BEES OF TORONTO

A GUIDE TO THEIR REMARKABLE WORLD

• City of Toronto Biodiversity Series •

WINNER OALA AWARD FOR SERVICE TO THE ENVIRONMENT

TORONTO

ROYAL ONTARIO MUSEUM

YORK UNIVERSITÉ UNIVERSITY

Live green Toronto

Imagine a Toronto with flourishing natural habitats and an urban environment made safe for a great diversity of wildlife species. Envision a city whose residents treasure their daily encounters with the remarkable and inspiring world of nature, and the variety of plants and animals who share this world. Take pride in a Toronto that aspires to be a world leader in the development of urban initiatives that will be critical to the preservation of our flora and fauna.

The Packer Collection at York University (PCYU) contains one of the largest research collections of wild bees in the world.

A female metallic green sweat bee, *Augochlora pura*, visits a flower in search of pollen and nectar for herself or to construct a pollen ball, which she will later lay an egg upon. This species makes nests in wood rather than in the ground like most of its relatives. Females of this bee species are solitary - working alone - tirelessly foraging on flowers to increase her contribution to the number of bees in the following generation. Active from late spring to late summer, this bee can have two or more generations per year with only mated females overwintering as adults. Most of Toronto's bees spend the winter as fully grown larvae in the nest, emerging once per year in sync with the timing of the native flowers they prefer.

Cover photo: *Augochlora sp. – Amro Zayed*

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Agapostemon virescens on a *Campanula* sp. flower.
Amro Zayed

"Indeed, in its need for variety and acceptance of randomness, a flourishing natural ecosystem is more like a city than like a plantation. Perhaps it will be the city that reawakens our understanding and appreciation of nature, in all its teeming, unpredictable complexity." – Jane Jacobs

Long horned bee, *Melissodes sp.* on Sunflower.
Sheila Dumesh

"So important are insects and other land-dwelling arthropods that if all were to disappear, humanity probably could not last more than a few months. Most of the amphibians, reptiles, birds, and mammals would crash to extinction about the same time. Next would go the bulk of the flowering plants and with them the physical structure of most forests and other terrestrial habitats of the world." – E. O. Wilson in "The Diversity of Life" (1992).

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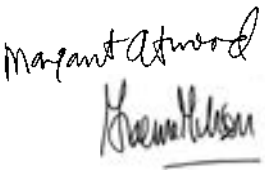
Welcome!

To encourage the celebration of all life on earth, the United Nations declared 2010 to be the Year of Biodiversity. We congratulate the City of Toronto for honouring this special year with this Biodiversity Series celebrating the flora and fauna of our city. Each booklet within the series – written by dedicated volunteers, both amateurs and professionals – offers Torontonians a comprehensive look at a major group of flora and fauna within our city.

We hope that this Biodiversity Series will achieve its main goal: to cultivate a sense of stewardship in Toronto area residents. If each of us becomes aware of the rich variety of life forms, their beauty and their critical roles within the varied ecosystems of Toronto, we will surely be inspired to protect this natural heritage. After all, our own health and ultimately our very survival is linked to the species and natural spaces that share the planet with us. Without plants, there would be no oxygen; without the life of the soil, there would be no plants; without unpolluted fresh water, we would die.

While there are many organizations actively engaged in protecting our city's flora and fauna, the support of ordinary citizens is critical to the conservation of our natural habitats. We hope you'll take a walk in one of our parks and open spaces, lower your blood pressure, look around you, and enjoy the diversity of trees, animals, fishes, birds, flowers, and even fungi that flourish among us.



With best wishes,
Margaret Atwood and
Graeme Gibson
January 2011

An Introduction to the Bees of Toronto

Bees are beautiful, bees are diverse, bees are important. But most people don't recognize most bees for what they are – essential components of almost all terrestrial ecosystem. And then there's the fact that many people think small bees are flies or wasps, or that some flies and wasps, such as yellowjackets, are bees. This isn't surprising, as evolutionarily, bees are vegetarian wasps. But they are all important. The only people who might justifiably not care about bees are those who are allergic to stings (though many bees cannot sting) and whose diet include nothing but seafood. In a world without bees, there would be far fewer fruits and vegetables, coffee would be a lot more expensive, there would be much fewer nuts and berries for birds and bears, and most wild plants would be incapable of sexual reproduction. While honey bees get most of the credit, a considerable amount of agricultural pollination is performed by wild bees. In Toronto, backyard fruits and vegetables are pollinated mostly by wild bees. So, it is a good thing that there are over 350 species living within the GTA. These vary from large and quite scary looking Virginia Carpenter bees that nest, mostly alone, in wooden fences to tiny little sweat bees that live in small colonies in the dirt in your backyard or even in a flowerbox.

This guide aims to introduce the reader to the great variety and spectacular beauty of these essential, yet often maligned, little insects.

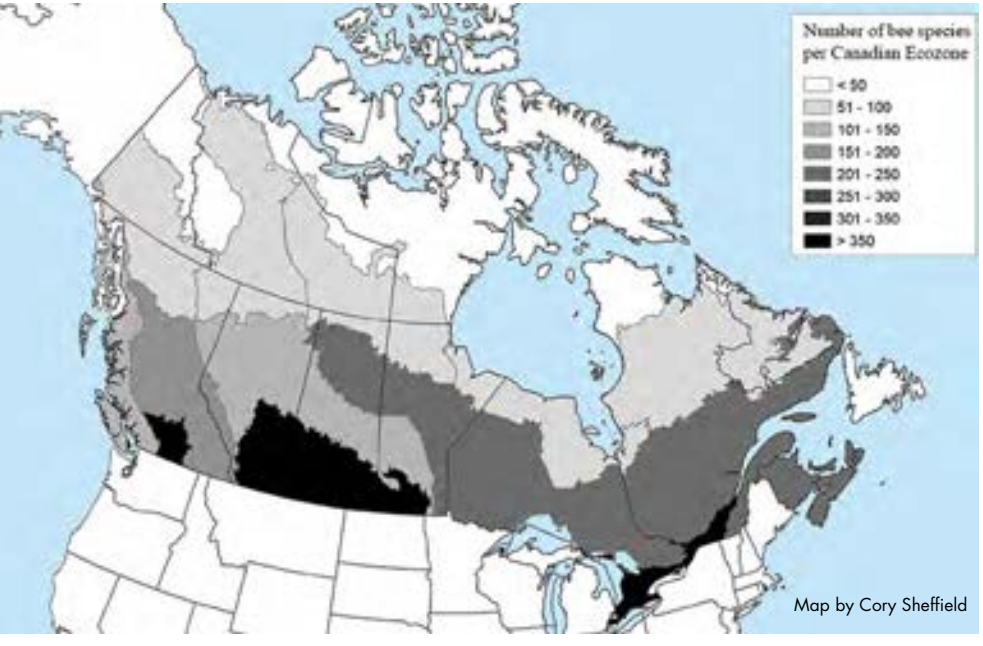
City of Toronto Biodiversity Series

Bees of Toronto is part of the Biodiversity Series developed by the City of Toronto in honour of the Year of Biodiversity 2010. A number of the non-human residents of Toronto (defined here as a 50 km radius from the Royal Ontario Museum) will be profiled in the Series. It is hoped that despite the severe biodiversity loss due to massive urbanization, pollution, invasive species, habitat loss and climate change, the Biodiversity Series will help to re-connect people with the natural world, and raise awareness of the seriousness that biodiversity loss represents and how it affects them directly. The Series will inform residents and visitors of opportunities to appreciate the variety of species inhabiting Toronto and how to help reduce biodiversity loss by making informed individual decisions.

Introduction to the Wonderful World of Bees

Bees are a very diverse group of organisms, with currently over 20,000 species in the world! There are many new species being discovered every year as scientists go on expeditions to remote areas in search of these flying insects. There are over 800 species in Canada, with over 350 in the General Toronto Area. Since bees rely on flowers as their food source, proximity to floral resources is very important. Although some bees can fly long distances, most nest close to their floral resources to reduce foraging times and energy expended commuting between food and home. When it comes to food preferences, some bees are generalists while others are specialists. Generalists (also called polylectic species) will feed on a wide variety of different plants, while specialists (oligolectic species) feed only on one or a few closely related plant species. It is, therefore, more difficult for specialist bees to survive if their specific flowers of choice disappear. Also, most of these specialist relationships are mutualistic because the plant is pollinated by the activities of the specialist bee.

Variation among bee species is vast. Their colour, size, and shape differ substantially. For example, the *Augochlora* bee which is commonly seen in Toronto in early summer, is metallic green! The most common and numerous genus in Toronto, *Lasioglossum*, includes black as well as dull green members. Other bee species can have blue, red, orange, yellow, or cream coloured markings on the body. Size is another variant – bees range from less than 2mm to nearly 4cm in body length! The smallest bee species is *Perdita minima* (at 1.6mm), while the largest is *Megachile pluto* (at 39mm).



Map by Cory Sheffield

A very large bee *(Bombus)* and a very small bee *(Perdita)*.
Sheila Dumesh

Misconceptions & Myths About Bees and the Fear of Getting Stung

The fear of bees, called “Melissophobia” or “Apiphobia”, is a common one in people. It is generally based on misconceptions; however, some people are extremely allergic to bee stings and must always be prepared with an epipen or other antihistamines.

When many people hear the word “bee”, they think of stinging insects, often seen hovering around their picnics in the summer. But this is an error of identification. Most times people think they are being “chased” by a bee, it’s actually a yellowjacket (a type of wasp). Yellowjackets are carnivorous, unlike bees (which are vegetarians), which is why they are present in the park and around your food while you eat. Bees are not usually interested in food or sweet drinks while they are busy visiting flowers for nectar and pollen! Many people believe that bees will chase and sting you and that they can recruit members of their colony to join them in this “chase”. Bees will rarely sting. They are not aggressive unless provoked and, as they are not territorial, they will not chase to sting for no reason. Wasps are much more aggressively defensive and therefore often more likely to sting when their nests are approached.

Contrary to many beliefs, not all bees are yellow and black. Bees come in a multitude of colours, from red to blue to metallic green! Also, not all bees are fuzzy. Although many bees are hairy to some degree, most are not as “fuzzy” as bumble bees and, therefore, many are often confused with wasps and flies. A good way to tell bees apart from flies is by their two pairs of wings (flies only have one set), and longer antennae (flies usually have very short ones).

Myth: Bees are most important for honey and wax production.

Fact: Only honey bees make honey and they constitute less than .05% of all bee species in the world! Some other bees might make a honey-like substance, but it’s used to feed their young and is not produced in mass quantities.

Myth: ALL bees can sting.
Fact: Only female bees can sting, as the “stinger” is a modified ovipositor (and only females lay eggs), and even many female bees cannot sting.

Myth: All bees die after they sting.
Fact: This only applies to the worker honey bee. All other bees do not lose their sting after stinging. They simply fly away.

Apis mellifera
Amro Zayed

Bombus sp.
Amro Zayed

A First Nations Legend: How the Honey Bee Got its Sting

Back in ancient times when the people were more pure and could converse with the animals and the Creator would visit with them, the people asked the Creator for something that was 'sweet' to the taste. So the Creator sent the Bee, but the Bee had no stinger. Down came the Bee and it found a suitable tree in which they could build a nest, live in, produce honey, multiply and feed its young. Soon the people came to the Bee and asked for some of the sweet syrup and the Bee gave each person a container-full. The people loved the syrup and greedily ate it, then went back to the Bee for more.

But the Bee replied, 'I have no more to give you for a while. You will have to wait.' The people were not happy, as they craved the sweet syrup. So they called upon the Creator, saying, 'the Bee does not give us enough of the golden syrup. We want more!!!' The Creator listened and sent down the Flower People. The Flower People began to spread all types of flowers across the land giving the Bees greater access and variety of flowers to pollinate and make more honey. The Flower People spread all kinds of beautiful wild flowers around to attract the Bees; bright blue, red, orange, purple and yellow. More Bees were created to help pollinate the flowers. The hive grew to be very large. The people seeing how big the hive was went to get more of the sweet syrup. So the Bees gave all the syrup to the people but left enough to feed their young. The people devoured the syrup and wanted more. The Bee responded, 'We don't have anymore, you will have to wait.'

The people were angry and asked the Flower People to make more flowers so they could have more of the golden syrup to eat. The Flower People responded, 'We made all the flowers we could and they are all pollinated. You will have to wait until Spring.' 'No, said the people, 'We want more now!!' So they went back to the Bee's hive and tore it apart killing almost all of the Bees and taking the syrup. The remaining Bees were angry. They asked the Creator what to do. The Creator was also annoyed at the behaviour of the people, so he told the Flower People to create some 'briar bushes' and the Bees to eat the briars.

The Bees did as the Creator said, they ate the briars and these were transformed into stingers. The Flower People created an entire briar patch around the Bee's tree. The next day, the people came back and started toward the Bee's hive for more syrup; but the briars around the tree scratched and tore at their bodies. Some of the people made it through the briars to the hive. Covered in welts, they yelled at the Bees, 'Give us some more syrup now, or we will do the same as we did yesterday, kill your young and destroy your home!' The Bees became angry and a loud hum came from the hive in the tree, and out they swarmed. The Bees stung the people all over until they were covered in welts and sent them running.

After that day, the people treated the Bees, flowers, and plants with great respect and always promised to replace whatever they asked for and never be greedy or take more than they needed.

First Nation's Perspectives on Bees

While stingless honey bees were revered by the Maya and other Mesoamerican cultures, manageable bees with large colony sizes capable of producing large amounts of honey were not found in Canada until the introduction of the honey bee in the 1600's. Nonetheless, the importance of bees for pollination, and the small amounts of honey produced by bumble bees, have been well known to indigenous cultures. First nations peoples also had a clear understanding that declines in berry production result from a decrease in bee populations.

More recently, a major impact of global warming has been an increase in the diversity of insects, especially in northern habitats where species for which there is no word in the local language are being discovered with increasing frequency. This includes an increasing diversity of bees. In some first nations languages the words used for bees are of a form which demonstrates a clear understanding that these insects are important: bees have been understood to play an important role in the environment by first nation's people for millenia.

Bees have been considered as important by first nation's communities for reasons additional to their ecological role. There are legends associated with the healing powers of bees and other insects and their causing of people coming back to life after death, just as the insects seemingly come back to life after winter. Bumble bees are among those invertebrates that have been considered by shamans as "helping spirits" and bees and other small organisms are thought to have the powers to connect different levels of reality and mediate among them. Fast flying insects are thought to give invulnerability through transferring the difficulties associated with hitting the insect

King George VI and Queen Victoria visiting a First Nations community in Canada (May 26, 1939).

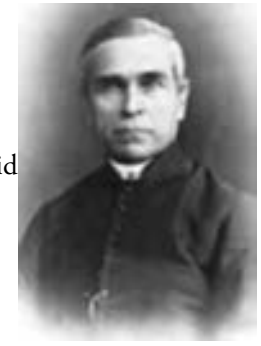
to the person wearing an amulet that incorporates bodies of insects. A bee accompanied by its entire brood is considered to provide greater vitality, increasing longevity and providing greater prowess in fisticuffs. Similarly, the incorporation of bees into clothing is thought to make childbirth easier.

Bees are recognised as being dangerous in some legends with the spirits of "big bees" sometimes being associated with assisting cannibals. Bumble bees have also been considered to play an important role in initiation into shamanism, possessing the ability to turn their buzzing into an earth-shaking experience.

Both beneficial and harmful potential of bees are also indicated in the interpretation of dreams, sometimes suggesting that death would soon come, sometimes predicting the return of fish.

Early Toronto Bee-ologists

Studies of bees (referred to as melittology) generally lagged behind investigations of birds, mammals and butterflies in Ontario. While Léon Provancher (1820-1892) was working on the bees (and other insects) of Quebec in the mid 1800's (and has a natural history society named after him) and Charles Robertson was studying the floral relations of bees while travelling by horse and buggy in Carlinville, Illinois in the late 1800's, there are few early records of melittological investigation from Ontario.



Léon Provancher

Some of the earliest studies of native bees from English-speaking Canada came from the pen of Carl Edmund Atwood (1906-1993), father of one of Canada's best known literary figures Margaret Atwood. His first papers on bees were published in the early 1930's, before he completed his PhD at the University of Toronto in 1937. While he spent much of his entomological career dealing with forest insect pests (some descriptions of these activities can be gleaned from some of Margaret's novels), he was involved with some of the more detailed surveys of bees of Ontario through his PhD student, Gerd Knerer, describing many new species, especially from the north.

The University of Toronto kept up the tradition of native bee research with sweat bee behaviour studied by Knerer and a wide range of topics related to bumble bees investigated by the productive Christopher Plowright's laboratory which also generated several other experts who have worked at Canadian Universities. Bee research continues at the University in the laboratory of James Thomson, who studies bee-flower interactions and did some of his training in Plowright's laboratory.

A separate locus of bee research is found at York University where Laurence Packer's laboratory has been studying bees since 1988. Most of this booklet was written by him, his friends, colleagues and students. Somewhat further west, Peter Kevan has recently retired from the University of Guelph after a career studying pollination, and Miriam Richards at Brock leads a lively, diverse research team with special emphasis on carpenter bees (great and small) around St. Catherine's and sweat bees in Ontario and Europe.

Margaret Atwood with her father, Carl Edmund Atwood, spending time in the remote outbacks of Ontario (circa 1942). Carl was an entomologist.

After doing a postdoctoral stint with Chris Plowright in 1979-80, James Thomson worked at the State University of New York at Stony Brook before returning to the U of T in 2000. He continues to pursue long-term field studies of pollination biology in Colorado, but several of his graduate students have worked in Ontario. In the winter, his lab switches to behavioural studies of commercial bumble bee colonies in laboratory flight cages. Most recently, the lab has developed artificial flowers that dispense and receive "pollen analogues"—actually, powdered food dyes that can be quantified by spectrophotometry. The flowers provide replenishing nectar by a simple capillary system, so they can be produced cheaply and deployed in large arrays that provide bees with realistic foraging challenges.

