







Master Gardeners Association of BC
Thompson Shuswap Chapter

# 2019 CITIZEN SCIENCE SUMMARY REPORT

# WE GRATEFULLY ACKNOWLEDGE


**GRANTS FROM:**

The City of Kamloops Social Planning Council
TD Bank Friends of the Environment Foundation
Teck Highland Valley Community Investment Program
The Entomological Society of BC
The Kamloops Naturalist Club

**PARTNERSHIPS WITH:**

Thompson Rivers University
Tk'emlúps te Secwépemc Band Council
BIG Little Science Centre
Gardengate Open Door Group



Report written by: Mae Frank
Edited by Dr. Lyn Baldwin & Elaine Sedgman

# Acknowledgments

Thompson Shuswap Master Gardeners Association (TSMGA) gratefully acknowledges the TD Friends of the Environment Foundation, the City of Kamloops Social Planning Council, Teck Highland Valley Community Investment Program, the Entomological Society of BC and the Kamloops Naturalist Club for their grants that contributed to the success of the Bee a Citizen Scientist Project. Thanks to these grants, TSMGA was able to integrate a number of activities throughout the summer that resulted in a highly engaged citizen science community, one that cares for the environment and advocates for pollinators.

Without our amazing Citizen Scientists who carried out these surveys, this project would never have taken place. In 2019, nineteen Citizen Scientists took part in at least one of the five group surveys in our managed and natural areas parks. All surveyed their own gardens three to four times during the summer. Thank you!

Much gratitude goes to Dr. Lyn Baldwin, Thompson Rivers University (TRU) plant biologist, who has been an unshakeable supporter of our project. Dr. Baldwin arranged access to the TRU biology lab, sought out students to work with TSMGA and supervised and edited students' papers. Importantly, over the past three years, Dr. Baldwin was able to leverage grants from Thompson Rivers University for the Citizen Science project: a TRU Community Driven Research Funds grant (CDRF) and two TRU Mind the Gap grants. Under her guidance, students received Undergraduate Research Experience Award Program (UREAP) grants to further their own research and an Undergraduate Research Apprenticeship. These grants were an essential key to the success of this project.

Thank you to Erin Udal, pollinator conservationist, who successfully trained the Citizen Scientists in person in 2017 and 2018 and through Skype in 2019.

TSMGA is very appreciative of Mae Frank's summer work with the 2019 Bee a Citizen Scientist Project. Frank co-ordinated the Citizen Science surveys within three Kamloops natural areas. She also set out blue vane traps, collected the insects, helped separate insects to genera, collated Citizen Scientist data and wrote the final report for TSMGA. Thank you also to Sami Suppanz who surveyed uncultivated areas and helped sort insects to genera. And to Jamie Lee Ushko who organized lab equipment and labelled and sorted bees in her spare time.

A huge thank you to Lincoln Best, native bee taxonomist extraordinaire, who sorted through thousands of specimens and identified to genus and species.

TSMGA is very grateful to the Tk'emlúps te Secwépemc Band Council for allowing us on their land in order to complete our pollinator surveys and to conduct our insect biodiversity survey through trapping.

Thank you to the BIG Little Science Centre and their partnership with TSMGA. The Centre has supported a Pollinator Day Camp vwith Master Gardeners every summer. (2017-2019)

Lastly, a shoutout to Gardengate for giving TSMGA a plot of land to test annuals and their ability to provide forage for pollinators. Gardengate staff irrigated the plot for us all summer!

## Special thanks to our citizen scientists:

Charyle Badesso (MG)
Lyn Baldwin
Sherry Bennett (MG)
Estelle Bérubé (MG)
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Richard Doucette
Basia Drozdz
Janet Erwood
Steve Joly
Lila Jennejohn
Phyllis Mader (MG)
Wendy McLean
Brenda Olynyk (MG)
Michael Ryan
Jesse Ritcey
Brenda Sanden (MG)
Elaine Sedgman (MG)
Samantha Suppanz

# INDEX



# FORWARD

Elaine Sedgman,
Thompson Shuswap Master Gardeners, Citizen Science Coordinator

Erin Udal led a second workshop via Skype training 20 more citizen scientists. In the lab, participants learned the basic biology of native and managed pollinators. Then out in the grounds of TRU, participants learned how to collect consistent standardized observational data. Each year seems to have its weather challenges. In 2017 it was relentless smoke from wildfires. In 2018 it was cold weather, clouds, wind and then wildfire smoke again in August. In 2019 we saw more variable weather with rain, wind and clouds and cooler temperatures.

Pollinator surveys over the past three years show that home gardens are very important for pollinator abundance. But perhaps not so much for pollinator diversity – that is another study!

Comparing 2017 and 2018 surveys of our managed parks to 2019 surveys, it was heartening to see an increase in bumblebees but disheartening to see a decrease in the other two native bee groups (cavity nesters and ground nesters) as well as managed honeybees. Over the past three years there was a 90% drop of Megachilidae sightings (cavity nesting bees) in Riverside Park and an 80% drop of the same family at McArthur Island. Three years is not enough time to come to any conclusions. We hope that we can persuade volunteers in future years to continue with observational surveys.

Thanks to our granters, TSMGA was able to integrate a number of activities throughout the summer of 2019; the work continues into 2020.

Completed in 2019:

1. 20 participants were trained as Citizen Scientists via Skype with Erin Udal, April 27th, 28th. In total, this three-year project has trained 45 people to recognize pollinators to functional groups and how to collect consistent standardized observational data.

2. 19 Citizen Scientists participated in at least one of the 5 group pollinator surveys and 4 home pollinator surveys. 2 group surveys took place in 2 managed parks in Kamloops: Riverside Park & the Butterfly/Xeriscape Gardens at McArthur Island. These two parks were surveyed every year during the project. In 2019, for the first time, surveys took place in three natural areas: Barnhartvale Nature Park, Moon Trail at Sun Rivers and Mt. Lolo Road on Tk'emlúps te Secwépemc Band land.

3. Pollinators were collected with blue vane traps by student Mae Frank, throughout the summer within these 3 natural area sites. Frank set up traps from May 28th until August 13th.

4. Identification work was carried out in August/September by taxonomist Lincoln Best.

Funding available allowed for the following taxonomic work by Lincoln Best:

- 7925 Bumble Bee specimens were completely curated.
- 15 species of Bumble Bees were identified.
- A set of phenological figures (life cycle events influenced by seasonal variations) for the Bumble Bee species for each site has been created as well as an estimate of richness of Bumble Bees for each site.
- Bumble Bee data will be published globally via CanadenSys, Canada's national biodiversity data portal to GBIF. Data and specimens provide exceptional potential for further taxonomic work and studies.
- Approximately 150 other species were collected, but there was not enough time or resources to prepare and curate the rest of the material.
- TRU received 12 drawers of prepped and pinned specimens with Bumble Bees organized taxonomically, and other specimens identified to genus. This material will have great potential for future study, eg ***Eucera*** specimens.
- TSMGA received one drawer of specimens for its use for education.

5. A Pollinator Day took place August 14th at the BIG Little Science Centre summer camp. 20 children took part. They examined a demonstration honeybee hive, were taught how to recognize native bees, & netted, examined, & released native bees at the Butterfly Garden at McArthur Island.

6. 30 people attended a Friday night presentation by Eva Antonijević on Xeriscape Planting for Pollinators.

7. 11 people attended a one-day Bumble Bee taxonomic workshop on Sept.8th.

8. In partnership with Gardengate, TSMGA used a plot to grow & assess annual flowers for pollinator visitation from June until September. Annuals that were visited most were annual sunflowers, tithonia, cerinthe, single marigold "Yellow Gem", dillweed, borage, sweet alyssum, mallow, phacelia and cosmos.

9. October 2019, Bee City Kamloops hosted a free presentation by Calgarian David Misfeldt. David was the project manager who created a pollinator corridor along Canyon Meadows Drive Boulevard.

Pollinator Education Work Continues in 2020:

Pollinator teaching sets were created in February/March 2020. 150 5x7" boxes hold pollinators of the 6 main functional groups described in the Citizen Science Monitoring Guide: ***Common Bees of the Southern Interior of BC.*** Specimens include Bumble Bees, Pollen Pants bees (ground nesters), Hairy Belly bees (cavity nesters), wasps and some flies.
Honey Bees were donated by a local bee keeper as they were not collected in the blue vane traps. More flies (Syrphid, if possible) are also needed to complete the sets.

