

Project Advisors: Professor Brajendra Mishra, Professor Stephen Sturm

Interviewers: Samantha Arroyas, Sophia Bogartz, Nathan Dynko, Jack O'Connell

Location of Interview: Master Chun Kwong's personal apiary

Individuals Interviewed: Master Chun Kwong

Date of Interview: February 20, 2024

Harry, cofounder of Beetales Ltd., was present and helped to provide translation. A research professor, Roger, was also present and listening in for this site visit.

Q: How did you start beekeeping? Who taught you?

Master Chun Kwong: When I was 6-8 years old, I lived in a city in mainland China and found beekeepers nearby. Then I met more beekeepers in the coming decades. After I retired from my career, I now manage my apiary at home. My brother is also a beekeeper in mainland China. He is 91 years old. Beekeepers usually live a long life. It is good for your health (drinks, sting therapy, etc.)

**Master Chun Kwong is now in his late 70s-80s.

Q: How many hives are in your apiary?

Master Chun Kwong: Usually about 40. There are some periods where my population decreases, and I must regain numbers. Recently we have tried to keep a few Western Bee, but virus was too bad. I have had this apiary for about 40 years.

Roger: Conducting research on wild bees. There are few studies on Asian Bees in Asia. Citizens are usually scared of bees, education is important for this. Some citizen science effort suggests good wild bee diversity in Hong Kong (still being finalized).

Apiary Tour:

Q: Mind touring/explaining this hive?

Master Chun Kwong: I usually inspect these hives twice per week. The plastic is insulation to help temperature in winter. Notice larvae have a more organized pattern because hives are healthy (currently no virus). Notice these hives have 4-6 frames in each. Western Honeybee usually has 6-10 frames. For this hive, I will capture the old queen since the new queen is emerging. I replace queens once per year to ensure every hive is healthy and strong. This separate hive has two queens separated by a divider and an upper compartment to collect honey. It is a hive that I am testing. This style of hive is more like western honeybee hive designs, with an upper compartment to for honey collection.

Q: Have you noticed differences in the environment here?

Master Chun Kwong: Flowers are blooming earlier this year. Climate and weather are also changing within the last 10-20 years. I notice it most when the flowers bloom. The flowers here used to bloom throughout the year, now they all bloom at once. Normally, I can extract honey multiple times in each season, but now I cannot. The higher temperatures also affect the bees: the queen lays less eggs when the temperature is too hot. Summer has become longer. This with less eggs because of the hotter weather makes it difficult to maintain the population of the hives. Having a smaller population also affects the bees' ability to fight viruses. Heavy rain can also flood hives. I lost between 20-30 hives to this, and it takes a long time to recover.

Q: What do you do when the flower bloom timing changes?

Master Chun Kwong: I supplement their diet with imported feed and pollen.

Q: Are there wild bees around?

Yes, many. Wild bees sometimes cause problems when they swarm near my hives.

Q: This town has a lot of beekeepers? Is there a beekeeping community here?

People in the village do not complain about me keeping bees here, but there is not a beekeeping community. Sometimes some of us will discuss our hives. People who do not want to talk about their hives don't. Some beekeepers here are struggling.