The Joys of Bee Watching

Busily scurrying over flowers, the pollen and nectar collecting activities of bees are easily seen by anyone with the time to stop and watch the flowers. While identification of most of our bees to the species level is beyond the capacity of most casual observers, there are some that can be told apart from all others easily, sometimes in combination with knowledge of the flower visited. Field guides to the most commonly seen bees, the bumble bees have been developed and the images presented in this booklet, along with some online guides that are being developed, will assist those who are fascinated by bees.

Female bees visit flowers for two reasons – collecting food for their offspring and feeding themselves. Both activities require pollen and nectar although the relative importance of the two ingredients is different. Adult female bees need small amounts of protein from pollen to help them develop eggs and large amounts of nectar to fuel their activities. The larvae need a lot of protein to grow and a smaller amount of nectar for energy.

Male bees visit flowers to obtain nectar to fuel their amorous advances. They also patrol flowers to find females. Mating attempts can often be seen as the male rapidly approaches a foraging female and makes contact, though they are usually rebuffed.


Sheila Dumesh


Sheila Dumesh

Nesting behaviour can be particularly entertaining to watch. Bees digging into the ground, chewing their way into pithy stems, carrying semicircular pieces of leaf back to line their nest, are all rather unusual activities that are enjoyable to watch. If you set-up a block of trap nests, quite a few cavity-nesting bees might be observed simultaneously. Careful observation of nest sites may enable you to see cuckoo bees trying to get into the nests of their hosts with the battles that ensue if the host returns while the cuckoo is still inside. Even honest host bees might fight among themselves for a nest. This can most easily be seen in large carpenter bees which will often engage in prolonged fights at the nest entrances which are in wood.

Territorial behaviour is most commonly seen in Wool Carder bees. The males patrol patches of plants where their potential mates congregate for food and nesting materials and aggressively fight off all intruders.

Tips for Bee Watching:

1. Sit down by some flowers that the bees are finding attractive.
2. Keep still – even if you disturb a bee, there is a good chance it will return, especially if there are comparatively few flowers around.
3. Short-distance binoculars may be useful, but so might be a magnifying glass or a camera.
4. If you take images of bees, you can then compare them to pictures in this booklet and in the various web-based resources noted at the end of this book.

The Seasons are Changing in a Buzz!

Imagine spring time. What are the first things that come to mind? Sun, flowers, leaves, green... This is a beautiful time of year, especially for us in Toronto, where the seasons are (usually) very well defined. Everything around you becomes much more colourful and more alive. Many animals come out of hibernation at this time, including bees. Once it's warm enough, bees that survived the harsh winter conditions will emerge and take flight. They will forage for nectar in order to get energy and a combination of nectar and pollen to feed their offspring. All of these actions aid in pollination. The bees will fly from flower to flower in search of food and in doing so, they will spread the pollen among the flowers they visit. This then helps in the reproduction of plants.


Sheila Dumesh


Ilona Naujokaitis-Lewis


Sheila Dumesh


Amro Zayed

Among the first bees to emerge in the spring are bumble bees. Due to their larger body size and amount of hair, these bees are able to fly in colder temperatures and even in the rain. Most other bees stay in their nests when it's cold, cloudy, or rainy. The bumble bees are able to raise their body temperature by vibrating their wing muscles very quickly, just as we shiver when cold. Once they are warm enough, they can fly. The queens emerge early and search for a nesting site where they can start building their colony, usually abandoned rodent or bird nests or other cavities. Queens are much larger in size than workers (all of which are females) and males. The queen begins building the first batch of cells where she will later lay her eggs. These eggs will hatch into larvae, then pupae, and eventually adults.

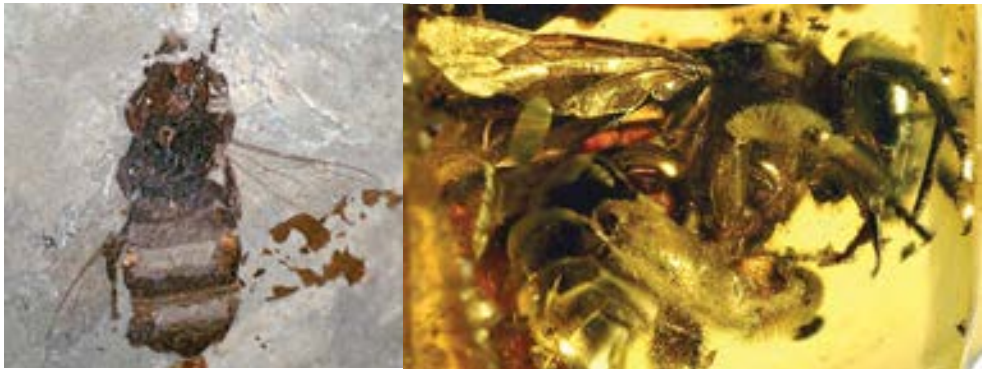
Toronto's Bee and Plant Communities

Much of the native landscape in our region was originally forested, with the Carolinian and Mixed Forest Zones being the ecological land classifications for the area. Forests are generally not good habitats for bees, although bumble bee queens and a few early spring bees can be found foraging on the early spring flowers that are in bloom before bud burst. However, oak savannah remnants, which can be found at High Park and elsewhere in the city, provide ideal conditions for a diversity of bees. Oak savannah is a type of tall-grass prairie with trees that are sparse enough that there is no continuous canopy. The sandy soil, with much insolation and many flowers provides ideal nesting habitat and floral resources for bees and the woodier vegetation also provides nest sites for those species that require hollowed cavities to make their nests.

Rivers and marshes are not very favourable for many bees, although there are a few species that prefer damp habitats; also, at least one local species specializes on pickerelweed and flies over water to get to the flowers of this aquatic plant. Sand dunes, as used to be more common on the Toronto Islands, provide habitat for a range of species that choose loose sand as a nesting substrate.

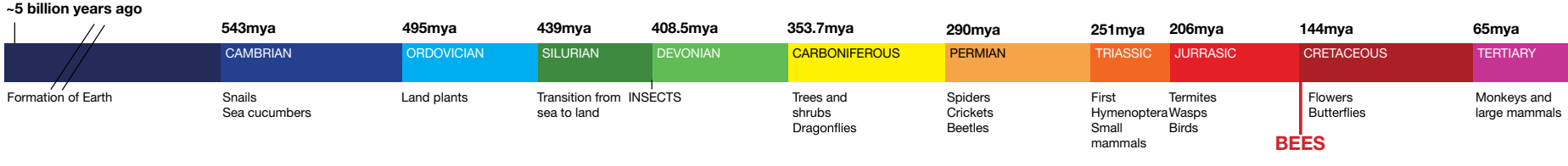
Cities and Bees

In comparison to native forests, an urban environment with patches of parkland, ravine, and large numbers of urban gardens, provides an abundance of floral and nest-site resources for bees. An evergreen forest may have no bees at all, a deciduous forest very few. But within our city there may be over 300 bee species and the average backyard garden will likely contain over 50 species, with some nesting and foraging there, and others visiting for pollen and nectar while nesting on a neighbour's property.



Left: The neotype of *Apis armbrusteri* (Miocene of Randeck Maar in Germany);
Right: The neotype of *Protobombus indecisus Cockerell* in Middle Eocene Baltic amber.
Both images courtesy of Michael S. Engel.

Where Bees Fit into the History of Life on Earth



Bee/Flower Co-evolution

Bees and flowers have been evolving with each other for over 100 million years. There was a rapid divergence of pollinators when the flowering plants first arose but this had a greater impact upon bee evolution than for any other insect group. Most flower-visiting insects use the sweet floral nectars as a source of energy to fuel their flight. Bees not only use nectar for energy, but also as an ingredient in the food that they collect for their offspring (along with pollen, and less commonly, floral oils). Consequently, bees have evolved particularly efficient nectar sucking equipment and their mouthparts' structure diverged rapidly. Characteristics associated with different mouthparts (also called "tongues") are often used by melittologists attempting to classify bees into major evolutionary lineages.

Pollen is the main ingredient in the food that bees collect for their offspring. Some bees will collect pollen from a wide variety of different flowers; others are more restricted in their dietary breadth.

Most social bees are generalists that are not very choosy when it comes to floral hosts; as they are active from spring to fall, they have to find food at different times of year, when there are different flowers in bloom. As we will see, some bees are so choosy that they are most easily identified based upon the flower that they might be found upon. In general, floral specialization is not mutual: although many bees may be very restricted in the flowers they will collect pollen from, flowers rarely depend upon specific bees for their pollination.

Steve Marshall

It is only the female bees that collect food for the offspring, generally by carrying pollen either on their hind legs or on the undersurface of the abdomen (some bees carry heavy pollen loads and use both these and additional surfaces for pollen transport). The pollen collecting hairs are referred to as a scopa. Honey and bumble bees are the only bees in Canada that, instead of a scopa, have a corbiculum on the hind leg – a bare, shiny area surrounded by hairs to form a "pollen basket". The pollen mass they carry is moistened with nectar before they return to their nest. These pellets can be scraped off the bees if the entrance to their hive is artificially narrowed and the resulting "bee pollen" can be purchased from health food stores.

Bees rely on flowers for pollen and nectar for their own consumption, but more importantly as food for their offspring. While many bees rely on one or a few related flowers for most of their offspring's food, it is uncommon for the flower to be reliant on only one or two species of bees for pollination.

One of the most interesting examples of bee-flower co-evolution can be found with the Sundrop Sweat Bee that visits sundrop flowers in the very early morning. The pollen grains of the sundrop flower are held together by spider-web like "viscin" threads. Unlike most bees, the Sundrop Sweat Bee does not have a dense brush of pollen collecting hairs, but a single comb-like row. The bee can rake all of the pollen from a single flower in a single visit and this gives the first bee to arrive a great advantage. This has resulted in these bees becoming active as soon as it is light enough for them to navigate. Some of their relatives in the United States have even become entirely nocturnal, flying mostly around the time of a full moon.

What are Bees?

It is often surprisingly difficult to tell whether a particular insect is a bee or not. There are two main reasons for this. First, many bees do not look like bees. This is especially true of masked bees and cuckoo bees because these are comparatively bald bees and do not have pollen collecting hairs. The masked bees carry pollen in their stomachs while the cuckoo bees lay their eggs in the nests of other bees and do not collect food at all. Second, there are many insects that have evolved to look like bees. Because many bees sting, predators learn to avoid them and so other insects that look like bees are also less likely to be chased by predators. This mimicry is quite common, especially among flies, some of which look like honey bees, others like bumble bees. Some day-flying moths look superficially like bumble bees indeed, there are some that are called Bumble Bee Hawkmoths.

Any insect in Toronto that actively collects pollen onto its hind legs or the underside of its abdomen will be a female bee. That leaves all male bees and both sexes of masked and cuckoo bees to be identified. Male bees are perhaps most easily identified through association with their females which they generally resemble except for having longer antennae and lacking pollen collecting structures. Masked bees have characteristic white or cream markings on the face – usually a pair of triangles between the compound eye and the antennae on each side of the face in the female; for males, the whole face below, and sometimes to the sides of, the antennae. They are comparatively bald and the combination of the facial colour and little hair is diagnostic for them. Cuckoo bees are very diverse and come in all sorts of colour patterns, though most have patterns of yellow, orange or red on them making them look quite wasp-like.

Left: Wasp species, *Polistes dominula*. Right: Bee species, *Melissodes sp*. Amro Zayed

Bees arose from digger wasps, moving down the food chain to provide pollen and nectar as food for their offspring rather than paralyzing insects or spiders. Because of these evolutionary relationships, bees are structurally similar to some of their wasp relatives. Bees are mostly hairier insects than wasps, though with the same exceptions of masked and cuckoo bees. Because of these close evolutionary relationships scientists have studied the structures of bees and wasps in considerable detail. There are numerous characteristics that enable us to separate bees from wasps other than those suggested above, but they generally require microscopic examination and are not of much use while watching insects in your garden.

Left: A syrphid fly in the genus *Criorhina*; Photo: Jeff Skevington. Right: *Bombus* sp. Sheila Dumesh

Bee Identification

While there are some bees in our area that are easy to identify to species at a glance, the existence of multiple groups of closely related ones means that microscopic examination is often necessary to correctly name a bee to the species level. The solitary mining bees – genus *Andrena* - are one of the most difficult groups to identify as there are approximately 70 species in this one genus in our area. With over 50 species, *Lasioglossum* sweat bees are also difficult and there was even a new species in this group that was first discovered in downtown Toronto and described for science in 2010.

Species that are easily identified at a glance include the Bicoloured Agapostemon, Ligated Gregarious Bee, Hoary Squash bee, quite a few of our bumble bees and the Eastern Calliopsis along with its own specific cuckoo the Calliopsis Cuckoo bee.

What time of year, in some cases what time of day, a bee flies can help identify them; though some of the social bees are active from spring to fall. Some bees are easily identified based upon the plants that they visit, these include the New England Dufourea (which collects pollen only from pickerelweed), Evening Primrose Sweat Bee (which is found early in the morning on sundrops), and Campanula Skinny Mason Bee (which only visits Campanula).


Sheila Dumesh

Although species level identification is often difficult, generic level identification can usually be done fairly quickly and the following guide, beginning on page 32, points out the most important characteristics for the genera that occur in our area.

DNA Barcoding

DNA barcoding uses a small fragment of DNA to tell apart closely related species. This method was invented at the University of Guelph at the very beginning of the 21st century and has been used to help sort out identification problems for some of the most difficult organisms on the planet. North American bees are well represented in the database and this information was an aid to the initial recognition of the new species collected from the annex neighbourhood in downtown. Over half of the bees expected to occur in Toronto have DNA barcodes available on the Barcode Of Life Datasystems (BOLD) website. Even a small piece of a bee's antenna taken from a live bee that can then be released is sufficient for accurate identification with this method – although you would need some fine forceps to remove the antenna and access to DNA sequencing facilities (you would also have to be careful to avoid getting stung). Some species can only be differentiated using genetic methods such as DNA barcoding. The Ligated Sweat bee has a close relative in the Southeastern United States and where the two co-occur, in the foothills of the Appalachian Mountains, they can only be told apart using genetic techniques such as DNA barcoding.

international BARCODE OF LIFE

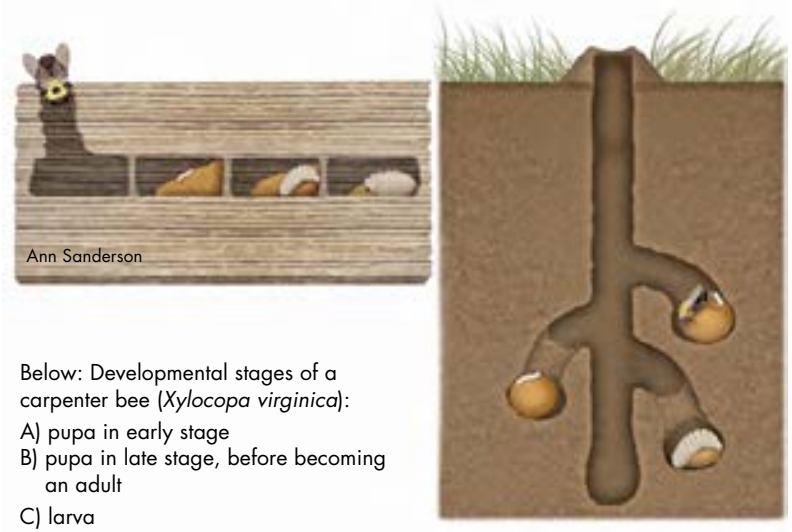
Bee Biology and Life Strategies

Bees are insects and insects are defined on the basis of having an external skeleton, three pairs of legs and a body that is divided into three parts – a head, a thorax and an abdomen. Bees belong to the group called the Hymenoptera, or "membrane-winged" insects, which also includes wasps, ants and sawflies. Certainly other insects have membranous wings, but the overall structure of hymenopteran wings includes comparatively few cells – clear membranous areas surrounded on all sides by wing veins (dark tube-like structures that strengthen the wing). Lacewings and dragonflies have membranous wings but far more cells such that their wings look like nets, or lace. True flies have membranous wings but very few cells because most of their veins run from the base to near the apex of the wing with comparatively few branches; they also only have one pair of wings. Other insects have scaly wings (butterflies and moths), leathery forewings (grasshoppers, crickets, true bugs) or hard wing cases (beetles and earwigs).