75 boxes contain (6) pinned specimens and 75 contain (6) cuvettes with specimens floated in preservative. Sets of 15 boxes each of pinned & cuvettes will be donated to TRU Eureka Science camps, TSMGA, BIG Little Science Centre, School District 73 and the Sk'elep school at Tk'emlúps te Secwépemc.

These sets will act as an incubator, providing a foundation for future community and educational work.

# RECOMMENDATIONS

It is widely known that pollinators are a keystone species to a regenerative food system. Native bees provide critical ecosystem services within the urban and rural environments of the Thompson-Nicola region. The savannah and grasslands of this area support Canada's most diverse bee fauna due, in part, to its high floral diversity. Grassland areas are among the most threatened ecosystems in BC. Kamloops is identified as a critical junction between several major grassland regions within our province. As well, a number of species-at-risk are linked to Kamloops' grasslands and their associated ecosystems.

Therefore, it is important that the city of Kamloops adopt policy that protects native bee populations as well as non-native honeybees within City Kamloops landscape management decisions. Citizen Scientists recommend:

1.The City of Kamloops protects existing nesting sites and provides additional nesting opportunities for both cavity nesting and ground nesting bees by expanding habitat. (see Appendix 1)

2.The City of Kamloops provides adequate three-season pollinator friendly forage for bees and consider using native plants as its first choice. (see Appendix 2)

3.The City of Kamloops develops policy guidelines for procurement of plants from greenhouses that do not use systemic pesticides.
(see Appendix 3)

4.The City of Kamloops develops a sustainable IPM plan, thereby cutting its glyphosate use and instead employs cultural, mechanical and biological methods of weed control. (see Appendix 4)

5.The City of Kamloops develops a policy of prohibiting honeybee hives within natural area parks. (see Appendix 5)

Appendix 1
The City of Kamloops is a Bee City. The council has made a declaration to "protect pollinators and their habitats through action and education."
Habitat loss is the number one reason for species decline. 70% of our bee species are solitary ground nesters and each bee species has its own requirements for nesting opportunities.
As the City expands its development into natural areas, it is destroying vital nesting sites for solitary ground nesting bees. The City should consider building bee banks: a warm, maintained, sheltered patch of bare ground where solitary mining, polyester, sweat and apidae bees can nest.
The City of Kamloops is also a Fire Smart City and has removed beetle killed trees, which provide nesting sites for cavity nesting bees. The City can replace this loss by placing nesting boxes within its parks.
It is also important to provide pollinator corridors and bee friendly hedgerows between various garden beds. Solitary bees are small and are unable to fly long distances.
https://xerces.org/guidelines-pollinator-friendly-parks/

NOTE: There is one ground nesting site in the Rose Garden in Riverside Park used by multiple species that emerge at different times of the year. It is strongly recommended that mulch not be used & raking should cease in this area. Educational signage for the public would be very helpful.

**Quotes from citizen scientists regarding the project**:

*The project made me look at the world though a bee's eyes.*
Lyn

*I enjoyed sharing our experiences, building upon our knowledge and being in a community that is like-minded.*
Sherry

*I'm taking more responsibility for my pollinators. I talk to my neighbours about their use of herbicides.*
Charyle

*I really liked learning how to ID the different species. It was cool learning something new.*
Richard

*I had the satisfaction that I was doing something important.*
Basia

# RECOMMENDATIONS cont.

Appendix 2
Bees need a continuous succession of plants high in nutrition throughout the growing season because different bee species emerge from their nests at different times of the year.
Native plants are important: research shows that specialist bees require the flowers with which they have evolved.
The three- year Citizen Science Pollinator Survey Project reveals that in July, pollinators are not foraging on many of the flowers that are planted within our managed parks.
https://www.pollinator.org/pollinator.org/assets/generalFiles/Thompson_Okanagan.Plateau.2019.pdf

Appendix 3
Many studies find that pollinators are especially vulnerable to neonicotinoid pesticides.
https://xerces.org/neonic-report-exec-summary/

Appendix 4
Two recent studies suggest that exposing honeybees to glyphosate disrupts their gut bacteria and makes the bees more susceptible to infections.
Motta, V. S. E, Raymann, K, and Moran, N. A. (2018) Glyphosate perturbs the gut microbiota of honey bees. Proceedings of the National Academy of Sciences (PNAS), (41): 10305-10310

Thompson, H. M., Levine, S. L., Doering, J., Norman, S., Manson, P., Sutton, P., and von Mérey, G. (2014). Evaluating exposure and potential effects on honeybee brood (Apis mellifera) development using glyphosate as an example. Integrated Environmental Assessment and Management, 10(3): 463-470.

Appendix 5
There are many studies that reveal that there is competition between honeybees (which are not native to North America) and native bees through direct and indirect affects such as:
1. Resource depletion: abundance of honeybees depletes the available pollen & nectar. There are thousands of honeybees in a hive whereas most our native bees are solitary and must forage for their young by themselves.
The resource extraction of pollen from one apiary is equal to 100,000 wild bees over 3 months! (Cane, 2017)
2. Resource shift: honey bees directly and indirectly (through resource depletion) force native bees to less rewarding and less abundant resources. (Godet, 2018)
3. Competitive exclusion: honeybee abundance completely forces native bees from the area. (Portman, 2018)

Elaine Sedgman
Thompson Shuswap Master Gardeners Association
Citizen Science Coordinator

# SUMMARY OF SURVEY METHODS

In order to develop monitoring skills, each participant in this project learned the basic biology of native pollinators in a two-day workshop with Erin Udal, pollinator conservationist. Conducted in both the field and laboratory, this workshop provided participants with the necessary skills to record the abundance of pollinators to functional groups (guilds) including: bumblebees, honey bees, "pollen pants" bees (solitary ground nesting bees), "hairy belly bees" (solitary cavity nesting bees), flies, wasps, and other (any other species that may transfer pollen such as butterflies or beetles). This project continues the monitoring of pollinator activity that was completed during the summers of 2017 (Battel 2017) and 2018, (Abbott 2018), with many of the same volunteers returning to collect data. Note: the word "guilds" was used by Erin Udal to describe "functional groups" and is used interchangeably within this document.

As in the past two years, 2019 surveys (individual or group) were conducted within 20 minutes, with participants recording only pollinators foraging on open flowers. All citizen scientists surveyed a residential home garden. These individual garden surveys were conducted during the first two weeks of the months June, July, August, and September, except when exceptionally rainy periods necessitated a prolonged sampling period. In order to minimize the effect of weather on pollinator diversity and abundance, surveys were conducted under the following conditions: air temperature of at least 20°C, minimal cloud cover, little to no wind. Restricting surveys to these weather conditions prevented underestimation of pollinator abundance as many pollinators limit their foraging activity in the presence of strong wind or insufficient sunlight.

To compare patterns of pollinator abundance in cultivated and uncultivated sites, each of these home gardens was paired with a nearby (within one kilometre) uncultivated site of the same size as a standard city lot. These sites were surveyed following the same methods used by citizen scientists within their gardens. In addition to pollinator surveys, a complete inventory of all flowering plant genera was recorded for each cultivated and uncultivated survey site.

Pollinator abundance, diversity, and flowering plant genera richness for both cultivated and uncultivated sites were recorded by TRU undergraduate students (Mae Frank, Sami Suppanz) and Dr. Lyn Baldwin

In addition, using the above protocols, group surveys were conducted during the summer in five separate sites within the Kamloops area. Surveys within two cultivated parks, Riverside and McArthur Island replicated 2017 and 2018 surveys. (Battel 2017; Abbott 2018). Surveys were also conducted in three natural areas: Dallas-Barnhartvale Nature Park, a city of Kamloops natural areas park and two on Tk'emlúps te Secwépemc land: Sun Rivers Moonscape Trail, and the roadside to Mt. Lolo.

Thompson Shuswap Master Gardeners acquired letters of permission from the City of Kamloops and the Tk'emlúps te Secwépemc Band Council to conduct visual pollinator surveys as well as to conduct insect biodiversity surveys using trapping methods.

# SUMMARY OF SURVEY METHODS cont.

Mae Frank also used these natural areas as sites for an Undergrad Research Project, comparing Citizen Science visual surveys with traditional trapping methods.

Trap surveys were set up from May 28th to August 13th and collected every 1-2 weeks throughout that period. Twelve blue vane traps were set up at Barnhartvale Nature Park, Sun Rivers Moonscape Trail, and Mt. Lolo for a total of thirty-six traps. Each trap was placed out of view from any public traffic and more than 20m away from any other traps. The traps were filled with a mixture of 50% propylene glycol and 50% deionized water )and samples were collected and stored in 95% ethanol until they could be cleaned, pinned, and identified.