Life cycle:

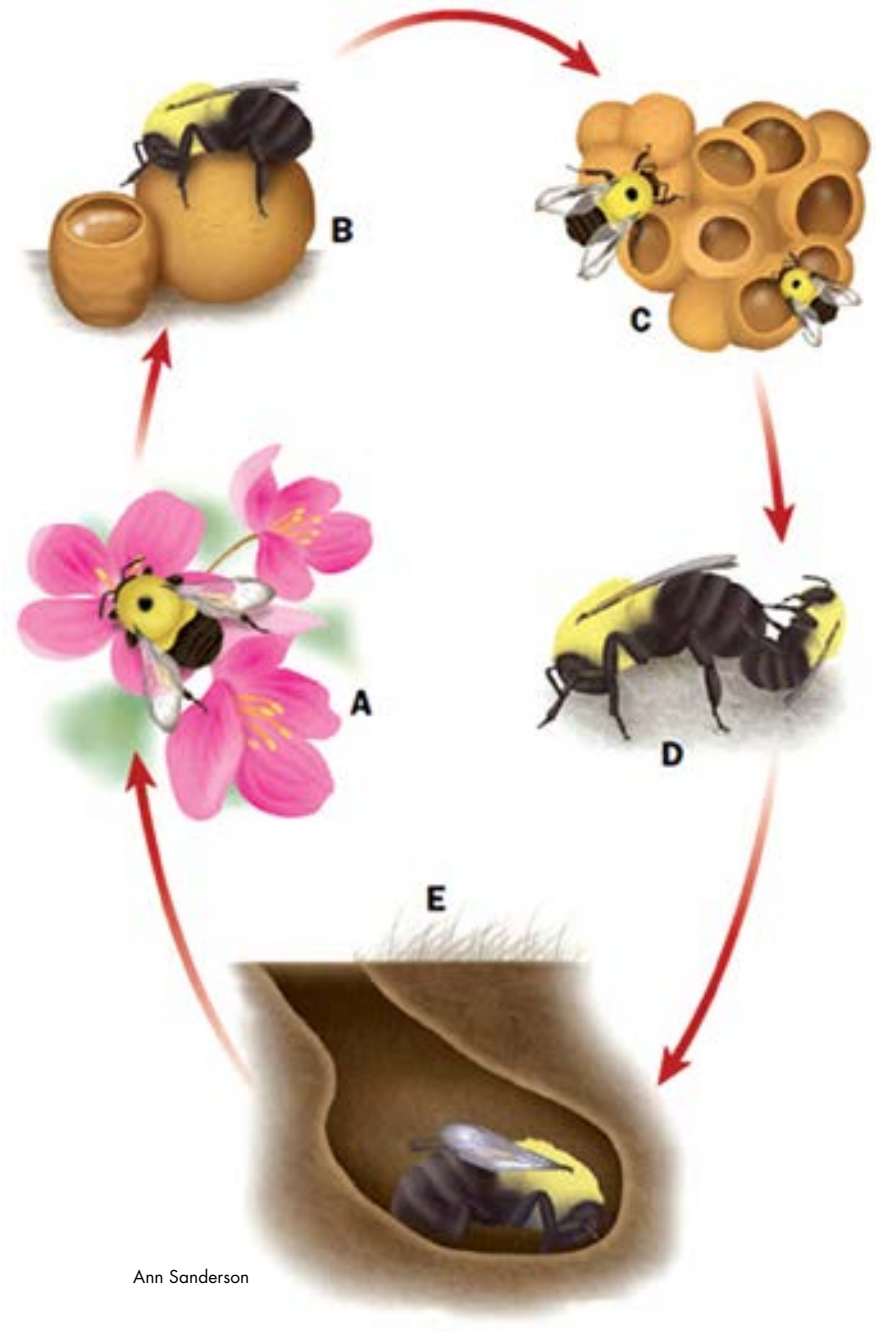
Like butterflies, most beetles and most true flies; bees start life as an egg which hatches into a larva that looks entirely different from the adult bee. Bee larvae are legless, white, rather featureless grubs that we rarely see. Metamorphosis from the grub to the adult bee occurs during the pupal stage. Bee pupae look like wingless adult bees but they start off entirely white coloured, just like the larvae, and only develop pigmentation soon before emerging as an adult.

Bee eggs are usually laid directly onto a pollen ball that has been provided by the mother bee. The pollen ball contains pollen and nectar and is usually round or oval in shape.



Below: Developmental stages of a carpenter bee (*Xylocopa virginica*):
A) pupa in early stage
B) pupa in late stage, before becoming an adult
C) larva

The egg hatches in a few days and the larva soon begins to feed upon the food provided for it. As the larva grows it sheds its skin four or five times: with an external skeleton there is only so much growth that can be accommodated before the exoskeleton becomes stretched to capacity. This period of active feeding and growth lasts from a few days to several weeks. The fully grown larva usually "rests" for some time before pupating. The pupa transforms into the adult, usually over a few weeks.



Ann Sanderson

Many bees have just one generation a year. The adults may be spring, summer or fall-flying and most of the rest of the year is spent in the natal nest as a juvenile stage or diapausing adult. In our climate, comparatively few bees have more than one generation a year and adults of most species are rarely seen for more than a month. Social bees are an interesting exception. Bumble bees and social sweat bees pass the winter as mated adult females that start a nest in spring and produce a brood of workers. The workers emerge and forage either to aid in the production of more workers or the next generation's males and overwintering females. These males and overwintering females become adults late in summer or in the fall. These social bees can be seen in most months from May to September (and sometimes earlier and/or later).

Most of our earliest active spring bees, such as some of the solitary mining bees, and mason bees, spend the winter as adults that have not left their nest. They can then start their own nests and begin foraging as soon as the weather becomes warm enough. Other bees overwinter as fully grown larvae that only pupate soon before the active

Ann Sanderson

Bee Nests

Bees have a wide variety of nesting strategies. Most nest in the ground in burrows and their nest sites can often be detected because of the piles of dirt the female makes at the entrance to her nest as she digs. Others nest in pre-existing cavities, such as beetle burrows in wood or cracks in walls. Some, such as the small carpenter bees, excavate tunnels in pithy stems whereas the Virginia Carpenter Bee will chew through wood, sometimes making its nests in wooden posts or garden furniture. There is one species of bee in Toronto that nests in empty snail shells.

Inside the nest, the female bee makes brood cells within which she constructs a pollen ball which she then lays an egg on. Most bees will work on one brood cell at a time, completing one before beginning the next. In most cases, the mother will not see her offspring, though some species will open the brood cell to inspect the contents from time to time. Most ground-nesting bees use glandular secretions to waterproof the brood cell to avoid waterlogging after a heavy rain. A few cover the pollen ball with waterproof secretions instead of lining the brood cell. The plasterer and masked bees line the brood cells with cellophane-like substances; their offspring develop inside what is essentially a plastic bag. These bees can provide a more liquid diet for their offspring because the bag is completely sealed and waterproof.

Some bees use extraneous construction materials in nesting. Leafcutter bees line the brood cells with mostly semicircular sections of leaves that they cut with their mandibles. The Wool Carder Bee collects plant hairs to make a soft nest lining like a pillow. Resin bees collect toffee-like plant sap and either make brood cells attached to a twig or stone or use it to line their nest in the ground or in wood.


Peter Ha


Sheila Dumesh


Amro Zayed


Amro Zayed

Social Bees

It is a common misconception that most bee species have complex social lives and live in hives. Most bees are entirely solitary and nest in burrows in the ground. But the social bees do exhibit a rich diversity of social patterns.

Many ground-nesting bees form aggregations of up to hundreds of nests per square metre. Each nest is occupied by a single, solitary female, but the presence of many close neighbours in the ground suggests at least a tolerance to crowding.

Communal bees are those that share a nest entrance but otherwise act as if they were solitary, each female constructs her own brood cells, forages for her offspring and lays eggs. Queens and workers are not found in communal bees but a reproductive division of labour is the basis for the other forms of social life among our bees: the queens laying the eggs (or at least most of them) and the workers doing most of the nest excavation, foraging and nest defence once the queen has adult offspring to assist her.

A reproductive division of labour takes two main forms, between individuals of similar age, such as sisters that have spent the winter together in the nest in which they were raised, or between a mother and her daughters. Societies with a mother queen and worker daughters are called eusocial and this type of organisation is found in honey bees, bumble bees and many sweat bees. Bees in which the only societies are semisocial, i.e. made up of workers that are sisters of the queen, are rare. The Northeastern Augochloropsis may have this type of society. However, quite a few eusocial sweat bees have colonies that sometimes start with a group of sisters with one of them, usually the largest, becoming the queen whose hard working sisters rarely survive long enough to see their nieces become adult.

Eusocial colonies may also become semisocial if the queen dies. When a colony is orphaned it is often the oldest or largest daughter that becomes the replacement queen and her sisters continue on as workers.

Bee societies are not always as smooth in their operation as we might think. In social sweat bee nests the workers may lay some of the eggs and the reproductive division of labour is not complete. In bumble bee colonies the workers sometimes kill the queen and produce male-destined eggs of their own (Eastern Plasterer Bee - *Colletes inaequalis*).

Below: a nesting aggregation of *Colletes inaequalis* in Lambton Park. Each mound of soil is a result of the digging done by the female bee creating her nest. These nests are in close proximity, showing the bees' tolerance to crowding as mentioned in this section on sociality.

Scott MacIvor

Threats to Bees - Natural Enemies

Factors affecting bees

Because of their need of a nest site as well as food sources to complete their development, bees are sensitive to a wider range of environmental factors than are most insects. They are also subject to direct predation.

Predators

Like most flying insects, bees are subject to being caught and eaten by spiders and aerial predators, such as birds and dragonflies. While the sting can be an admirable defence against many predators not all bees sting. Indeed, because it is a modified egg-laying apparatus, the sting is not present in males and even in female bees the ability to sting has been lost in some groups: you can pick up solitary mining bee females with impunity because their sting is too short to pierce your skin (though beware of putting their tail end near a cut or graze, or of misidentifying this particular group of bees for other mining bees that can sting).

Some predators specialize on consuming bees. For example, some robber flies wait around nesting aggregations of bees and suck the juices from a bee that they capture. Bee wolves are digger wasps that paralyze bees which they take back to their nest. From several to perhaps a dozen bees are stored in a brood cell before the mother wasp lays an egg which will hatch into a larva that consumes the paralyzed bees provided for it.

Parasitoids

Bees have some specialized parasitoids that will attack them. Thick-headed flies are a family of true flies that attack bees and wasps. The female flies dart at their victim and quickly insert the barbed end of an egg into the intersegmental membranes of the hapless host's abdomen. The fly larva then emerges into the body of the bee and eats the soft inner tissues, eventually killing the host.

There is a variety of parasitic wasps that attack bees, especially those that nest in stems. These generally have long ovipositors that they use to drill through the stem from the side, or through one or more brood cells to reach the host bee larva in the nest.

Top Left: a Thick-headed Fly; Bottom Left: a spider has caught a sand wasp; Right: an assassin bug has assassinated a bumble bee

Jeff Skevington

Sheila Dumesh

Ilona Naujokaitis-Lewis

Left: An anthrax bee fly which develops inside large carpenter bee nests; Centre: Maggots of *Melittobia* in the nest of a resin bee; Right: A cuckoo bee

Food thieves

Because bees collect protein rich pollen for their offspring, each nest usually contains substantial supplies of food, and as the nests themselves are often aggregated, bees provide a rich source of food for natural enemies that have evolved adaptations to gain access to it.

Some species of bee-fly hover over mining bee nesting sites and flick eggs down the tunnel. The eggs hatch into larvae that will consume one or more bee larvae, attacking them when they are fully grown. Larvae of oil and blister beetles find a flower, wait for a bee to land on it and then attach to the bee to be taken back to the nest where they will eat the pollen balls and usually the bee larvae also. Stem and wood nesting bees can have the entire contents of their nest consumed by birds; large carpenter bees are particularly susceptible to woodpecker attack.

The most common enemies of bees are often other bees – the cuckoo bees that enter their nests and lay an egg inside the brood cell. The adult cuckoo sometimes eats the egg of the host, but sometimes the killing of the rightful occupant is left to the young cuckoo bee larva. Host-killing larvae usually have scythe-like mandibles with which to dismember the host egg or larva.

Environmental factors

Ground-nesting bees are subject to drowning when the soil becomes waterlogged. While most have nest site choices or nest architectures that minimize the chances that this will happen, very wet soil likely increases mortality from mould and microbes. The pollen and nectar collected by the adult female for her offspring is subject to fermentation, germs and fungi (although mites that many bees carry with them are often very capable nest cleaners in such situations).

Some bees make their nests in among stones and in unusually hot years, or in unusually sunny locations, the developing brood may overheat and be cooked within the nest. Local bees are adapted to survive winter cold. Ground-nesting bees usually avoid freezing by overwintering below the frost line. Bees that overwinter in stems or wood will experience the full force of freezing winter and have biochemical means of avoiding freezing solid, often using sugary antifreeze compounds.

During periods when adult bees are foraging, a quick change in the weather can be problematic – “april showers” where warm and sunny weather is punctuated by cold rain can catch bees out of their nests and may be fatal. A sudden hail storm may batter a bee to lethal effect.

Threats to Bees - Human Effects

Habitat Loss:

In urban areas, habitat loss is a major threat to native animals. For bees, good habitat is required for feeding, nesting and for overwintering.

Feeding Habitat: Bees fulfill their energy requirements from sipping on nectar and gain protein from eating pollen. Their vegetarian lifestyle makes them susceptible to habitat loss as they need the right kind of flowers throughout their foraging periods. Generally, this means native flowering plants, as many of the showy common garden plants have been bred to have reduced nectar and pollen. This also means the plants have to be insecticide free, as these chemicals meant for thrips and other pests may also kill or otherwise injure bees. Many plants for sale in large garden centres are grown with pesticides in the soil which then transfer into the nectar and pollen. By buying locally grown organic and native plants, you can be assured you are providing native bees with the forage habitat they need.

Nesting Habitat: Bees are very industrious insects and will search high and low for the right nest site within which to raise their young. In natural landscapes, most bees are found nesting in sandy patches, other types of sparsely vegetated soil, hollowed twigs and holes in wood while bumble bees prefer abandoned rodent burrows and holes in tree trunks. In urban settings, bees sometimes consider additional nest sites, such as at the base of fire hydrants, holes in abandoned furniture, in strategically placed drinking straws and in tunnels burrowed into decks and fences. While sometimes a bit of an inconvenience for us, these nests sites are crucial to allow females to raise the next generation of pollinators. If you do find a nest, try to leave it alone until the bees vacate the premises on their own, something they will usually do as winter approaches. You can even provide nest sites by leaving broken raspberry stalks and bare patches of earth in your garden.

Conversion of a garden or lawn to concrete or gravel will change it from being suitable for many bees to being impossible for any of them to nest in. Certain gardening practices are also detrimental to bee populations: tilling the soil can destroy ground-nesting bee nests, burning of dried stems or old wood will kill any bees nesting inside. The bundles of raspberry canes and other sticks and stems that are put out for collection in spring will often contain overwintering bees. Mulching will make the ground surface unattractive for bees, or disrupt any nesting that has already started. A dense lawn is used as nesting substrate by far fewer species than a garden that contains patches of bare soil.

Overwintering Habitat: While most bees spend the winter in the nest they were born into, some overwinter elsewhere in cavities, tunnels and new burrows in the ground or in dry stems or wood. Bumble bee queens tend to overwinter in mulch or rotting logs, usually close to the nest where she was born. If you find an overwintering site, leave it alone until the bee vacates, usually in spring.


Sheila Dumesh

Introduced species

In places with limited food and nest space available, the introduction of non-native bee species may negatively impact native bees. The introduction of the Wool Carder Bee and the European Honey Bee may make it harder for native bees to find enough resources to raise the next generation. Males of the Wool Carder Bee (*Anthidium manicatum*) are very territorial. Once a male chooses a territory, it defends the plants in that territory, allowing only females of its own species to feed from them: any other bee which tries to feed on a male Wool Carder Bee's territory will be attacked repeatedly until it leaves.

The European Honey Bee (*Apis mellifera*), while an important pollinator economically, likely poses a threat to native bees. Honey bee colonies are massive in comparison to even the largest local bumble bee colonies (approx. 50,000 and 200 respectively). Additionally honey bees store honey to sustain them through the winter. This means that one honey bee colony can potentially out compete 1000s of native bees for food. However, the impact of honey bees on native bees in an urban setting has not yet been investigated thoroughly.

The Giant Resin Bee (*Megachile sculpturalis*) is an Asian species that was introduced into eastern North America and made its way to the GTA a few years ago. It has been reported fighting at large carpenter bee nest entrances, usurping the nest of a native bee species. It will be interesting to monitor relative changes in abundance of these two species over time.

Two of our introduced species: The European Honey Bee (above); The Giant Resin Bee (below)

Chemicals

Herbicides will reduce the food available to bees. Pesticides will kill them directly, but sometimes the indirect effects may be worse in the long run. Some pesticides seem to cause bees to become disoriented, reduce their fertility or compromise their immune system. The latter may be particularly pernicious in the case of bumble bees and the honey bee where our activities of moving colonies around for agricultural production is exposing the bees to novel diseases: a combination of a weakened ability to fight infection and new diseases has been suggested to be the cause of colony collapse disorder in honey bees.

The total number of bee species in the Toronto area certainly exceeds 300. Many are very difficult to identify to the species level even with a microscope. These hundreds of species are divided among almost 40 different genera, and this taxonomic level is generally more easily identified with the naked eye. The images on pages 32-37 should assist.

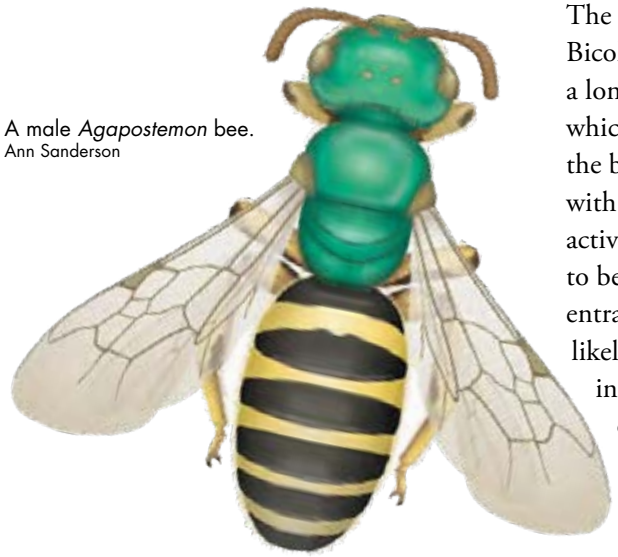
Toronto's (un)Official Bee: Bicoloured Agapostemon (*Agapostemon virescens*)

The Bicoloured Agapostemon is an ideal choice as our city's (un)official melittological mascot for at least three reasons. First, the females are the easiest bees to identify: no other insect in our area has a brilliant bright green head and thorax combined with a black abdomen. The males are similarly bright green at the front but their abdomen is yellow and black striped. Second it is a common bee in Toronto, both in gardens and wilder areas such as the Leslie Street Spit, although it is usually overlooked. The females can easily be found in early summer mornings foraging on thistles (both wild and cultivated forms) and other flowers. The males are abundant in late summer where they sometimes swarm around Rose of Sharon or Hollyhock flowers where some will also spend the night.


Sheila Dumesh


Amro Zayed


Stephen Humphrey



A male *Agapostemon* bee.
Ann Sanderson

The third reason is the most interesting of all: this bee is very welcoming of strangers. Bicoloured Agapostemon nest in the ground and each brood cell is fashioned at the end of a long side branch to the burrow that the female digs. These bees form communal nests in which multiple individuals use the same nest entrance, but each live in separate branches to the burrow, deeper beneath the soil surface. Their social set up is similar to a condominium with one entrance that is shared among all occupants who then go about the rest of their activities in their own apartments. The reason these bees have this social arrangement seems to be that it gives them increased nest defence against potential enemies that might try to gain entrance. Because there is strength in numbers with this social set-up, these bees are far more likely to permit any unrelated Bicoloured Agapostemon individuals – complete strangers – into their nests to increase entrance surveillance. Most bees will defend their nests against others of their own species, but it seems that our (un)official bee is much more tolerant of newcomers, and this makes it a particularly appropriate choice as the city's (un)official bee species.

Amro Zayed

Melanie Lawton

Melanie Lawton

Featured Bee: Ligated Sweat Bee *(Halictus ligatus)*

This is a bee that you can find from late May through to September because it lives in small societies that are active most of the flowering year. It is comparatively easy to identify with its large head that is triangular in side view with very wide and pointed cheeks and narrow white hair bands on the abdomen. Overwintering females spend the cold season in burrows that they dig deep below the nest in which they were raised. As the weather warms in spring they dig upwards towards the surface and sometimes come into contact with one or more sisters who are doing the same. Sometimes two or more of the sisters will share the old nest in a semisocial society in which the largest individual (usually) becomes the queen and her sisters become workers. As many as 6 females have been found nesting together in this way, although the most normal arrangement is for there to be a single female in each nest in late spring/early summer.

Solitary females gradually produce a brood of workers, usually only 4 or 5, sometimes with a male among them. The semisocial spring nests may produce a larger brood, perhaps as many as a dozen workers. Because they are produced rather slowly and their mortality rate is quite high, there are rarely more than two or three adult workers active in the nest at any one time in midsummer. In addition to acting as workers foraging while their mother or a sister of theirs guards the nest, they also lay some eggs. The workers are usually quite a lot smaller than their queen and they have a less robust head.

These bees can be found throughout the city where there is suitable bare or sparsely vegetated soil, but they are particularly common along roadside banks where there are many wild white chrysanthemums growing. This is a favoured food source for these bees even though it is an introduced plant.


Amro Zayed


Sheila Dumesh

Featured Bee: Common Eastern Plasterer Bee *(Colletes inaequalis)*

This is one of the earliest bees to start flying in spring and also one of the most abundant bees in the city's parks. As soon as the weather becomes warm enough in late March or April, Common Eastern Plasterer Bees start emerging from their overwintering burrows in the ground. Males cluster around virgin females that are digging upwards to reach the soil surface and the mayhem that ensues can sometimes result in some bees being killed in the crush.

Once they have mated, the female excavates a burrow in the ground, showing a preference for nesting in patches of bare, or sparsely vegetated, soil. Their large nest entrances within a mound of excavated soil are easy to find in April in places such as Lambton Park and High Park.

Beneath the ground, the females construct a row of brood cells that they line with a cellophane-like secretion that is transparent. The brood cells are arranged end-to-end and as soon as one has been largely filled with a liquidy pollen and nectar mixture and the egg has been laid, the female seals the top of the cell with a disc of the same transparent plastic-like material and begins the next brood cell. The completed nest is like a freezie with patches of yellow food provisions for the developing larvae.

Early in spring the females collect pollen from maple and birch catkins, moving onto brighter flowers once these wind-pollinated trees have finished flowering.


Amro Zayed


Sabrina Malach


Deb Chute

Featured Bee: Honey Bee *(Apis mellifera)*

The European Honey Bee (*Apis mellifera*) is not a recent migrant to Ontario (or Toronto). In fact, Ontario has a rich history of beekeeping. The leading local beekeeping supplier, FW Jones, was founded in Ontario in 1878; Beeton Ontario (now New Tecumseth) was named in honour of Canada's most successful beekeeper, and the Canadian Bee Journal (still published today) began in 1885.

In Toronto, honey bees can be found on roofs, in yards, and in gardens in managed colonies maintained by practiced beekeepers and beekeeping co-operatives. You can have a look at colonies (and sample some honey) at local landmarks such as Casa Loma and the Opera House. Try some local honey during your next visit to a farmer's market!

A honey bee colony is composed of three adult bee castes (three different kinds of adults). The first, the queen, is the reproductive machine of a colony; she lays the eggs that develop into adult bees. The second is made up of the workers, all of which are female. Early in its life the worker is called a nurse bee and acts to care for developing bee larvae and eggs and building the wax comb. Later in life, the worker becomes a forager and collects nectar and pollen to maintain the colony. Worker bees are also responsible for storing the honey that we steal from them. The honey bees you see in a garden are foragers. Finally, the drones are the only males in a colony. Drones live very brief lives and, oddly, die after mating; they perform no known work within a colony.

Important Dates:

"World Apitherapy Day" (March 30): aimed towards enhancing the understanding of therapeutic use and health benefits of bee products.

"Day of the Honey Bee" (May 29): raising awareness of the plight of the honey bee in Canada. Started in Saskatchewan in 2009 by Clinton Ekdahl.

Photos below: Amro Zayed




A colony begins with a mated queen and a cohort of workers (from 20 000-100 000). These can be ordered by mail, collected in swarms, or split from larger colonies. A beekeeper will place these bees in a colony box where they will reside for the year. In the spring, the queen will begin laying eggs that will develop into workers. As the population of a colony grows rapidly and honey stores begin to accumulate, the worker bees start to feed royal jelly to a few of the queen-laid eggs. Royal jelly turns an ordinary egg into one destined to be a queen. When this queen becomes adult, the phenomenon of swarming occurs—the old queen will leave the nest with half of the bees in the colony. This "swarm" will fly en masse and land. This is usually met with some fright by the public—seeing a mass of bees hanging from a tree branch (or a car's side mirror) can be rather surprising. But the mass is actually very gentle and takes up temporary residence at its landing site en route to a new home. A swarm can be collected by a beekeeper and put in a new colony box, or it ca its own home—anywhere from a cavity in a tree to an open attic. If you see a swarm, it's usually b contact your local beekeeping organization!

Once a home is found, the workers produce wax co and begin foraging. Meanwhile, back in the original hive, the new queen flies out of the colony and mates with several drones and oddly, the drones die after mating. She returns to lay eggs and begin life in the ne colony. As fall sets in, forage becomes scarce and the colony prepares for winter. Drones are thrown out of the colony, and queens stop egg laying. As the cold hits, the bees form a tight cluster in the centre of their colony and survive the winter by using their stores of honey.

Honey bee, *Apis mellifera*
illustration by Ann Sanderson

Susan Berman

Honey bee hives in the Portlands in Toronto's waterfront. Diane Borsato

Honey bee hive in tree. Amro Zayed

Featured Bee: Virginia Carpenter Bee *(Xylocopa virginica)*

This is one of the largest bees in Toronto and they are often mistaken for bumble bee queens. However, both sexes have a faint bluish reflection to the black part of the abdomen, males have a face that is white because of the exoskeleton rather than having pale hairs, and the females have a dull, completely hairy hind leg whereas bumble bees have a shiny pollen basket.

Virginia Carpenter Bees are becoming more common in southern Ontario as the climate warms. They nest in soft wood, making dime-sized holes as their nest entrance. They have extremely strong mandibles that they use to chew through the wood to excavate their nests: you can hear them at work if you listen carefully. The females make a long tunnel, construct a pollen ball, lay an egg and then make a narrow partition before constructing another pollen ball. Eventually, a row of developing offspring is produced each in its own brood cell separated by a thin disk of sawdust from their siblings on either side.

Because chewing through even soft wood is a laborious business, some individuals try to take over the nests of others and long fights can sometimes result at the nest entrance as the original owner tries to eject the usurper. Probably also because of the work involved, females may sometimes share nests with a relative. Because adults of this species can live for several years, nests are sometimes shared by multiple generations.

Jess Vickruck

Amro Zayed

Featured Bee: Alfalfa Leafcutter Bee *(Megachile rotundata)*

The term Leafcutter Bee refers to most species in the genus *Megachile*, which make brood cells from pieces of leaves and less commonly of flower petals; some species in the genus use resin instead of leaves. These are the bees that make neat semicircular cuts on the edges of leaves of roses and other plants: different species preferring different plants to line their nest. When removed from the nesting substrate, the row of brood cells looks quite a lot like a cigar.

There are seventeen species of leafcutter bee in our area. One of the most common is the Alfalfa Leafcutter Bee, which was introduced into North America for purposes of pollinating alfalfa, an important fodder crop for cattle. The species has been managed in North America for its pollination services for decades. Canada has been a leader in developing rearing technologies for it and Canadian-bred Alfalfa Leafcutter Bees have been sent around the world for pollination, even being taken back to areas within its original native Old World range. The Alfalfa Leafcutter Bee is not restricted to collecting pollen from alfalfa, indeed it is one of the more generalist of our bees. However, it is particularly effective at pollinating this legume, being far more efficient per individual bee visit than are honey bees.

Alfalfa Leafcutter Bees use a wide range of nest sites; the common feature being that they are approximately cylindrical holes that are in a comparatively sheltered location. Leafcutter Bees have been found nesting in abandoned beetle burrows in wood, old raspberry canes, wooden furniture, fence posts, holes in brick walls and inside garden furniture made of metal tubing.

Scott MacIvor


The exotic, M. *centuncularis*.
Deb Chute


Leafcutter Bee, *Megachile* sp.
Amro Zayed

Featured Endangered species: The Rusty-patched Bumble Bee *(Bombus affinis)*

The Rusty-patched Bumble Bee was recently listed as an Endangered species both by COSEWIC for Canada and COSSARO for Ontario. As recently as 30 years ago it was one of the most common bumble bee species in the city of Toronto and now it has the unfortunate claim to fame as being the first bee to be listed as endangered in North America. In the past 15 years, it has become exceedingly rare with only a few individuals turning up each year within its previous range in southern ON and the eastern US. In Canada, it has been found recently only at the Pinery Provincial Park.

The Rusty-patched Bumble Bee is distinctive in that its workers have a brownish-patch of hair surrounded by yellow on their abdomen. Be careful to not confuse it with common urban species such as the Brown-belted Bumble Bee *(Bombus griseocollis)*, the Tri-coloured Bumble Bee *(Bombus ternarius)* and the Red-belted Bumble Bee *(Bombus rufocinctus)*.

The Rusty-patched Bumble Bee used to be one of the first bees out in the spring (usually early April), pollinating early blooming flowers such as apples, rhododendrons and crocuses. It also had one of the longest colony cycles of all the native bees, with workers and males still found to be foraging on goldenrods and asters at the end of October. The cause of decline for this previously common species is still the subject of much study. It is suspected that climate change, the use of new pesticides and/or introduced diseases may explain its rapid decline over a very large area.

Please keep an eye out for this Endangered species and report sightings (preferably with photographs) to Bumble Bee Watch (bumblebeewatch.org).

Sheila Colla

Bombus affinis
Illustration by Ann Sanderson

Featured Introduced Species: Wool Carder Bee *(Anthidium manicatum)*

Most bees are fairly secretive creatures, the Wool Carder Bee is a marked exception. They are large brightly coloured bees and the males will fight off any flying intruder to the patch of flowers that they defend. Female Wool Carder Bees shave the hairs from the hairy leaves of particular plants, like sage, and use these hairs to make "wool" that lines their nest. They will also collect pollen and nectar from the same, as well as other, plants. The males defend patches of flowers and mate with the females that come there for nesting materials and food.

Male Wool Carder Bees have three strong spines at the apex of the abdomen and a strongly armoured underside to their body. This equipment is used on persistent territorial invaders such as Honey Bees. If repeated chasing or head butting another flower visitor does not result in retreat, the Wool Carder male will attack from behind, curl it's abdomen underneath the intruder and crush it with its spines against its underside. These bees are great fun to watch as they hover around inspecting intruders and fighting them off.

The Wool Carder Bee has gained an almost worldwide distribution as a result of it being taken around through human travel and trade. Originally it was found only in Europe, but it has been taken to North America (with separate introductions to the East and West coasts), New Zealand, South Africa and Brazil. It is now one of the most widespread bees that is not actively managed by humans.


Amro Zayed

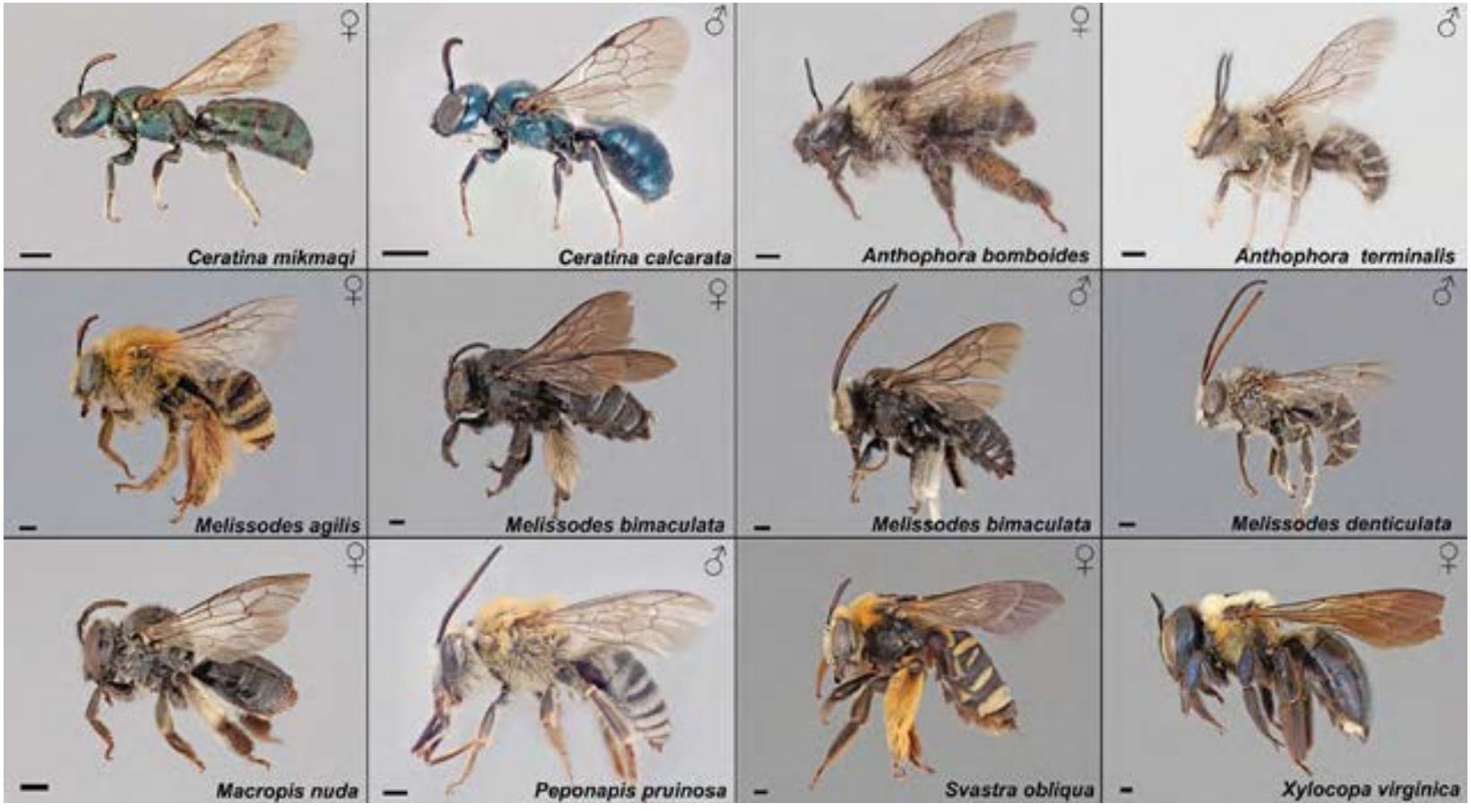

Amro Zayed

Apid Bees: Family Apidae (Honey Bees, Bumble Bees and their relatives)