Samples were used to compare survey techniques to trapping techniques, so subsampling was performed on trap sampling periods that surrounded the nature surveys. Each site sample consisted of 20 random subsamples containing 15 pollinators. Subsampling allowed for more timely and efficient processing, as well as greater statistical power and comparability to the surveys. It is important to note that any non-bumble bee pollinators that lacked pollen hairs (including cuckoo bees and males) were classified as pollen-pants bees as their identification was not thoroughly covered in the 2019 workshop. However, experienced participants from 2017/2018 would certainly recognize our two common cuckoo bees by colour and body shape: Nomada and Coelioxys. They also recognized male Halictus (ground nesting, pollen pants bees) and were questioning their abundance in late August, early September. As it turns out, their abundance at that time of year is part of their lifecycle.

Samples were processed at Thompson Rivers University, with the help of Lincoln R. Best. Notable specimens were organized, counted, pinned, and tagged for use as a reference collection for Thompson Rivers University and future studies on pollinators in Kamloops, BC. Of these prepared specimens, 150 pollinator guild teaching collections were created with the help of the TSMGA for educational outreach programs for youth in Kamloops: School District 73, the Big Little Science Center, Tk'emlúps te Secwépemc Band, and TRU's Eureka Science Camp.

# SUMMARY OF FINDINGS

During the past three summers, participants in this project completed 356 surveys and observed more than 10,000 individual pollinators within the Kamloops landscape. Collectively, students and citizen scientists spent more than 100 hours observing the pollinators in a range of Kamloops green spaces including cultivated gardens, community gardens, cultivated city parks and uncultivated green spaces. In 2019 as in the previous years, the abundance and diversity of pollinator species varied between natural and cultivated sites as well as throughout the growing season. In 2019, two cultivated parks—McArthur Island and Riverside Park and three natural areas— Dallas-Barnhartvale, Sun Rivers, and Mt. Lolo were surveyed.

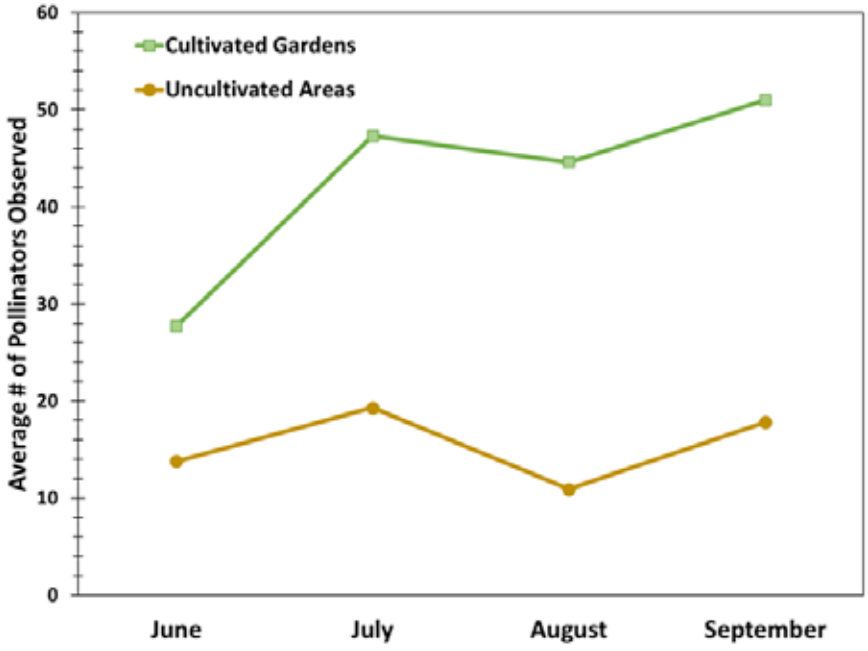
## 2019 Individual Survey Results

| | Cultivated Gardens | | | Uncultivated Areas | | |
|---|---|---|---|---|---|---|
| **Month** | **Temp (°C)** | **Wind** | **Sky** | **Temp (°C)** | **Wind** | **Sky** |
| **June** | 26 | Light Air* | Overcast | 26.8 | Gentle Breeze* | Cloudy |
| **July** | 25* | Light Air | Cloudy | 22.8* | Light Breeze | Cloudy |
| **August** | 26 | Light Air | Clear | 24.6 | Light Air | Clear |
| **September** | 24 | Light Breeze* | Cloudy | 24.2 | Light Air* | Cloudy |

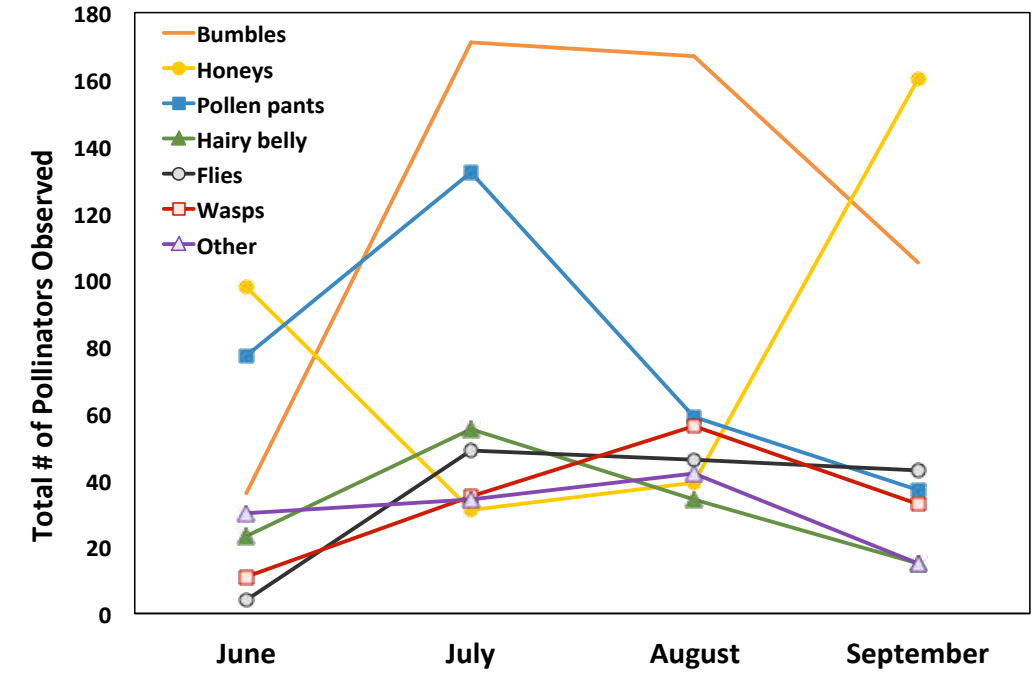
Table 1. The average temperature of garden and uncultivated area pollinator surveys for 2019 in Kamloops, BC.
* indicates a significant difference between cultivated gardens and uncultivated areas ($p<0.05$), two-tailed T-test

Most of the environmental conditions were similar between cultivated and uncultivated site surveys, but the July uncultivated surveys occurred under slightly cooler conditions than surveys in the cultivated areas ($p = 0.0176$). June and September wind speed also varied between cultivated and uncultivated area surveys with uncultivated area surveys experiencing windier conditions in June and cultivated area surveys experiencing windier conditions in September.

Figure 1. The average number of total pollinators seen in garden and uncultivated area surveys for the summer of 2019 in Kamloops, BC.




In this study, the average number of pollinators observed per survey varied by both month and habitat type (cultivated garden versus uncultivated green space, Figure 1). Participants observed 2-4 times as many pollinators in cultivated garden spaces than in nearby uncultivated areas. Overall, pollinators in gardens accounted for approximately 73% of all pollinators recorded in individual surveys. However, the seasonal pattern of abundance showed similar trends in both habitat types. The peak average abundance of all pollinators was observed in July and the lowest abundance was observed in August. The drop in August pollinator abundance may reflect a seasonal gap between the emergence of spring bees and late summer bees. Certainly, Kamloops summer drought means that there are few flowering species available in uncultivated areas until Rabbitbrush (Chrysothamnus nauseous) blooms in September.



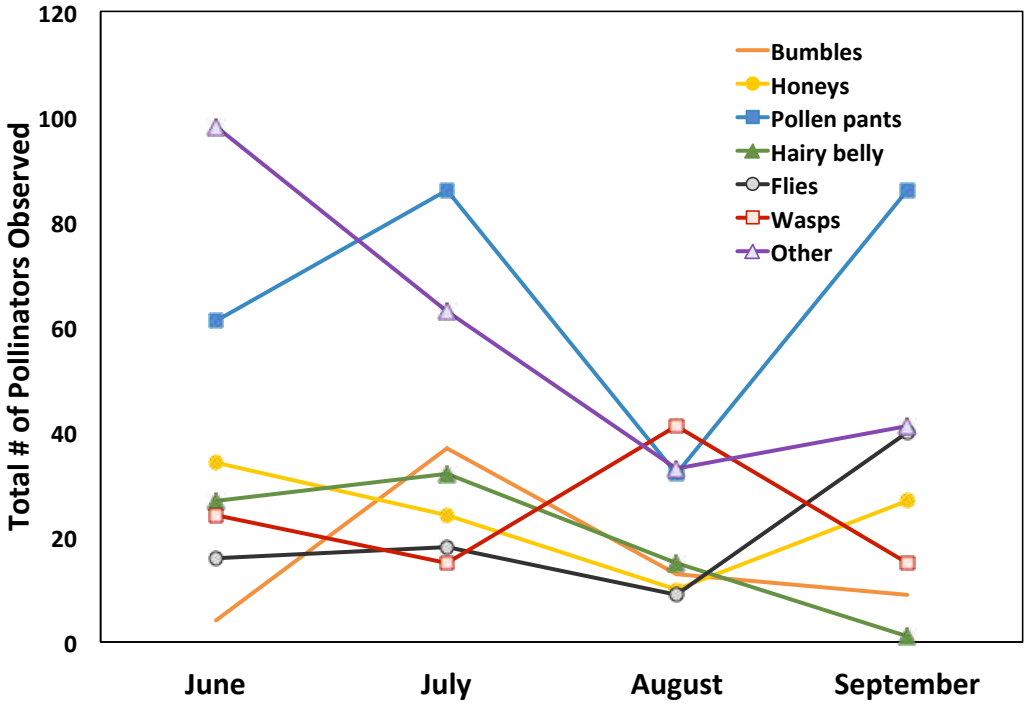




Figure 2. The total number of pollinators from each guild observed in cultivated gardens (a) and uncultivated areas (b) throughout Kamloops, 2019.

a) Cultivated Garden Areas

b) Uncultivated Areas

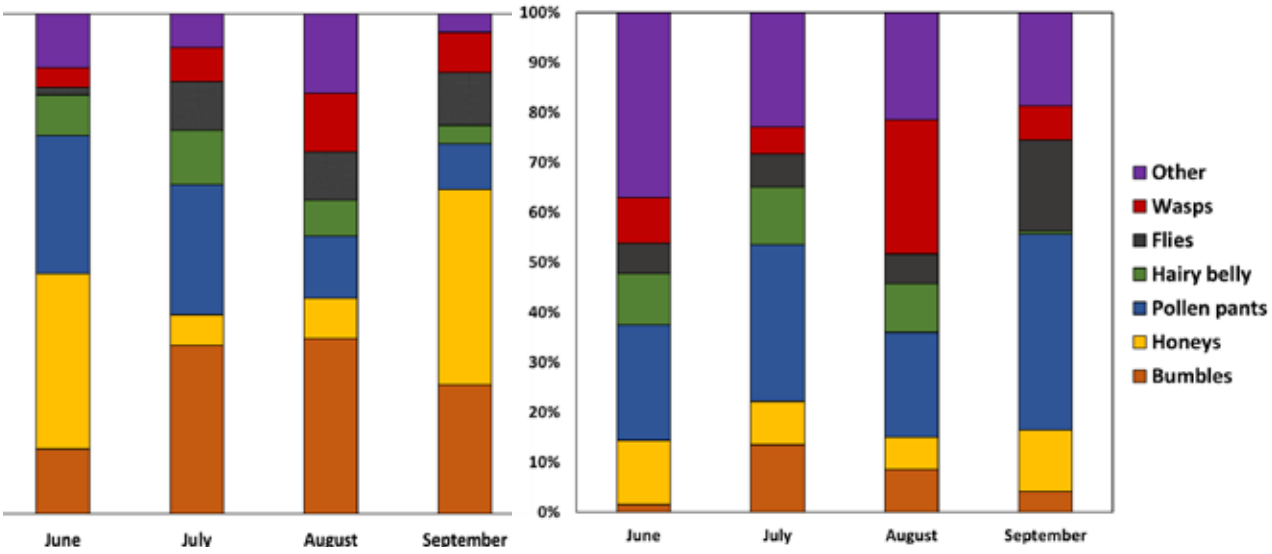
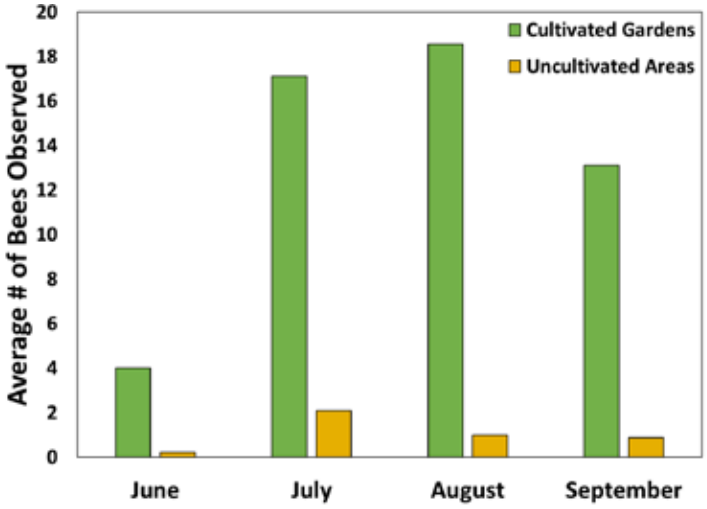
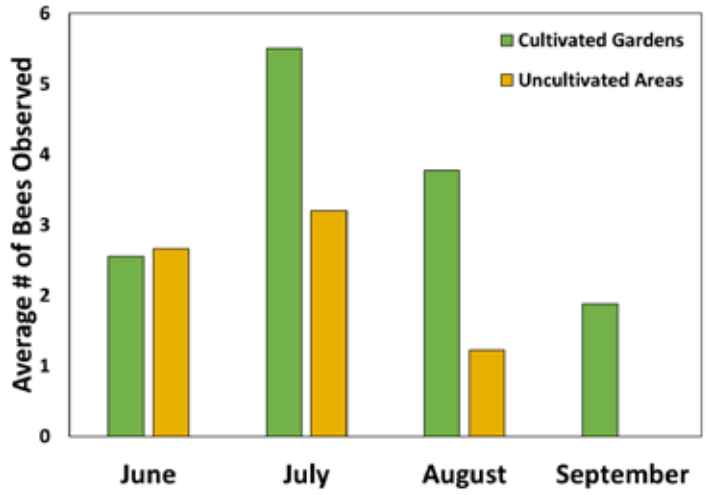



Figure 3. The average percentage of different pollinator guilds observed in cultivated gardens (a) and uncultivated areas (b) throughout Kamloops in 2019.

Not only did pollinator abundance vary by month, but the abundance of pollinator guilds also varied by month and habitat (Figure 2 and Figure 3). In cultivated gardens, honeybees and bumblebees dominated participants' observations of pollinators (Figure 3a). Honeybees were present if there was a hive somewhere near. Honeybees and Bumblebees are considered generalist species and will forage on most floral resources.

In comparison, our observations in uncultivated areas recorded far fewer bumble bees and honeybees and a much larger percentage of pollen pants bees and "other" pollinators (beetles, butterflies, Figure 1b). Bumble bees and honeybees need flowering plants throughout the season as they must support their colonies. Gardens are a source of constant blooming genera throughout the season, whereas solitary bees only live and forage for a very short time (2 -3 weeks) making them able to do better in desert areas. Pollen pants bees are native solitary bees, so they may be more drawn to natural areas with native plants such as Prickly Pear Cacti and Mariposa Lily that aren't often in gardens. Pollen pants bees may rely on uncultivated areas for suitable ground nesting sites, as cultivated gardens are often irrigated, mulched or tilled, and overcrowded with flowering plants. Pollinators classified as "other" in our sampling protocol may also be dependent upon specific native plants. Possibly a more plausible reason might be that gardeners do not provide nesting sites for ground nesting bees.