*Each scale bar is equal to 1mm

PCYU lab, York University

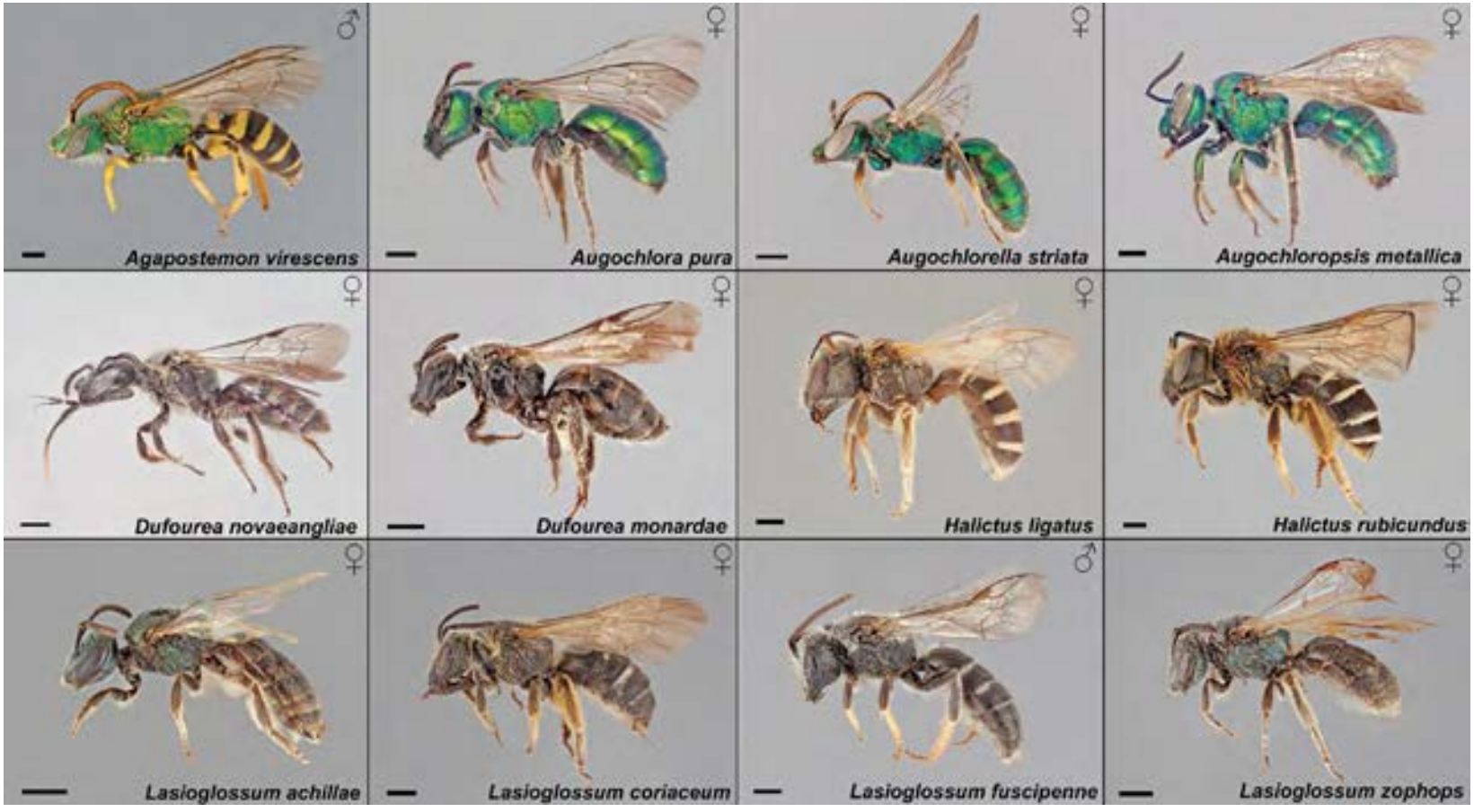
Family Apidae (and our only member of the Family Melittidae, *Macropis nuda*)



*Each scale bar is equal to 1mm

PCYU lab, York University

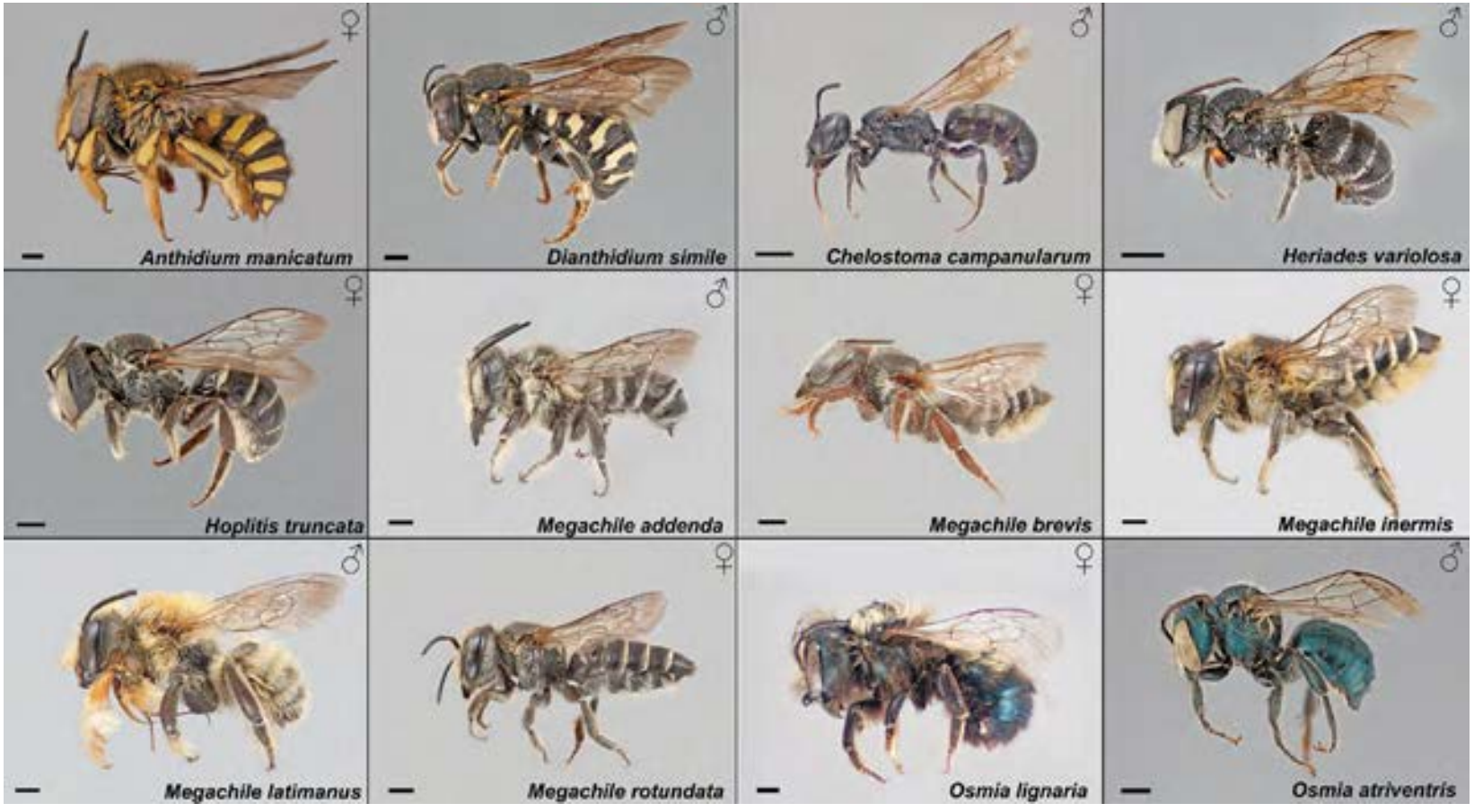
Sweat Bees: Family Halictidae



*Each scale bar is equal to 1mm

PCYU lab, York University

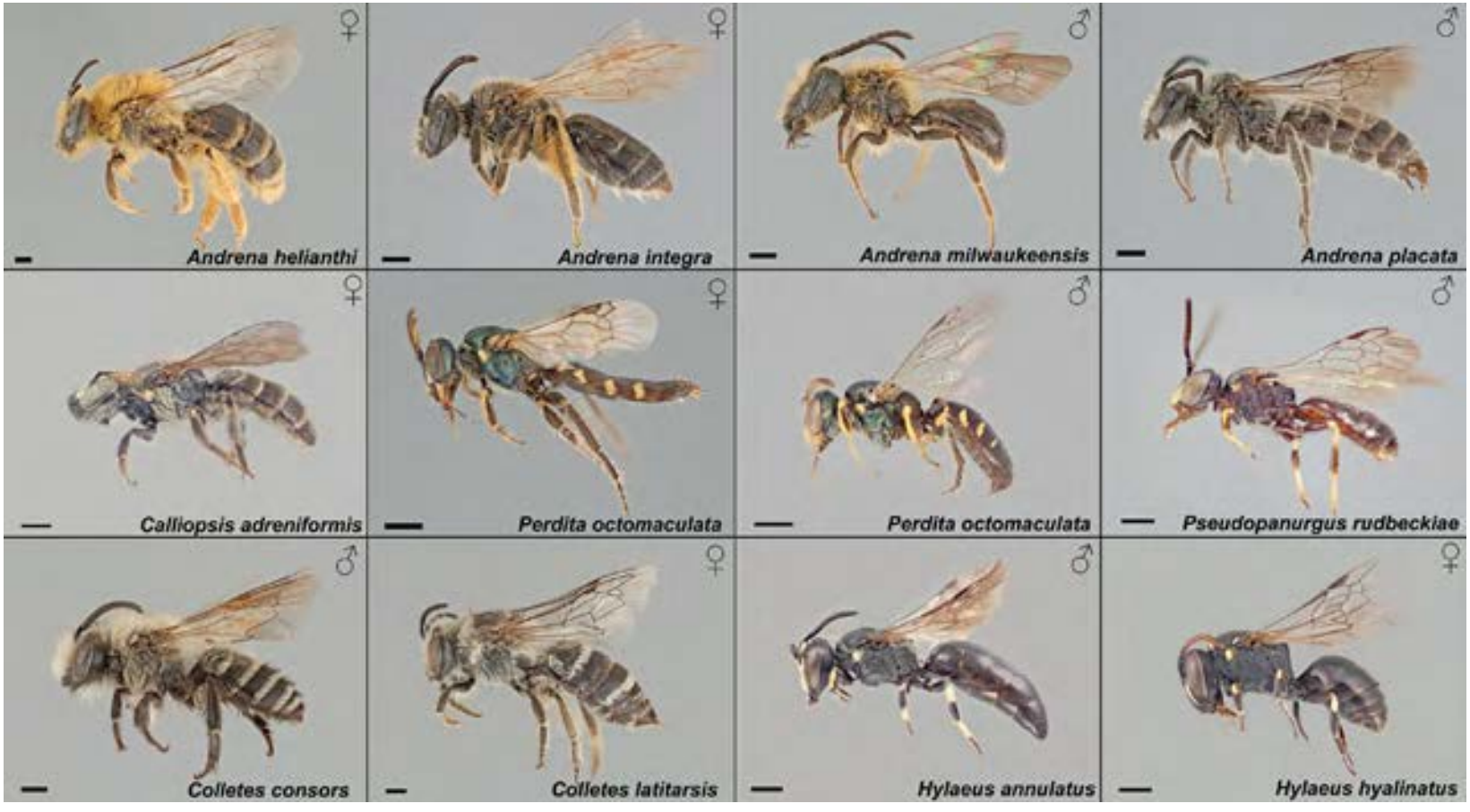
Leaf Cutter Bees: Family Megachilidae



*Each scale bar is equal to 1mm

PCYU lab, York University

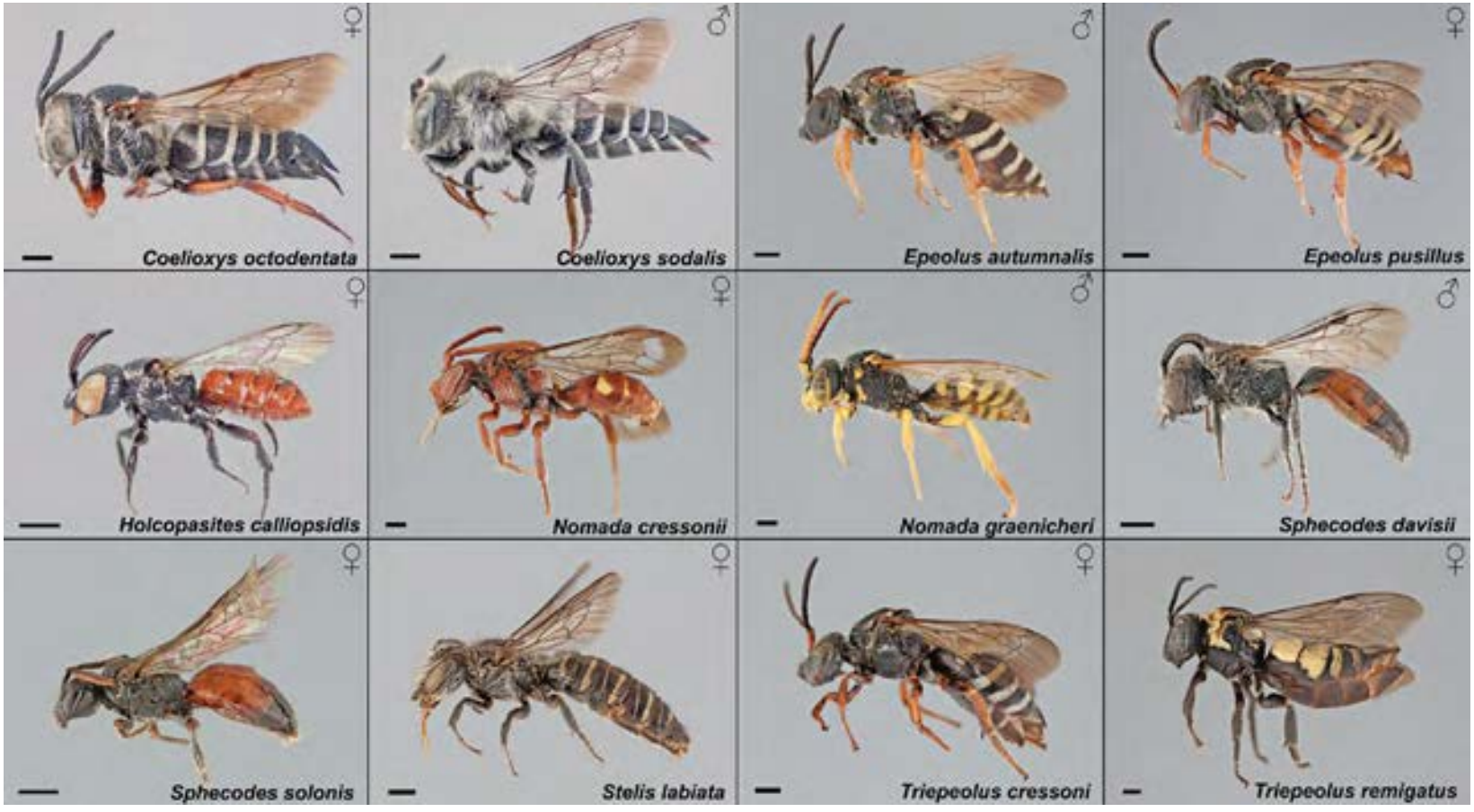
Mining Bees: Family Andrenidae & Plasterer Bees: Family Colletidae



*Each scale bar is equal to 1mm

PCYU lab, York University

Cleptoparasitic Bees (among all bee families)



*Each scale bar is equal to 1mm

PCYU lab, York University

Ceratina. Steve Marshall

Ceratina. Amro Zayed

Anthophora terminalis. Steve Marshall

Hylaeus. Amro Zayed

Sphecodes. Steve Marshall

Hylaeus (top right), *Lasioglossum* (centre). Steve Marshall

Chelostoma campanularum. Steve Marshall

A Study on the Nesting Habits of Urban Bees

Beginning in 2011, a survey of Toronto's cavity-nesting bees involving hundreds of Toronto's citizens was developed and carried out by Scott MacIvor during his PhD as a member of the Packer Lab at York University. Scott uses nestboxes, or "bee condos" set up in hundreds of home and community gardens, parks, and green roofs. The bees nest in cardboard tubes of different widths to suit the nesting requirements of different cavity-nesting bee species. They are held together in a piece of plastic drainpipe so they are protected from the rain. Bees use these nesting tubes to construct brood cells made of different materials, usually mud, leaves, or tree resins, depending on the bee species, in a linear series from the back of the tube to the front. In each completed brood cell, pollen and nectar is packed, onto which a single egg is laid. Most species have only one generation per year.

These nestboxes are used by over 40 species of bee, both exotic and native, in and around the city of Toronto and, as one might expect, provide a multitude of data. These include species presence and absence, diversity, pollen and nesting material collected, the rate of brood failure or abandonment, parasite loads, nest architecture, and genetics, all of which can be analyzed and used to evaluate how bees adapt or fail with changing local and landscape characteristics in our city. Pollen analysis from nests has revealed that the bees collect food from a wide variety of native, non-native, and ornamental flowering plants, shrubs, and trees.

With rising interest in urban agriculture and wildlife gardening, citizen science projects that examine bee diversity and success of enhancement strategies are important. This is critical as at the same time natural areas in and around the city are re-zoned and built over, or eroded and invaded by a variety of cosmopolitan or invasive species. Studies that both monitor urban wild bee populations and evaluate mechanisms for augmenting their numbers help to engage the public in pollinator stewardship as well as more closely link urban wild bee populations to city planning and building design.


Alessandra Leopardi


Peter Hallett

Bee Hotspots in the City – The city of Toronto is full of hot spots for bee watching in the spring, summer, and fall seasons. Here are a few of our favourite locations in the city to experience many dozens of species of bee nesting above or below the ground, and foraging on flowers.

Morningside Park, Scarborough

Morningside Park is the largest contiguous forest in the 170 ha Highland watershed. There are large areas of bare sandy, sun-baked soil on embankments and beaches along the winding river in the park. Some of the beaches bordering the river system are easily accessible from the walking trails that criss-cross the park. Morningside Park is home to many and possibly hundreds of bee species, but in April and May you'll find aggregations of one unique ground nesting Common Eastern Plasterer Bee, *Colletes inaequalis*. The bee can often be seen flying back and forth from their nests in these undisturbed sandy beaches to nearby willow trees that line the trails and the embankments to the river and to perennial spring ephemerals that dot the wooded areas. Common Eastern Plasterer Bee also nests along semicompacted walking trails in well-draining soils; often these nests are quickly located by watching the entrances of what will at first glance appear to be small ant mounds with large entrances.