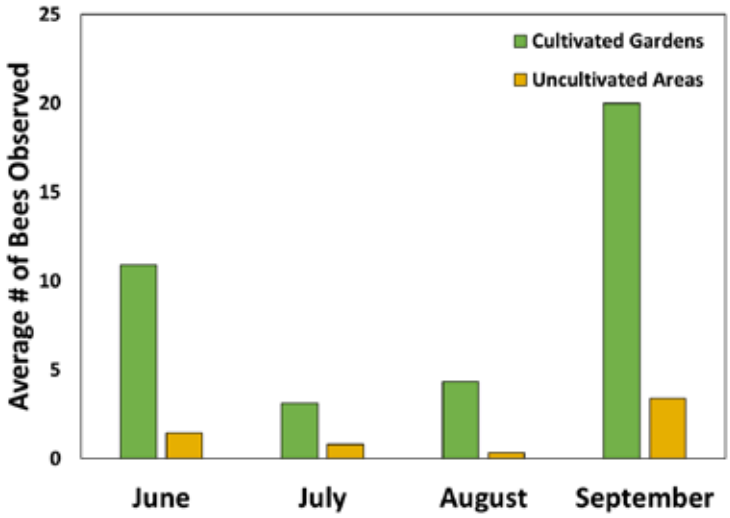




Figure 4. A comparison of the average number of bumble bees (a), hairy belly bees (b), and honeybees (c) seen in gardens and uncultivated areas throughout Kamloops in 2019.

The differing abundance of pollinator guilds in Kamloops' green spaces is illustrated in the seasonal trends of bumblebees, hairy belly bees and honeybees (Figure 4). Bumble bees (Figure 4a) were observed 8-20 times more in garden areas than in uncultivated areas with an average of 13 appearances per survey. One cultivated garden survey in September saw 45 instances of bumble bees pollinating plants within 20 minutes! Bumble bees are broadly polylectic; they are attracted to a wide range of plant families that are high in nectar and pollen.

In comparison, not only were hairy belly bees far less abundant overall, they completely disappeared from our observations in September in uncultivated sites (Figure 4b). In two of the four months, we observed a significantly higher number of these bees in cultivated garden sites than in uncultivated sites (August, p=0.043; September, p=0.011).

Finally, the seasonal occurrence of honeybees in cultivated and uncultivated sites exhibited a different trend (Figure 4c). Observed honeybee abundance was significantly higher in gardens in June (p=0.036) and August (p=0.013) than in their neighbouring uncultivated areas. Interestingly, honeybee abundance in both habitat types peaked in September; this may be due to a seasonal behaviour as the summer is ending and weather is changing.

Table 2. Flowering plants on which pollinators were observed foraging in gardens and uncultivated areas during individual surveys within Kamloops.

| Month | Uncultivated Plants | Garden Plants |
|---|---|---|
| June | *Achillea, Gaillardia, Tetradymia, Crepis, Medicago, Matricaria, Erigeron, Sisymbrium, Artemisia, Calochortus, Castilleja, Melilotus, Rosa*<br>***13 Genera*** | *Nepeta, Rubus, Achillea, Potentilla, Phacelia, Geranium, Rosa, Allium, Trifolium, Allaria, Papaver, Peony, Salvia, Aquilegia, Dianthus, Weigela, Bellis, Matricaria, Campanula, Thymus, Hydrangea, Robinia, Centaurea, Symphytum, Calendula, Bidens, Spirea, Borago, Cosmos, Hyssopus, Fagopyrum, Valeriana, Ficaria, Hemerocallis, Lobularia, Aquilegia, Levisticum, Thymophylla, Cerastium, Dicentra, Tagetes, Helianthus, Ranunculus, Antirrhinum, Lobelia, Amium, Dictamnus, Penstemon, Sambuca, Tragopogon, Fuschia, Linum, Hieracium, Heuchera*<br>***44 Genera*** |
| July | *Medicago, Achillea, Castilleja, Centaurea, Calochortus, Antennaria, Arctostaphylos, Gaillardia, Grindelia*<br>*9 Genera* | *Allium, Nepata, Sedum, Hyacinthoides, Rudbeckia, Fragaria, Lychnis, Salvia, Aquilegia, Heuchera, Calendula, Thymus, Geranium, Achillea, Stachys, Echinaceae, Oreganum, Chrysanthemum, Levisticum, Alyssum, Hemerocallis, Tagetes, Veronicastrum, Gilia, Cerinthe, Eryngium, Rubus, Monarda, Trifolium, Spirea, Helianthus, Solanum, Papaver, Rosa, Anethum, Borago, Coriandrum, Lavendula, Sutera, Cucurbita, Cucumis, Mentha, Phacelia, Ocimum, Dianthus, Hyssopus, Anagallis, Campanula, Dahlia, Penstemon, Potentilla, Cosmos, Hosta, Cornus, Digitalis, Scabiosa, Delphinium, Eruca, Phlox, Polemonium, Bidens, Lamium, Lysimachia, Veronica, Stellaria, Liatris, Asclepias*<br>***57 Genera*** |
| August | *Medicago, Chrysothamnus, Achillea, Centaurea, Grindelia, Cirsium, Solidago, Symphyotrichum, Artemisia, Gaillardia, Linaria*<br>***11 Genera*** | *Nepeta, Rosa, Solidago, Echinaceae, Oreganum, Scabiosa, Monarda, Sedum, Rudbeckia, Achillea, Salvia, Perovskia, Calendula, Lavendula, Cucumis, Cucurbita, Papaver, Cosmos , Dianthus, Helianthus, Hyssopus, Mentha, Cirsium, Potentilla, Hosta, Linum, Uvularia , Clematis, Centaurea, Stachys, Cornus, Geranium, Veronica, Tagetes, Ocimum, Phaecelia, Campanula, Borago, Alyssum, Alcea, Trifolium, Coriandrum, Begonia, Rubus, Hyacinthoides, Cichorium, Goniolimon, Spirea, Petroselinum, Solanum, Delphinium, Bidens, Vicia, Phlox, Taraxacum, Eryngium, Antirrhinum, Gypsophila, Myosotis, Chrysanthemum, Heliopsis, Hieracium, Dahlia, Zinnia, Zea, Sutera*<br>***66 Genera*** |
| September | *Medicago, Chrysothamnus, Achillea, Centaurea, Grindelia, Heterotheca, Lactuca, Cirsium, Aster*<br>***9 Genera*** | *Nepata, Sedum, Heuchera, Oreganum, Perovskia, Hyssopus, Astilbe, Fragaria, Hosta, Mentha, Hydrangea, Geranium, Petunia, Begonia, Rudbeckia, Helianthus, Alyssum, Ocimum, Heliopsis, Daucis, Dianthus, Centaurea, Aster, Sisymbrium, Zinnia, Echinaceae, Cosmo, Achillea, Lavendula, Alcea, Tagetes, Potentilla, Antirrhinum, Chrysanthemum, Goniolimon, Phaseolus, Monarda, Portulaca, Bidens, Gaillardia, Gypsophila, Curcurbita, Dahlia, Cichorium, Sutera, Galinsoga, Salvia, Borago*<br>***48 Genera*** |

Within the two habitat types, pollinators were observed on very different flowering plant genera. Only a few forage genera such as ***Achillea, Centaurea, Gaillardia***, and ***Rosa***, were common to both habitat types. ***Achillea*** and ***Centaurea*** hosted the most pollinators in both cultivated and uncultivated areas. As garden variety flowers are often hybridized or difficult to key out to species, we maintained a genus level taxonomic precision to ensure accuracy in our records. Each month, between 44 and 66 different genera were observed with pollination events while only 9-13 genera were observed in uncultivated areas (Table 2). Overall, both environments had very different genera, but the cultivated gardens showed a much higher diversity of flowering genera every month throughout the summer.

# RESULTS ACROSS YEARS (2017-2019)

Although this report is meant to summarize the results of our 2019 monitoring program (see our two prior final reports for more detailed information concerning 2017 and 2018 monitoring results from Battel 2017, Abbott 2018, available https://www.mgabc.org/content/thompson-shuswap.), it is interesting to compare general trends across years (Figure 5).