If looking for good spots to bee watch in Morningside Park in the summer, avoid the densely forested areas as bees like to be out in the sun preferring open meadow and scrubby areas rather than those that are shaded and enclosed. Some of the forest edges at the foot of the large maintained picnic lawns provide lots of broken branches and patches of Staghorn Sumac for cavity-nesting bees. Also, ground nesting bees that prefer to nest in slopes find sunny patches on the naturally eroding embankments to be good nesting locations, just be careful to stay sufficiency far away that you can see them but aren't trampling potential nesting sites. If feeling less adventurous, try the newly planted pollinator garden near the Morningside Park Community Centre at the Morningside Ave. entrance to the park. This is well maintained and attracts many species of bee living in the park, not all of which are common in other areas of the city. Finally, on the east side of Morningside Ave., across from the park is the University of Toronto Scarborough Campus. In recent years, there has been significant enhancement of bee-friendly plantings in the campus landscape. A great spot to observe bees here is at the large East Arrival Court bioswale at the edge of the parking lot. It contains swaths of flowering vegetation including bee-favourites such as jewelweed and an assortment of asters.

City of Toronto

Lambton Park, West End Toronto

Lambton Park is small, less than 8 ha in size, and adjacent to the Humber River. It is accessible by going north on Howland Ave. off of Dundas St. W. and circling into the Lambton Arena parking lot adjacent to the park. Lambton Park is near High Park, and shares similar ecological attributes: both are fragments of a rare habitat type in Southern Ontario, the black Oak Savannah. These habitats are characterized as being sunny and open with widely spaced trees in soils that are sandy, dry, well draining and non-compacted. This habitat houses numerous rare species, although it is no longer possible to find Karner Blue or Frosted Elfin Butterflies in them in Ontario as these have been extirpated from Canada. Not surprisingly, the park is also home to dozens of rare plant species and is designated as an environmentally sensitive area in the city of Toronto.

The open grounds at Lambton Park are scattered with large dead and partially decomposing tree stumps, some many metres high, and also fallen logs. Many of these are left exposed to sun and can be found to the South-East of the parking area. These provide very suitable habitat for a variety of cavity-nesting bees that prefer to nest in beetle-bored holes in sun-warmed wood, including mason bees, leaf cutter bees and the bright green Common Augochlora as seen on the front cover of this booklet.

Perhaps Lambton Park's most significant contribution to Toronto's bee diversity is its mosaic of open sandy bare ground patches all along the hydro corridor, towards the ridge and embankment towards the Humber river, and throughout the walking and BMX trail system connecting all areas of the Park. Indeed, despite the uniqueness of the habitat in the park, the bees share it with a host of dog-walkers and BMX cyclists. Interestingly, these activities maintain the bare sandy soil patch edges to a surprisingly suitable compaction level for the bees (as well as various wasps). Both these groups of insects often nest in tight aggregations along the paths and into the patchy grasses areas. As mentioned, many other species of bees (*Colletes, Andrena, Agapostemon, Halictus*) and wasps (such as the bee-eating bee wolves of the genus *Philanthus*) will be found actively tending nests in this "premium" soil in any given month of the year (except during winter), and given the infrequency and isolation of these nesting habitats around the city, we must take every care to monitor and conserve them.

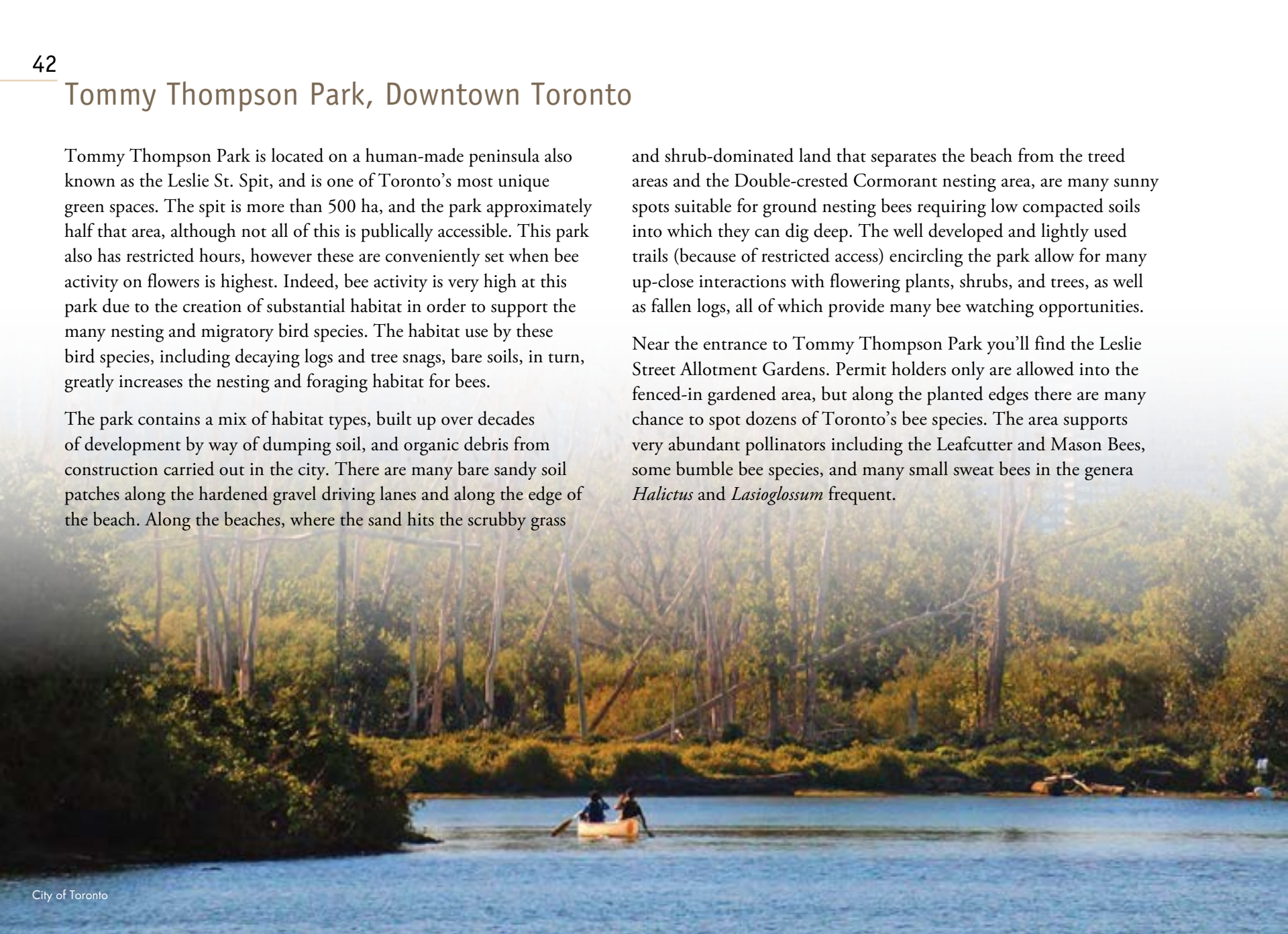
Melanie Lawton

Tommy Thompson Park, Downtown Toronto

Tommy Thompson Park is located on a human-made peninsula also known as the Leslie St. Spit, and is one of Toronto's most unique green spaces. The spit is more than 500 ha, and the park approximately half that area, although not all of this is publically accessible. This park also has restricted hours, however these are conveniently set when bee activity on flowers is highest. Indeed, bee activity is very high at this park due to the creation of substantial habitat in order to support the many nesting and migratory bird species. The habitat use by these bird species, including decaying logs and tree snags, bare soils, in turn, greatly increases the nesting and foraging habitat for bees.

The park contains a mix of habitat types, built up over decades of development by way of dumping soil, and organic debris from construction carried out in the city. There are many bare sandy soil patches along the hardened gravel driving lanes and along the edge of the beach. Along the beaches, where the sand hits the scrubby grass and shrub-dominated land that separates the beach from the treed areas and the Double-crested Cormorant nesting area, are many sunny spots suitable for ground nesting bees requiring low compacted soils into which they can dig deep. The well developed and lightly used trails (because of restricted access) encircling the park allow for many up-close interactions with flowering plants, shrubs, and trees, as well as fallen logs, all of which provide many bee watching opportunities.

Near the entrance to Tommy Thompson Park you'll find the Leslie Street Allotment Gardens. Permit holders only are allowed into the fenced-in gardened area, but along the planted edges there are many chance to spot dozens of Toronto's bee species. The area supports very abundant pollinators including the Leafcutter and Mason Bees, some bumble bee species, and many small sweat bees in the genera *Halictus* and *Lasioglossum* frequent.



City of Toronto

Toronto Community Gardens

Many cultivated foods that we grow, like fruits, seeds, nuts, and some vegetables, result from a flower that require bees to pollinate them. As a result, community gardens often become hot spots for bee activity no matter where you are in the city. Flowers of fruit trees, berry bushes, or herbs like mint or thyme are particularly attractive to a wide variety of bees. Also, community gardens are managed by a diverse set of users, whose objectives (food production) ensure there are plants in bloom continuously throughout the growing season. Citizens that participate in community gardening encourage bee populations in their local neighbourhoods.

Community gardens are also hot spots for observing bees at nesting sites. Bees tend to nest close to sources of pollen and nectar and in urban areas, where backyard habitat may be shaded or have simple plant communities, community gardens provide valuable additional resources. Piles of soil, as well as other bare patches of ground can be home to ground nesting bees while bamboo stakes, fence posts, and various plant stalks cut during continuous harvesting (e.g. blackberry or raspberry) can house cavity-nesting bees. Sometimes common in our community gardens is the Hoary Squash Bee, *Peponapis pruinosa*, which has a preference for cucurbits (Cucumbers, Squash, Pumpkin, etc.), and the Agile Long-horned Bee, *Melissodes agilis* common on another easy-to-grow garden flower: the sunflower. Following some of the basic principles of design in creating a pollinator garden, you too can create a bee hotspot in your own yard or neighbourhood space.

Honey bees are sometimes common in community gardens but rarely are they managed there because of provincial by-laws that limit where bee hives can be kept. The “Fresh City Farms” cultivated farm at Downsview Park is one exception, where honey bees are maintained near the garden by the Toronto Beekeeping Co-operative.

City of Toronto

Much needed nectar source for bees in the centre of the city. *Allium* in bloom on the Mountain Equipment Co-Op green roof on King Street.
Scott MacIvor

Checklist of the Bee Species of Toronto Area (2015)

It becomes difficult to provide exact numbers of species for a particular geographic area since the natural world doesn't live by our boundaries. This list is based on published records and personal observations in the field; however, the actual number of bee species in the Toronto area is likely higher than listed here. This list will likely grow with changes in species ranges as well as new records for Toronto in the future.

Number of bee families: 6
Number of bee genera: 37
Number of bee species: 364

COLLETIDAE

Colletes aberrans
Colletes americanus
Colletes consors
Colletes hyalinus
Colletes impunctatus
Colletes inaequalis
Colletes kincaidii
Colletes latitarsis
Colletes nudus
Colletes simulans
Colletes solidaginis
Colletes validus
Colletes willistoni
Hylaeus affinis
Hylaeus annulatus
Hylaeus basalis
*Hylaeus hyalinatus**
Hylaeus illinoisensis
*Hylaeus leptocephalus**
Hylaeus mesillae
Hylaeus modestus
*Hylaeus punctatus**
Hylaeus saniculae
Hylaeus verticalis

ANDRENIDAE

Andrena algida
Andrena aliciae
Andrena alleghaniensis
Andrena andrenoides
Andrena arabis
Andrena asteris
Andrena barbilabris
Andrena bisalicis
Andrena bradleyi
Andrena brevipalpis
Andrena canadensis
Andrena carlini
Andrena carolina
Andrena ceanothi
Andrena clarkella
Andrena commoda
Andrena crataegi
Andrena cressonii
Andrena distans
Andrena dunningi
Andrena erigeniae
Andrena erythrogaster
Andrena erythronii
Andrena forbesii
Andrena fragilis
Andrena frigida
Andrena geranii
Andrena helianthi
Andrena hippotes
Andrena hirticincta
Andrena imitatrix
Andrena integra
Andrena kalmiae
Andrena macoupinensis
Andrena mandibularis
Andrena mariae
Andrena melanochroa
Andrena milwaukeensis
Andrena miranda
Andrena miserabilis
Andrena morrisonella
Andrena nasonii
Andrena nigrihirta
Andrena nivalis
Andrena nubecula
Andrena nuda
Andrena perplexa
Andrena persimulata
Andrena placata
Andrena platyparia
Andrena regularis
Andrena rehni
Andrena robertsonii
Andrena rufosignata
Andrena rugosa
Andrena salictaria
Andrena sigmundi
Andrena simplex
Andrena spiraeana
Andrena thaspii
Andrena tridens
Andrena vicina
Andrena virginiana
Andrena wellesleyana
Andrena wheeleri
*Andrena wilkella**
Andrena wilmattae
Andrena w-scripta
Andrena ziziae
Calliopsis andreniformis
Perdita albipennis
Perdita bequaerti
Perdita halictoides
Perdita maculigera
Perdita octomaculata
Pseudopanurgus aestivalis
Pseudopanurgus rudbeckiae

HALICTIDAE

Agapostemon sericeus
Agapostemon splendens
Agapostemon texanus
Agapostemon virescens
Augochlora pura
Augochlorella aurata
Augochloropsis metallica
Dufourea marginata
Dufourea maura
Dufourea monardae
Dufourea novaeangliae
Halictus confusus
Halictus ligatus
Halictus parallelus
Halictus rubicundus
Lasioglossum achilleae

Lasioglossum acuminatum
Lasioglossum admirandum
Lasioglossum albipenne
Lasioglossum anomalum
Lasioglossum athabascense
Lasioglossum atwoodi
Lasioglossum birkmanni
Lasioglossum bruneri
Lasioglossum callidum
Lasioglossum cinctipes
Lasioglossum coeruleum
Lasioglossum comagenense
Lasioglossum coriaceum
Lasioglossum cressonii
Lasioglossum dreisbachi
Lasioglossum ellisiae
Lasioglossum ephialtum
Lasioglossum fattigi
Lasioglossum forbesii
Lasioglossum foveolatum
Lasioglossum foxii
Lasioglossum fuscipenne
Lasioglossum heterognathum
Lasioglossum hitchensi
Lasioglossum imitatum
Lasioglossum inconditum
Lasioglossum laevissimum
Lasioglossum leucocomum
*Lasioglossum leucozonium**
Lasioglossum lineatulum
Lasioglossum lionotum
Lasioglossum lustrans
Lasioglossum macoupinense
Lasioglossum michiganense
Lasioglossum nelumbonis
Lasioglossum nigroviride
Lasioglossum novascotiae
Lasioglossum oblongum
Lasioglossum obscurum
Lasioglossum oceanicum
Lasioglossum oenotherae
Lasioglossum paraforbesii
Lasioglossum paramirandum
Lasioglossum pectorale
Lasioglossum perpunctatum
Lasioglossum pictum
Lasioglossum pilosum
Lasioglossum planatum
Lasioglossum quebecense
Lasioglossum rufulipes
Lasioglossum subversans
Lasioglossum subviridatum
Lasioglossum taylorae
Lasioglossum tegulare
Lasioglossum tenax
Lasioglossum timothyi
Lasioglossum truncatum
Lasioglossum versans
Lasioglossum versatum
Lasioglossum vierecki
Lasioglossum viridatum
Lasioglossum weemsi
Lasioglossum zephyrum
*Lasioglossum zonulum**
Lasioglossum zophops
Sphecodes aroniae
Sphecodes atlantis
Sphecodes autumnalis
Sphecodes clematidis
Sphecodes confertus
Sphecodes coronus
Sphecodes cressonii
Sphecodes davisii
Sphecodes dichrous
Sphecodes galerus
Sphecodes heraclei
Sphecodes illinoensis
Sphecodes levis
Sphecodes mandibularis
Sphecodes minor
Sphecodes persimilis
Sphecodes pimpinellae
Sphecodes prosphorus
Sphecodes ranunculi
Sphecodes solonis
Sphecodes stygius

MELITTIDAE

Macropis nuda

MEGACHILIDAE

Anthidiellum notatum
*Anthidium manicatum**
*Anthidium oblongatum**
Anthidium psoraleae
*Chelostoma campanularum**
Chelostoma philadelphi
*Chelostoma rapunculi**
Dianthidium simile
Heriades carinatus
Heriades leavitti
Heriades variolosa
Hoplitis albifrons
*Hoplitis anthocopoides**
Hoplitis pilosifrons
Hoplitis producta
Hoplitis spoliata
Hoplitis truncata
Coelioxys alternata
Coelioxys banksi
Coelioxys funeraria
Coelioxys modesta
Coelioxys moesta
Coelioxys octodentata
Coelioxys porterae
Coelioxys rufitarsis
Coelioxys sayi
Coelioxys sodalis
Megachile addenda
Megachile brevis
Megachile campanulae
Megachile centuncularis
*Megachile ericetorum**
Megachile frigida
Megachile gemula
Megachile inermis
Megachile latimanus
Megachile melanophaea
Megachile mendica
Megachile montivaga
Megachile pugnata
Megachile relativa
*Megachile rotundata**
*Megachile sculpturalis**
Megachile texana
Osmia albiventris
Osmia atriventris
Osmia bucephala
*Osmia caerulescens**
Osmia collinsiae
Osmia conjucta
Osmia distincta
Osmia felti
Osmia georgica
Osmia inermis
Osmia inspergens
Osmia lignaria
Osmia nigriventris
Osmia proxima
Osmia pumila
Osmia simillima
Osmia tersula

Osmia texana
Stelis coarctatus
Stelis foederalis
Stelis labiata
Stelis lateralis
Stelis louisae
Stelis subemarginata
Stelis trypetina

APIDAE

Anthophora bomboides
Anthophora terminalis
*Apis mellifera**
*Bombus affinis***
Bombus auricomus
Bombus bimaculatus
Bombus bohemicus
Bombus borealis
Bombus citrinus
Bombus fervidus
Bombus flavidus
Bombus frigidus
Bombus griseocollis
Bombus impatiens
Bombus insularis
Bombus pensylvanicus
Bombus perplexus
Bombus rufocinctus
Bombus sandersoni
Bombus ternarius
Bombus terricola
Bombus vagans
Ceratina calcarata
Ceratina dupla
Ceratina mikmaqi
Ceratina strenua
*Epeoloides pilosulus***
Epeolus americanus
Epeolus autumnalis
Epeolus bifasciatus
Epeolus canadensis
Epeolus ilicis
Epeolus interruptus
Epeolus lanhami
Epeolus lectoides
Epeolus minimus
Epeolus pusillus
Epeolus scutellaris
Holcopasites calliopsidis
Melissodes agilis
Melissodes apicata
Melissodes bidentis
Melissodes bimaculata
Melissodes communis
Melissodes denticulata
Melissodes dentiventris
Melissodes desponsa
Melissodes druriella
Melissodes subillata
Melissodes trinodis
Nomada armatella
Nomada articulata
Nomada banksi
Nomada bella
Nomada besseyi
Nomada bethunei
Nomada ceanothi
Nomada cressonii
Nomada cuneata
Nomada dentariae
Nomada denticulata
Nomada depressa
Nomada florilega
Nomada gracilis
Nomada graenicheri
Nomada illinoensis
Nomada imbricata
Nomada integerrima
Nomada lehighensis
Nomada lepida
Nomada luteoloides
Nomada maculata
Nomada obliterata
Nomada ovata
Nomada parva
Nomada placida
Nomada pygmaea
Nomada sayi
Nomada sobrina
Nomada valida
Nomada vicina
Peponapis pruinosa
Svastra obliqua
Triepeolus cressonii
Triepeolus lunatus
Triepeolus michiganensis
Triepeolus pectoralis
Triepeolus remigatus
Triepeolus rhododontus
Xylocopa virginica

* refers to introduced species
** refers to endangered species


Deb Chute

A Chronology of the Toronto Bee Year

January and February

Solitary bees and next year's queens of bumble and social sweat bees are in diapause, a kind of hibernation, during the coldest time of year. The solitary bees may overwinter as fully grown larvae or as adults that have not yet left the nest. Most ground-nesting bees will be below the frost line, those that nest in twigs and wood will have filled their blood with anti-freeze-like substances to prevent them from freezing solid. Honey bees are keeping themselves warm by clustering together in a crowd in the middle of the hive.

March

As the weather warms, diapause is broken and some fully grown bee larvae may pupate. Species that overwinter as adults in the ground may start to dig upwards to ready themselves for flight. If there is an unusually warm spell (something which is happening with increasing frequency) some of the early-emerging bees may be seen.

Sheila Dumesh

Sheila Dumesh

April

As soon as the temperature gets to around 12°C on a sunny day, the first spring bees will become active. Overwintered queens of bumble and social sweat bees will forage on flowers, replenish their energy reserves and eat the pollen for protein that they need to start developing their eggs. The social sweat bee females will start digging new nests or refurbish the old one if they spent the winter inside it. Queen bumble bees will spend a long time searching for a suitable nest site and can often be seen inspecting various corners of a garden. Some solitary bee females begin nesting. The Common Eastern Plasterer Bee is one of the earliest to emerge and will forage on birch and maple catkins before more showy flowers open. They can be found forming mating swarms, where many males compete for a female that is burrowing up from the ground beneath.

May

Solitary mining bees and some *Osmia* mason bees can be found on Dandelion flowers and White Clover. Many mining bees are particularly attracted to willow and sallow catkins in late April and in May. By this time the social bee queens have usually started to produce a brood of workers and the earliest emerging species, such as the Band-footed Sweat Bee may even have completed a brood of half a dozen or so offspring and the queen will cease activity and wait in her nest for her worker daughters to emerge. The first cuckoo bees of spring usually start being active a few days after their hosts. Nomad bees, small wasp-like insects that you see flying low over the ground searching for host nests, start to become common especially on warm, south-facing slopes or rockeries.

June

Bumble bees now seem to be much smaller than they were earlier in the year. This is because the workers are smaller than the queens that started the colonies in April or early May. Many solitary bees are also foraging, though by now most of the adults of early spring species will have died off leaving only their developing brood. Leafcutter bees and Wool Carder Bees become active in this month and masked bees and small carpenter bees become common in gardens that have the resources that they need. Bicoloured Agapostemon females and other bright green bees will be foraging on the simpler flowers, asters and raspberries for example. Evening Primrose Sweat Bee females can be found if you watch sundrop flowers before 9am. These bees take all of the pollen from a single flower in one visit and so the first bee to get there gains all of the resources.

July

Gardeners have an abundance of tomatoes in flower by the hottest days of summer and worker bumble bees and some solitary bees such as the Red-tailed Flower bee collect pollen from these flowers and pollinate your crop. Red-tailed Flower Bees in particular can be heard making high-pitched buzzing sounds as they vibrate the flowers to loosen the pollen. Hoary Squash Bees can be seen tumbling in and out of squash and zucchini flowers early in the morning and the males might be found sleeping in a larger squash flower that has closed for the day. Eastern Calliopsis and the Calliopsis Cuckoo Bees that search for their nests can be seen in some sandy areas such as around the edges of a pond or lake. Social bees will usually switch from producing more worker-destined eggs to male and next year's queens at the height of summer.

Sheila Dumesh

August

Males of the social bees start becoming common in late summer and the green, yellow and black males of *Agapostemon* species may be so abundant that they appear to be swarming around Rose of Sharon bushes in their search for females. Workers of social bees become less and less common towards the end of the month. Nonetheless, there are some solitary bees that are most commonly found in this month, such as the Bee-balm Dufourea and there are still some species that have yet to even emerge as active adults.

September

Some solitary bees only start nesting as autumn approaches. Specialist bees that forage only on Goldenrod or asters become more common in this month. These include some of the fall plasterer and mining bees such as the Translucent Plasterer Bee and the Hairy Yellow Mining Bee. The cuckoos that attack these species, such as the Puny Colletes Cuckoo Bee, can also only be found at this time of year, more often low on the ground looking for host nests rather than on flowers. Male bumble bees are common on flowers at this time of year, their mates, which will become queens the following year, are less common because once they have mated and filled their stomachs with nectar, they locate somewhere to overwinter and do not emerge again until the following year.

October

The last of the fall bees will be foraging on late blooming flowers and their specific cuckoo bees can still be found searching the ground on warm days. Bumble bee males keep flying until killed by frost or exhaustion and many will start looking rather ragged as winter approaches.

November

Most bees are in their overwintering chambers by this time. A few solitary bees may be seen on the warmest days early in the month, but even bumble bee males will be uncommon as the flowering season comes to an end.

December

All of our bees are hidden from view, overwintering beneath the ground or in holes in stems, wood or in walls. You can still find adult Small Carpenter Bees by splitting open dried stems of fennel or raspberry canes, but they won't be flying around at this time. Even the late summer and early fall solitary bee offspring have become fully grown larvae by December.

Sheila Dumesh

Sheila Colla

Flowers, Flowers, and more Flowers

Flowers are a delight to people and to bees. The pollen from flowers is the food for baby bees, so an abundant and diverse supply of flowers from early spring to fall supports many kinds of bees. One of the pleasant challenges of gardening for bees is figuring out how to have flowers in bloom continuously from April until October! One important thing to bear in mind when designing a garden for bees is that simpler flowers, such as asters and raspberries, are generally better for bees than complex ones such as delphiniums and gladioli.

Spring

Early-blooming plants are essential to queen bumble bees beginning their colonies. Ontario native flowers such as Canadian Bloodroot, violets, or our Provincial flower the Trillium are good for some bee species, and can be mixed in as bulbs with displays. Flowering shrubs and fruit trees are great if you have space, but if you have to think smaller try some strawberry plants. The bees that pollinate your fruit-yielding flowers will benefit and you'll have more fruit to eat later in the season. A lovely shrub or small tree that should be planted more often is the Canadian Serviceberry, whose charming white blooms open early and are followed by delicious small purple berries for pies or for the birds.

There's often a lull in blooms in late spring before summer blossoms come, but this slow period for bees can be nicely filled in by growing raspberry or blackberry bushes, again with delectable side benefits for the gardener. There's one more plus with berry bushes: if you leave about two feet/60 cm of year-old stems on the bush when you do fall pruning, stem-nesting bees will nest inside the canes the next year. Leave these old stems until the following year and you will not just have fed the bees with your fruit bushes, you will have housed them too!

Summer

Almost anything goes during the summer months, when garden bloom is easiest to arrange. Annuals or perennials, short or tall, it's hard to go wrong in this season...but, it is possible! Did you know that some garden varieties of flowers have been deliberately bred to lack pollen and nectar? These plants may look good to us, but are not so good for bees. Examples include most highly doubled flowers such as many rose varieties, (although many wild roses contain lots of pollen – just look carefully at a flower to be sure) and packets of sunflower seeds advertised as "pollen-free".

Some great native plants bloom for a long time in the summer – these include pink and purple coneflowers, many kinds of golden daisies like the Black-Eyed Susan, and the scarlet, pink, white or purple flowers of the well-named Bee Balm species. One good trick to know is that after the flowers fade, cutting them off (dead-heading, gardeners call it) will often cause a second, third, or even fourth wave of bloom.

Deb Chute

Fall

Goldenrods, purple asters, and later chrysanthemums are typical flowers of early, middle, and late fall. All of them are attractive, long-flowering, and quite helpful to bees. In a smaller space or a window box, try planting the fragrant white flowers of Sweet Alyssum, mixed with other hardy stalwarts such as stocks and calendulas. In recent years this mix bloomed up to and even past Halloween.

Lawns

The grand manorial lawns of Britain that we now imitate were closely cropped by livestock and contained a variety of flowering plants as well as grasses. Modern bluegrass-only lawns are much more vulnerable to bald spots caused by Japanese beetles or other grubs than a mixed lawn, and a mixed lawn stays greener with less watering in hot dry summer conditions than a grass-only lawn. Delightfully low maintenance lawn seed mixes are sold by Ontario growers that can be cut once a month and require no watering once established. They will be very attractive to bees. Or, you can very simply and quickly create a bee-friendly lawn by sowing White Clover and flowering Creeping Thyme in with your grass. You will have fragrant white and pink flowers mixed in with your grass and a constant stream of bee visitors!

Water features

Many gardeners enjoy the soothing sound of a fountain falling into a small garden pond, and water can be in surprisingly short supply for bees and other wildlife in some parts of the city. If you build a water feature, add a small shore of fine sand or soil where bees and butterflies will come to drink. You can even do this by putting something like a towel or sponge into a birdbath. If you plant native water plants like our purple-blue Pickerelweed in the shallow parts of a pond, you may attract unusual kinds of bees such as the New England Dufourea.

Special habitats

Just as blackberry and raspberry canes are used for nests by some kinds of bees, there are other special habitats you can create in a corner in your garden. For example, some kinds of bumble bees nest in the dense stems at the base of the large clumps of ornamental grasses, so leave a foot or so of old stems when you prune. Simply loosely piling hay or stems in an out-of-the-way spot may tempt bumbles to breed. Other kinds of bees nest in tunnels in the ground. Parts of the city with fine sandy soils and hillsides, such the High Park area or the Beaches, make perfect places for some ground nesting bees. If you have a garden with fine soil and a slope, leaving a few exposed miniature “cliffs” a few inches tall will attract bees that like a vertical surface to start their burrow in. A good place for this is the garden path: placing flagstones so that their downhill edges stand above a mini-cliff creates habitat very easily. There are also instructions and designs for “bee condos” – garden sculptures that native bees will nest in – in the reference section of the booklet. These are increasingly popular and provide a challenge for your creativity.

Honey Bee Beekeeping in Toronto

Honey bees are not native to Toronto and originally came from Europe to North America with the settlers who brought them by ship in the early 1600's for honey production. While there are approximately 20,000 different types of wild bees in the world there are only about 7 different recognized species of honey bees only one of which is used in North America but exists in numerous strains. Some of the most common honey bee strains used in Toronto's urban beekeeping scene are Carnolian, from the subspecies *Apis mellifera carnica* and the Italian from the subspecies *A. m. ligustica*.

While there are no municipal by-laws governing beekeeping in Toronto there is the Ontario Bees Act R.R.O. 1990 which requires that all hives in the province be registered with the provincial apiarist. This is done among other things to help control the spread of disease between colonies. Further the Act stipulates that hives must be placed 30m from a property line or 10m from a highway. Due to the small size of lots in the City of Toronto there are not many locations to practice urban beekeeping legally. Changes to the Act do occur and it is advised that anyone wishing to keep honey bees should consult e-laws Ontario for the latest version.

One must remember that over 100 years ago, Toronto was mostly prime farmland with beekeeping practiced to help increase crop yield due to the bees' pollination services as well as honey production, beeswax candles and other health products from the hives such as bee pollen, propolis and royal jelly. The development of the city built over lots of prime farmland and as the city grew and was no longer an agricultural entity beekeeping was less and less practiced. Nevertheless Charles Sauriol, one of Canada's most honored naturalists, was a champion of conservation lands while Toronto was urbanizing and along the Don Valley he had a 40 acre property where he was a longstanding beekeeper.


Brock Harpur


Nadia Tsvetkov


Nadia Tsvetkov

Today, the Toronto Beekeepers Co-operative (TBC), which has been in existence since 2002, manages about 30 hives in the City. Six are on the rooftop herbal garden of the Fairmount Royal York Hotel, where the honey is used in the hotel's meals and some is taken to the Distillery District where the Mill Street Brewery makes a honey lager. TBC manages three hives for the Toronto Botanical Garden where some TBC members are instructors of an introductory beekeeping course. The TBC also has about 22 hives at Downsview Park, where participation in the Park's educational program is a part of their beekeeping activities. The TBC partners with FoodShare (See www.torontobees.ca). FoodShare, a charitable organization that promotes urban agriculture, receives half of the honey harvested and the rest is divided among the co-op members. In April of 2011 the TBC was awarded a "Green Toronto Award" by the City of Toronto, in the "Local Food" category. The award recognized TBC's work in supporting honey bee populations throughout the City but also the valuable work that honey bees contribute as pollinators, helping boost local food production.


Scott MacIvor

There are also some beehives at the St. George campus of the University of Toronto as well as a permanent observation hive at the Royal Ontario Museum that is managed by Paul Kelly of the University of Guelph, a leading centre of honey bee research in Canada. A former member of the TBC manages some hives at the Four Seasons Centre for the Performing Arts as well as at Casa Loma. Some colonies are also at Toronto's Centre Island and in the Leslie Street Spit area where Brian Hamlin is the beekeeper; he also mentors beekeeping activities at the University of Toronto Scarborough Campus.

The Toronto District Beekeepers Association (TDBA) has been in existence for just over 100 years and during the beekeeping season has monthly meetings at the Kortright Centre. There TDBA members get together to discuss various beekeeping practices often with a guest speaker such as the provincial apiarist or other esteemed members of the beekeeping community. This provides a forum for members to share their knowledge about important issues such as diseases and other pests that can harm honey bees. Charles Sauriol's legacy of beekeeping continues with his grandson Andre Flys being a longstanding member of the 150+ members of the TDBA.

Now some newly constructed buildings in the City of Toronto have required a green roof (photo to left). This welcome environmentally friendly by-law can provide additional forage for native and honey bees in the City. It is expected that interest in beekeeping within the GTA will increase in the future.

Bees in the Arts

Local bees, wasps and other pollinators not only fascinate biologists, they also capture the imagination of creative artists. Many of these artists look for new ways to encounter these important but frequently overlooked creatures with photography, video, visual art, sound recordings and poetry.

Here are some examples of people in the arts and their perspective on bees: the intriguing, often invisible world of these tiny Torontonians.

Sarah Peebles & Resonating Bodies

Composer, audio and installation artist and environmental activist Sarah Peebles works with biologists, technicians, designers and other artists to create outdoor installations, mixed media works and the blog "Resonating Bodies", which engages and educates a broad audience about bee biodiversity and which documents these artworks (resonatingbodies.wordpress.com).

Peebles is interested in bringing people in direct contact with wild bees and their environments in intimate, immersive settings. Her viewable and listenable homes for solitary bees, "Audio Bee Booths and Cabinets", are permanent outdoor installations which bring together sculpture, bioart, sound and habitat interpretation. Woodburned illustrations of pollinators, plants and life cycles tell the story on the outside of the cabinets. Inside, grooved boards covered with plexiglass provide individual apartments, like condos, for the many varieties of solitary bees and wasps naturally found in the area. Vibrational sensors embedded in the nesting planks are connected to an amplifier and act as very sensitive microphones. Using headphones and a magnifying lens, visitors experience a micro world which normally takes place in the dark, safely spying on the bee's and wasp's nesting activities, life cycles, parasites, and their dynamic relationships with the surrounding habitat.