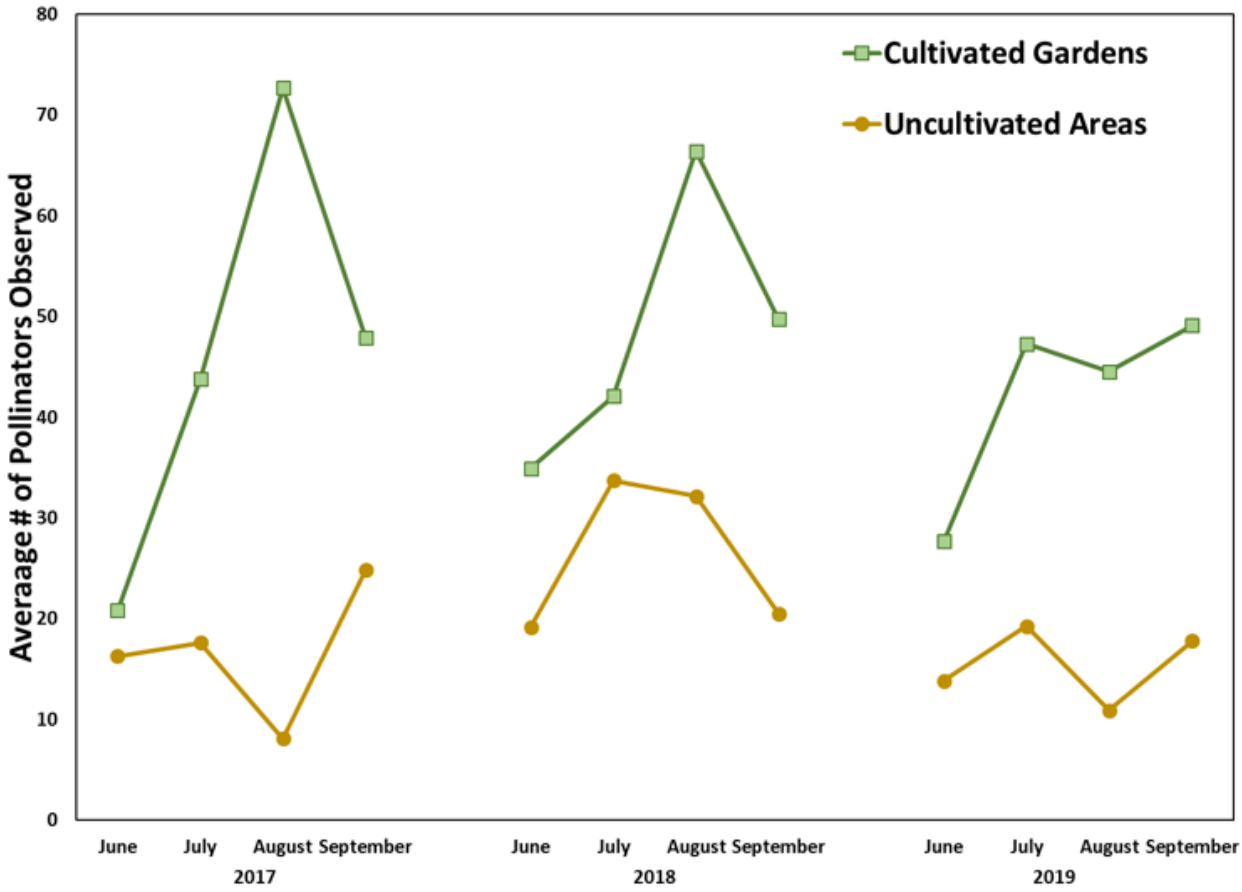



Figure 5. The average number of pollinators seen in cultivated garden and uncultivated area surveys for the summer of 2017-2019 in Kamloops, BC

Overall, the 2019 seasonal trend in pollinator abundance appears to be unique as compared to those we observed in 2017 and 2018. Although we observed a drop in August pollinator abundance in uncultivated areas (which was also observed in 2019), we did not see a corresponding increase in pollinator abundance in cultivated areas that we observed in both 2017 and 2018 (Figure 5). One clear trend is that gardens have been active with pollinators throughout the summer for every year the surveys have occurred.

# LONG TERM GROUP SURVEY RESULTS

Two group surveys were completed this year in cultivated parks as a continuation of an ongoing yearly survey. Group surveys were carried out at Riverside and McArthur Island Parks on the same weekend as in the previous years—in order to provide as much consistency within our sampling effort. It should be noted that even with the consistency in date over the years, McArthur Island showed a decrease in temperature and an increase in wind conditions over the years. Riverside Park indicated a substantial decline in all pollination guilds except honeybees and "other" guilds. This year in McArthur Island, we observed fewer individual pollinators than in previous years for all pollinator guilds except honeybees and wasps.

Table 3. Survey conditions for the 2017-2019 Kamloops park group surveys.

| | Riverside Park | | | McArthur Island | | |
|---|---|---|---|---|---|---|
| **Year** | 2017 | 2018 | 2019 | 2017 | 2018 | 2019 |
| **Date** | July 15th | July 14th | July 13th | July 29th | July 28th | July 27th |
| **Temp (°C)** | 25 | 22.3 | 23.7 | 30 | 24 | 19.5 |
| **Wind** | Gentle Breeze | Light Air | Light Air | Calm | Light Air | Light Breeze |
| **Sky** | Partly Cloudy | Clear | Cloudy | Clear | Clear | Cloudy |

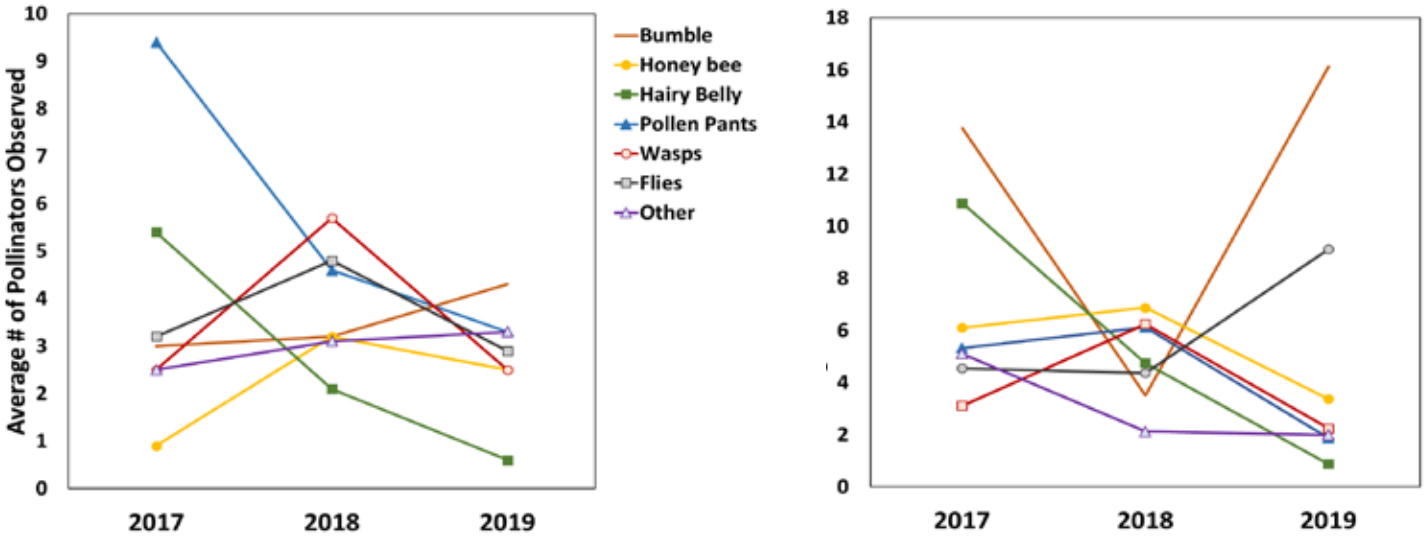
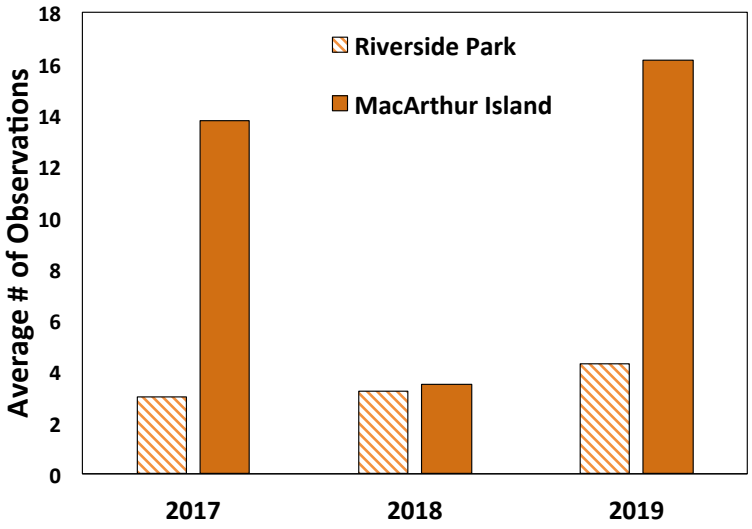



Figure 6. The average number of pollinators seen in each guild at Riverside Park (a) and McArthur Island (b) from 2017-2019 citizen science group surveys.

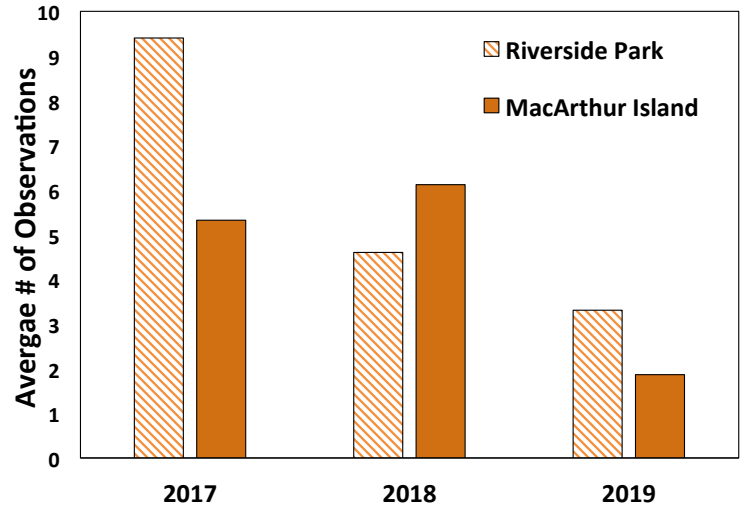
Figure 7 .Significant trends found for bumble bees (a), pollen pants bees (b), and hairy belly bees (c) over the past three years in two parks in Kamloops, BC.

a) Bumble bees



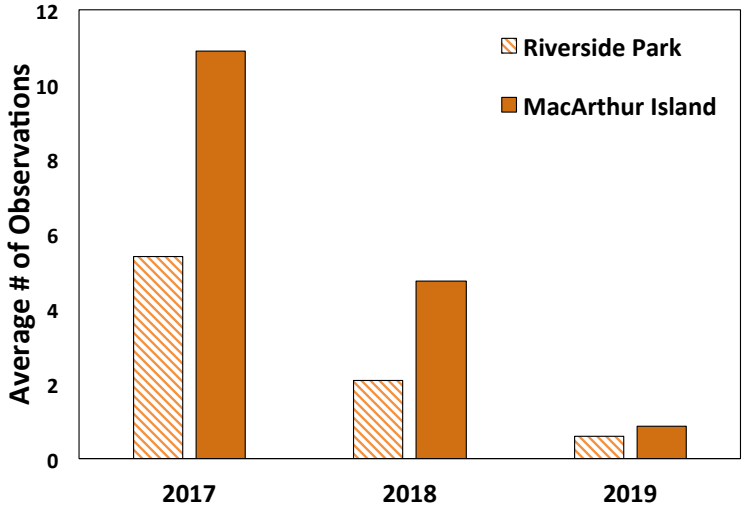

There were also significant differences in pollinator abundance between the two surveyed parks. In 2017 and 2019, bumble bees were 4 times more likely to be observed in McArthur Island than Riverside Park (Figure 7a). In 2018 there was a significant dip in observations (p=0.054), followed by a significant increase the following year (p=0.024) at McArthur Island. The reason for the dip in observations is unknown, but it may simply be due to slight changes in wind, cloud cover, or shade temperature. It should be noted that the wildfires of 2017 and 2018 led to erratic sampling conditions, including wildfire smoke.

b) Pollen Pants bees



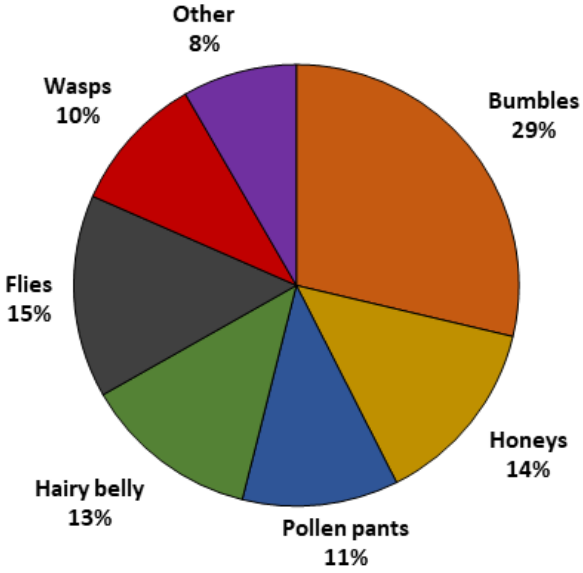

In all three years, we observed pollen pants bees (solitary ground nesting bees) foraging on flowers in both Riverside and McArthur Island Parks, but their observed average abundance has decreased over time (Figure 7b). Since 2017, the number of observed pollen pants bees has dropped from 9.4 to 3.3 (p=0.057) in Riverside and from 5.3 to 1.9 (p=0.088) in McArthur Island. The slight increase in McArthur Island's 2018 sightings paired with marginal statistical significance in both parks (p>0.05) suggests that this these population trends may be natural or due to the conditions of the survey. Future studies and monitoring would be beneficial to ensuring that our pollen pants populations remain healthy.

c) Hairy Belly Bee




The most unsettling trend found over the past three years is the decline of hairy belly bee observations (solitary cavity nesting bees) in both Riverside and McArthur Island Park (Figure 7c). Riverside Park sightings have declined from 5.4 to 0.6 (p=0.001) per observer with only 30% of 2019 surveyors seeing any bees of this guild compared to 90% in 2017. McArthur Island saw an 80% drop from 2017-2019 in the number of hairy belly bees seen. Although these surveys are only a snapshot of each year, and other daily factors may have affected the decline in observations, these trends should still be a cause for concern because trends were seen in both Riverside and McArthur Island Park.

a) McArthur Island Park




b) Riverside Park

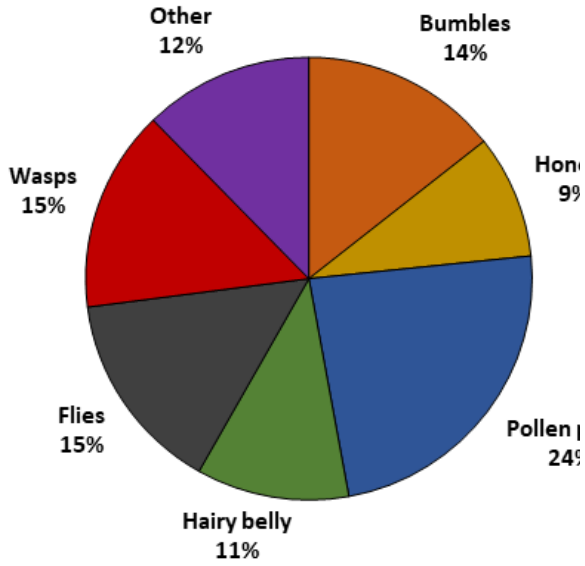



Figure 8. The average percentage of pollinator observations at McArthur Island Park (a) and Riverside Park (b) found from 2017-2019 citizen science surveys.

In our 2017-2019 surveys in McArthur Island, we observed an average of 39.8 pollinators per survey (all guilds combined), with bumblebees making up 29% of the observed pollinators. "Other" pollinators—such as beetles and butterflies—made up the smallest portion of pollinator observations with only 8% of the total sightings. The other five guilds each made up between 10-15% of the population (Figure 8a).

In contrast, our surveys of Riverside Park resulted in observations of an average 24.4 pollinators per survey with pollen pants being the most popular pollinator making up 24% of observations. Honeybees had the lowest number of observations in Riverside Park, totalling 9% of observed pollinators. In 2018, a feral honeybee hive was present at Riverside Park, but few honeybees were observed pollinating during the survey. An explanation could be that flowers within the park were not providing resources that the bees needed. Each of the other guilds made up between 11-15% of observations (Figure 8b).

## Natural Areas Group Surveys and Trapping Results

Throughout the summer, three sites were chosen to set up traps in an effort to create a native bee species list for Kamloops, BC. The traps were set from May 28th-August 13th and surveys were done once at each site throughout the season (Table 4). The conditions for all the group surveys were similar with temperature ranging between 19.8-23.3 degrees, light breeze, and clear to partly cloudy conditions. Pollinators collected in traps were taken from the week surrounding the surveys to ensure that the same seasonal pollinators were present.