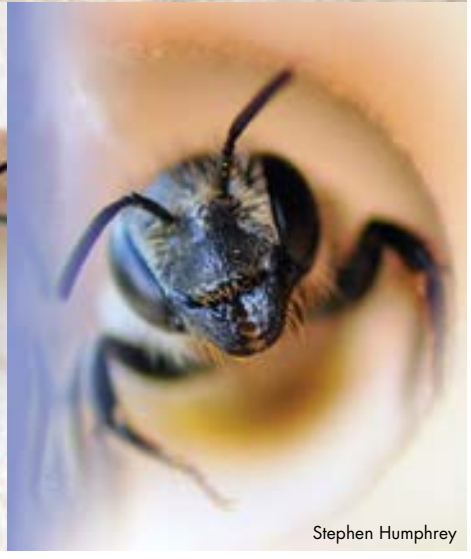
Audio Bee Booths and Cabinets in the Toronto-Guelph-Niagara region are open to the public and are documented online at "Resonating Bodies". They were created with the assistance of several talented craft artists. "Resonating Bodies" group collaborations have included "Bumble Domicile" exhibit, "Odes to Solitary Bees" video-poems and "Bee Trading Cards" (with Stephen Humphrey, next page). See the RB blog for artists, scientists and details.

Resonating Bodies Bee Trading Cards are sold through the Pollinator Partnership.
Rob Cruickshank

The Audio Bee Booth "Pollination Wunder Station" (Sarah Peebles) and inhabitants.
Rob Cruickshank

Stephen Humphrey

Stephen Humphrey



Stephen Humphrey

Stephen Humphrey

Odes To Solitary Bees

Writer, journalist and photographer Stephen Humphrey spent hours and hours in front of "audio bee booths", designed by artist Sarah Peebles, watching and listening to leafcutter bees, mud dauber wasps and other curious residents of Toronto's insect world.

The result was striking videos and photographs, and short poems based on the Japanese tanka form, which attempt to describe the lives of solitary bees and wasps in five short lines.

These "Odes of Solitary Bees" recently appeared on large scrolls in a Vancouver Island gallery. The "Odes" and the videos which accompany them can be viewed on the Resonating Bodies website.

In 2010 Stephen was named writer-in-residence at the University of Guelph's School of Environmental Science, making him one of just a handful of writers who've been residents in a science department.

In 2012 the CBC aired the radio documentary "Dancing In the Dark", which featured Stephen interviewing renowned scientists about bee intelligence. In 2013, "Dancing In the Dark" placed as a finalist for the prestigious New York Festival Award [in the Environment & Ecology category].

www.stephenhumphrey.ca

Things With Wings

www.charmainelurch.ca

Charmaine Lurch is a painter, wire sculpture artist and arts educator. Her recent work highlights wild bees and brings them into the popular imagination, through her larger-than-life wire sculptures. These sculptures evoke the relative invisibility of wild bees and call attention to the tremendous role they play in sustaining our ecosystem.

It was while observing and recording the structure and volume of bees through drawing that she envisioned the physical manipulation of wire as a means of capturing the elusive nature of these creatures.

This body of work contrasts cool metal wire, against brilliantly coloured threads, which are woven through some of the artworks and based on the actual colours of wild bees.

Collaboration is integral to Charmaine's creative process. This includes discussing wild bees with the public. On occasion, she invites volunteer beekeepers to work on the construction of the pieces, learn about bees and explore their own creativity.

Ongoing conversations with scientist and environmentalists continually shift her perspective and allow her to expand on initial concepts. These collaborations help bring the scientific dialogue to life, and highlights the role of the artist in bringing awareness to important environmental issues.

Top: Charmaine Lurch with two of her sculptured 3D bee models.

Below: a close-up of one of the bee sculptures, resembling Agapostemon, a metallic green bee commonly found around the city of Toronto in late summer (see page 22 for more details on this bee).

Five of Ele Willoughby's linocut artworks. Bee genera depicted, clockwise from top left: *Osmia, Megachile, Bombus, Apis, Melissodes*.

You can find all of Ele's artwork at:
www.etsy.com/ca/shop/minouette/search?search_query=bee

Ele Willoughby

www.fragmentalist.com

Ele Willoughby is a Toronto-based printmaker and multimedia artist. Her work in progress involves relief prints (prints made from the surface of blocks in wood, stone or other materials where the negative space is carved away) of local bees in electrically conductive ink. The special ink in these prints makes them act as proximity sensors. If a viewer approaches any image of a given bee species it will trigger an audio recording of the associated bee. Ele plans to feature six bees local to the Toronto region in her work. So far Ele has made linocut images of the six species and worked out how the sensor and speaker will work. The bees will be printed onto paper which itself will act as a speaker (thanks to some simple electronics and magnets).

The graphic coloration of bumble bees initially attracted Ele as an excellent subject for a relief print. Upon learning about the local biodiversity of bees, she was then inspired to make further portraits of different species. She was intrigued that the best known, typical 'default' concept of a bee for most people is the Honey Bee, although honey bees are far from typical. No honey bees are native to North America. Many bees are solitary, live in the ground and do not make hives or honey. Several bees are unexpected colours, like metallic blue-green, rather than yellow. Her planned work will contrast the 'default' honey bee with actual native species, which look, sound and behave differently. The interactivity of the piece will allow the viewer the sense of getting to know, and hopefully celebrate, the bees which are native and important to our ecology.

Local Policy Initiatives to Protect Bees

City of Toronto

Protecting and enhancing the natural environment and biodiversity is a high priority for the City of Toronto. The Official Plan is the City's guiding land use planning document. It protects important natural areas and functions, supports biodiversity and requires that the natural environment be taken into account as part of our city building activities.

Toronto's natural heritage features and functions have been mapped and are identified as a natural heritage system on Map 9 of the Official Plan. Most of these areas are located within the extensive network of valleys and ravines that cross our City, along the shoreline of Lake Ontario and in Rouge Park, and are protected by zoning and land use designations. These areas provide habitat for a wide variety of native plants and animals and help sustain local biodiversity. When new development is proposed in or near the natural heritage system, the proposed development's impact must be evaluated and measures must be identified to protect the system, mitigate negative impacts and improve the system.

Good stewardship supports and enhances biodiversity. The Ravine and Natural Feature Protection Bylaw protects forests and valley slopes by regulating removal of trees and changes to grade.

The City also undertakes a wide range of stewardship activities in parks and natural areas, often in partnerships with other agencies, institutions and community groups. Examples include control of invasive species in ravines and woodlands; naturalization programs; tree planting events; ecological enhancement of existing habitats; creation of new habitats such as wetlands and meadows; and restoration of rivers and streams.

The impact of the built environment on biodiversity and the natural environment is also being reduced. Toronto's Bird-Friendly Development Guidelines and the "Lights Out Toronto!" campaign identify building design and lighting strategies that reduce migratory bird deaths. The Green Roof Bylaw is creating green spaces on rooftops that support insects and some birds and have the potential for further biodiversity enhancements. The Toronto Green Standard, which all nevw development applications are required to meet, includes performance measures that help preserve the urban forest, encourage tree survival and growth, and ensure native species are planted. Collectively, all of these actions reduce the impact of our city building activities on the natural environment and help protect and increase biodiversity.

Wildlife Preservation Canada

Working towards saving species at risk, WPC is a non-government organization striving towards conserving our Canadian wildlife. From captive breeding to reintroducion, this organization is committed to the recovery of endangered species. WPC is working to restore populations of at-risk bumble bees nationally by engaging citizen scientists, working with landowners to restore habitat and through targeted conservation management.

TRCA

The Toronto and Region Conservation Authority is geared towards a sutainable environment in the city. Their goal is to expand the green spaces across the GTA, while educating the community to live healthier. Working with individuals as well as businesses and governments, the TRCA builds strong relationships with others, thereby aiding in the environmental protection and restoration.

Nature Conservancy of Canada

The Nature Conservancy of Canada works nationally to protect and restore areas of natural diversity; conserving our country's natural heritage. These areas provide important and high quality habitat for hundreds of species of native pollinators throughout Canada.

Federal and International Policies for Pollinators

COSEWIC

The Committee on the Status of Engangered Wildlife in Canada (COSEWIC) is a non-governmental panel of wildlfe experts who evaluate the status of species at risk or nearly at risk.

Thus far, 471 species are listed as threatened or endangered in Canada and, among those are two bee species: the Rusty-patched Bumble Bee, *Bombus affinis*, and the Macropis cuckoo bee, *Epeoloides pilosulus*.

Two additional bumble bee species have been assessed by COSEWIC, but are not yet formally listed by the government: the Gypsy cuckoo bumble bee, *B. bohemicus*, and the western bumble bee, *B. occidentalis*.

The Species at Risk Act of Canada (SARA) works towards preventing the loss of wildlife species in Canada. In order to do so, the focus of COSEWIC is to manage those species which are at lower risk and to help in the recovery of those which are already threatened or endangered in the wild.

How You Can Help Bees

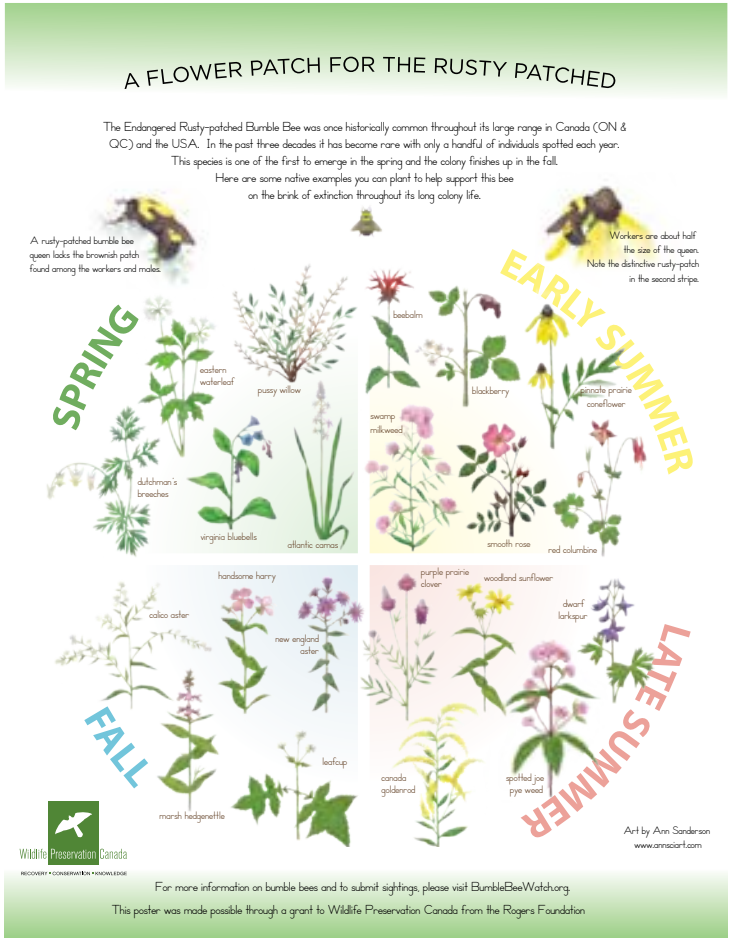
1. Use as little mulch as possible. You would not want compost piled on top of the entrance to your home, and putting mulch, or compost, on top of a bee's nest entrance causes them lots of trouble. Indeed, leaving open patches of soil encourages ground-nesting bees. South-facing slopes and rockeries can be particularly good.

2. Cut plant stems as far above the node as possible, letting that portion of the stem dry. This will be good nesting material for certain cavity nesting bees that will sculpt out the pithy stem to build a nest.

3. Don't throw away twigs and small branches which are cut back during winter or spring maintenance. Many of these will house nesting bee larvae that will emerge in the late spring or summer. Keeping these bundled up, off the ground, and in a sunny spot, will ensure these bees will survive and pollinate the flowers, fruits, and vegetables in your yard.

4. Pesticides should be avoided. These chemicals are broad spectrum, so will also kill many other beneficial organisms. In order to eradicate weeds and other unwanted plant residents, try pulling them out of the ground when they are small. Instead of spraying toxic chemicals, try using dish detergent mixed with water, a baking soda solution, or an infusion of garlic, onions and chiles.

5. Plant a variety of (native) flowers. Native plantings are best, but also important to incorporate are flowers of different colours, heights, and flowering times. Although many native plants might be considered to be weeds, our local bees will be adapted to use these; the complex floral design of horticultural and many exotic plant varieties are difficult, or impossible, for bees to access. Many vegetable and fruit plants are great for bees and they will work hard to pollinate them. Raspberries are particularly good: many bees use their pollen and multiple genera will nest in the old canes.



Xylocopa virginica on obedient plant.
Deb Chute

Conclusion

Bees are vital to our ecosystems as a result of the pollination services they provide. Without bees pollinating our crops and wild plants, we would be left with a very limited source of food. Most of our colourful fruits and vegetables would be in short supply and prices would skyrocket. Not to forget, coffee production is increased by bees and most of us would not be able to wake up without a cup. Many other animals rely on the services provided by bees in terrestrial ecosystems. It's very important to do what's possible in order to conserve what is left of our natural world, and bees are a great part.

With a changing landscape and increased habitat fragmentation over the recent past, some bee species have become endangered or even extirpated from the Toronto area. We still have over 300 species of bee in the city and they buzz in our gardens, parks, nature trails, and even in the downtown core. Protecting the habitats for thriving plant and animal species is vital and can only be done with committment and understanding of the importance of the cause. Many groups, such as citizen scientists, stewardship programs, educational facilities, and government agencies are striving for a better understanding of biodiversity of the city and how to conserve and protect it. Public events also help spread knowledge to the many communities within the city of Toronto.

The fear of bees, because of their sting, should be counteracted by their beauty and vital role as pollinating insects. Bees are indicators of the status of an ecosystem and can be used for monitoring purposes. Rather than running away from a bee, watch it as it moves from flower to flower, working hard to provide us with a diverse and colourful landscape. They should be inspiring for these reasons and we owe it to them to protect the spaces in which they nest and feed.

Melissodes on a large Sunflower at the Perth-Dupont Community Garden.
Susan Berman

Select Bee Guides and Resources

BOOKS

Field Guides

P. H. Williams, R. W. Thorp, L. L. Richardson & S. R. Colla. 2014. **Bumble Bees of North America: An Identification Guide.** Princeton University Press. 208pp

S. R. Colla, L. L. Richardson & P. H. Wilson. 2011. **Bumble Bees of the Eastern United States.** United States Department of Agriculture. 103pp

(Also available online: www.fs.fed.us/wildflowers/pollinators/documents/BumbleBeeGuideEast2011.pdf)

J. S. Wilson & O. J. Messinger Carril. 2015. **The Bees in Your Backyard: A Guide to North America's Bees.** Princeton University Press. 288pp

D. Goulson. 2003. **Bumble Bees: Their Behaviour and Ecology.** Oxford University Press

Bombus. Scott MacIvor

Books

S. L. Buchmann & G. P. Nabhan. 2012. **The Forgotten Pollinators.** Island Press

S. Droege & L. Packer. 2015. **Bees: An Up-Close Look At Pollinators Around The World.** Voyageur Press.

H. Holm. 2013. **Pollinators of Native Plants: Attract, Observe and Identify Pollinators and Beneficial Insects with Native Plants.** Pollination Press LLC

C. Michener. 2007. **Bees of the World.** John Hopkins University Press

C. O'Toole & A. Raw. 1991. **Bees of the World.** Blandford Press

L. Packer. 2010. **Keeping the Bees.** Harper Collins

K. Weiss. 1997. **Little Book of Bees.** Springer-Verlag

Xerces Society. 2011. **Attracting Native Pollinators: The Xerces Society Guide to Conserving North American Bees and Butterflies and Their Habitat.** Storey Publishing Inc

WEBSITES

Online Bee Identification Guides:

Discover Life:
www.discoverlife.org

Canadian Journal of Arthropod Identification:
www.biology.ualberta.ca/bsc/ejournal/ejournal.html

Bug Guide:
www. bugguide.net

Bee Families of the World:
www.yorku.ca/bugsrus/BFoW/Images/Introduction/Introduction.html

Bee Genera of Eastern Canada:
www.biology.ualberta.ca/bsc/ejournal/pgs_03/pgs_03_key.html

Colour Key to the Bombus of the World:
www.nhm.ac.uk/research-curation/research/projects/bombus/_key_colour_world/worldcolourkey.html

Xerces Society of Invertebrate Conservation:
www.xerces.org

Bumble Bee Pocket Identification Guides:
www.xerces.org/publications/identification-guides/bumble-bee-pocket-id/

Xerces Society of Invertebrate Conservation:
www.xerces.org/bumble bees/

Honey Bee Information and Beekeeping:

Ontario Bee Keepers Association:
www.ontariobee.com

Toronto Bee Keepers Cooperative:
www. torontobees.ca

General Bee Information:

Beautiful North American Bees:
www. beautifulbees.org

Pollinator Partnership:
www. pollinator.org

Mobile Applications:

Bee Smart:
Pollinator Gardener

Megachile rotundata. Scott MacIvor

Acknowledgements

Contributing Authors

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Sheila Colla (left), Cory Sheffield (below), Steve Marshall, Sam Droege, Stephen Humphrey, Charmaine Lurch, Sarah Peebles, and Ele Willoughby.

The list of the bees of the GTA (presented herein) is based upon the bees of Ontario portion of the checklist of the bees of Canada, a work in preparation by Cory Sheffield (Royal Saskatchewan Museum).

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Royal Ontario Museum: www.rom.on.ca

Biodiversity Institute of Ontario, University of Guelph: www.biodiversity.uoguelph.ca

Ontario Beekeeper's Association: www.ontariobee.com

First nations legend: www.firstpeople.us/FP-Html-Legends/HowTheHoneyBeeGotTheirStinger-Cherokee.html

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Office of the Vice President for Research and Innovation at York University

Back cover photo: The mining bee, *Andrena dunningi*, is a pollinator active in spring. It tunnels a nest underground, preferring soft, sandy, and bare soils. Sheila Dumesh

The Common Eastern Bumble Bee, *Bombus impatiens* visits a Canadian thistle *(Cirsium arvense) flower*. Sheila Colla