Table 4. Location and survey conditions for natural park surveys associated with trapping surveys in Kamloops, 2019.

| Site | Date | Surveys | Temp (°C) | Wind | Sky |
|---|---|---|---|---|---|
| Barnhartvale Nature Park | May 21st 2019 | 12 | 19.8 | Light Breeze | Partly Cloudy |
| Sun Rivers Moonscape Trail | June 15th 2019 | 11 | 23.3 | Light Breeze | Clear |
| Mt. Lolo Private Land | July 14th 2019 | 12 | 22.1 | Light Breeze | Partly Cloudy |

Table 5. The average number of pollinators observed from each guild in three natural park citizen science group surveys in Kamloops, 2019 (n=12).

| | Barnhartvale | Sun Rivers | Mt. Lolo |
|---|---|---|---|
| Bumble Bees | 1.17 | 0.27 | 5.33 |
| Honeybees | 0.42 | 0.18 | 0.08 |
| Hairy Belly Bees | 2 | 4.91 | 3.67 |
| Pollen Pants Bees | 0.25 | 1.91 | 0.17 |
| Flies | 0.5 | 0.27 | 1 |
| Wasps | 0.58 | 1.09 | 0.42 |
| Other | 11 | 4.27 | 10.33 |
| **Total** | **15.92** | **12.9** | **21** |

Dallas-Barnhartvale Nature Park had an average of 15.92 observations per survey with the highest number of honeybee and "other" guilds observed (Table 5). The higher average of honeybee observations may have been due to honeybee hives situated less than 1km from the survey sites. This area had a large amount of leafy spurge (Euphorbia esula) on which abundant ants and beetles were nectaring which might explain the high number of "other" pollinators (Table 5).

Sun Rivers had the fewest pollinator observations with an average of 12.9 pollinators per survey. This site did show the greatest average for pollen pants, hairy belly bee, and wasp observations. These guilds are solitary and may be more inclined to survive the drier Sun Rivers area, as it is a south facing slope dominated by bluebunch wheatgrass (***Pseudoroegneria spicata)*** and big sage brush (***Artemisia tridentata***).

The site with the highest number of observations was Mt. Lolo. Each survey had an average of 21 pollinator observations and the highest average of bumble bees per survey (5.33) many of which were observed on Bee Balm (Monarda sp, Table 6). This site also had the most fly observations per survey and the least honeybee, pollen pants bee, and wasp observations. One unique character about this site is that it frequently had cattle on it, which may have consequences related to high soil disturbance. Mt. Lolo was the highest elevation site at 903m with a more moist ecosystem as compared to the other two sites, with had an active creek and aspen trees.

Table 6. Plants on which pollinators were observed in the three natural area studies in the Kamloops, 2019.

| Barnhartvale | Sun Rivers | Mt. Lolo |
|---|---|---|
| *Achillea millefolium* | *Achillea millefolium* | *Achillea millefolium* |
| *Antennaria* | *Calochortus macrocarpus* | *Calochortus macrocarpus* |
| *Asclepias speciose* | *Erigeron sp* | *Campanula sp.* |
| *Boechera sp.* | *Gaillardia sp.* | *Centaurea maculosa* |
| *Castilleja thompsonii* | *Heterotheca* | *Erigeron sp.* |
| *Euphorbia esula* | *Linaria genistifolia sp. Dalmatica* | *Gailardia sp.* |
| *Linum sp.* | *Medicago sp.* | *Lomatium sp.* |
| *Lomatium sp.* | *Opuntia fragilis* | *Medicago lupulina* |
| *Sysimbrium sp.* | *Circium sp.* | *Monarda sp.* |
| *Vicia sp.* | | *Potentilla sp.* |
| *Lithospermum sp.* | | *Rosa sp.* |
| | | *Stellaria sp.* |
| | | *Symphoricarpos albus* |
| | | *Sysimbrium sp.* |
| | | *Verbascum thapsus* |
| | | *Circium sp* |

With the trap samples, a list of bumble bees and native bee species was created. Kamloops is home to at least 15 of the 32 BC native bumble bee species including the Western Bumble Bee (Bombus occidentalis) which is a species at risk according to Committee on the Status of Endangered Wildlife in Canada (COSEWIC).The samples collected provide the first baseline list for native bee species around Kamloops which is a big step towards understanding and taking appropriate actions to help local pollinator communities to thrive.

## List of Solitary or Semi-Social Bee Species Trapped in Kamloops and Archived at Thompson Rivers University

### Ground Nesting Bees (Pollen Pants Bees)

| Halictidae Family | Andrenidae Family | Apidae Family | Colletidae Family |
|---|---|---|---|
| *Halictus farinosus* | *Andrena prunorum* | *Anthophora urbana* | Colletes |
| *Halictus tripartitus* | | *Anthophora bomboides* | |
| *Agapostemon texanus* | | *Anthophora ursine* | |
| *Agapostemon virescens* | | *Anthophora terminalis* | |
| *Lasioglossum* | | *Melissodes agilis* | |
| *Lasioglossum sisymbrii* | | *Melissodes microsticta* | |
| *Dufourea maura* | | *Melissodes rivalis* | |
| | | *Diadasia australis* | |
| | | *Ceratina* (nests in wood) | |

| Cavity Nesting Bees (Hairy Belly Bees) | Bumble bees |
|---|---|
| **Megachilidae family** | *B. appositus* |
| *Dianthidium* | *B. bifarius* |
| *Osmia* | *B. centralis* |
| *Megachile perihirta* | *B. fervidus* |
| *Hoplitis albifrons* | *B. flavifrons* |
| | *B. huntii* |
| **Cuckoo bees (Cleptoparasitic Bees)** | *B. insularis,* |
| *Melecta* | *B. melanopygus* |
| *Sphecodes* | *B. mixtus* |
| *Nomada* | *B. nevadensis* |
| *Coelioxys* | *B. occidentalis* |
| | *B. perplexus* |
| | *B. rufocinctus* |
| | *B. ternarius* |
| | *B. vagans* |

### List of Other Bees Documented in Participants' Gardens in Past Years

*Bombus vosnesenskii*
*Halictus rubicundus*
*Andrena subgenus Cnemidandrena*
*Heriades*
*Anthidium manicatum* (non-native),
*Megachile rotundata* (non native)

# Conclusion

This citizen science project generated baseline data regarding pollinator abundance and diversity in participants' backyards adjoined to uncultivated areas, as well as cultivated parks, and natural areas. The project created a community of citizen scientists interested in the health and well being of native pollinators and are also aware of the diversity and abundance of our native bees.

The data collected over the past three years clearly indicate that Kamloops is home to a diverse mix of pollinators. The lack of information surrounding native bee abundance and diversity has often meant that honeybees become the focus of municipal policy aimed at maintaining or increasing pollination services. This project revealed that Kamloops gardens are visited by many pollinators from many different functional groups. There is also a high diversity of bumble bees located in our area. The author believed that the preservation and creation of habitat for hairy belly bees (cavity nesting bees) and pollen pants bees (ground nesting bees) within city parks should be a top priority. Some changes that may help include:

a. Promoting the use of native pollinator friendly plants in city projects and backyard gardens,

b. Creating pollinator gardens throughout the city that include suitable nesting habitat or nesting boxes within them,

c. Identifying and protecting current pollinator foraging habitat and nesting,

d.Installing cavity nesting bee nests or drilling holes in fallen logs

e. Implementing and funding community events that educate the public of the importance and the diversity of native bee populations within Kamloops, BC,

f. Continuing citizen science and independent research on local native bees.

Citizen science has been a very important and useful tool throughout this project. It has not only generated data and numbers, it has cultivated an increased understanding of pollinator health, diversity and abundance. Many of the citizen scientists have been making changes like the ones listed above to their personal gardens in hopes of attracting more native bees to their yards. The amount of excitement and love that they had for this project has helped to keep it running for the past three years.

For future studies it would be important to answer such questions as: What plants provide the best nectar and pollen sources for pollinators? Where are pollinators nesting within our urban landscape? Do honeybees affect our native pollinators? Many of the participants have been pondering these questions over the course of this study. Understanding where native pollinators fit into our urbanized city will be important as Kamloops continues to expand into our pollinators' habitats. It is hoped that the City of Kamloops and Tk'emlúps te Secwépemc Band asks these questions before urbanization eliminates these important sites.

Mae Frank, 2020.

All photographs by Elaine Sedgman
except for:
Susan Hammond:
Pollinator game, front cover

Master Gardeners Association of BC
Thompson Shuswap Chapter

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