TRINIDAD AND TOBAGO
POLLINATOR COMMUNITY SCIENCE MONITORING GUIDE

Government of the Republic of Trinidad and Tobago
Ministry of Planning and Development

BESNet
Biodiversity and Ecosystem Services Network

UNDP

Acknowledgements

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The Xerces Society for Invertebrate Conservation is a donor-supported nonprofit organization that protects our world through the conservation of invertebrates and their habitats. Xerces has championed Earth's most biodiverse and overlooked animals for over 50 years, protecting the life that sustains us. Learn more at xerces.org.

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We are grateful to the many photographers who allowed us to use their wonderful photographs in this monitoring guide.

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Getting Started

Introduction

Invertebrates are tremendously diverse and ecologically valuable. They filter water, recycle nutrients, pollinate flowers, and are food for other wildlife. Pollinators are especially vital because of the ecosystem services they provide by pollinating crops and wildflowers. Insect pollinators include bees, wasps, flies, beetles, butterflies, and moths. Of these, bees are often the most effective pollinators because (with a few exceptions) they are the only group that actively collects pollen to feed their young and therefore have bodies that are very effective at carrying large amounts of pollen. Many other species are also involved in pollinating plants. Birds and bats are some of the more notable ones, especially in the Caribbean.

This Citizen Science Monitoring Guide will allow you to track richness and abundance of various pollinator groups in a variety of sites including gardens, agricultural areas, restoration sites, tropical forests, and almost any habitat where they occur.

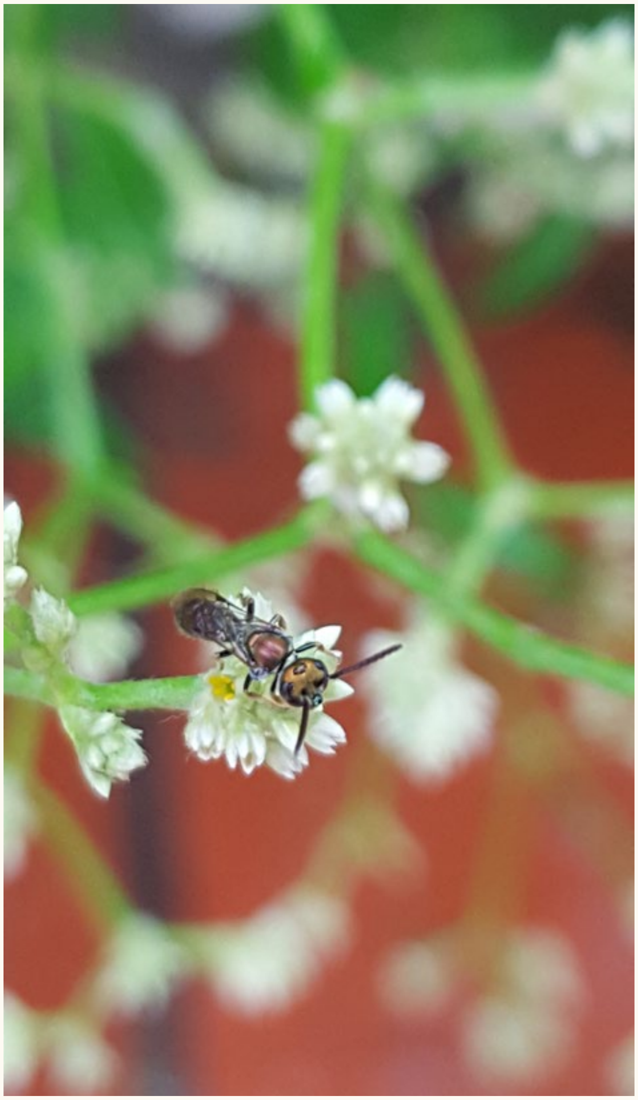


Figure 1: Bees are one of most important group of pollinators in Trinidad and Tobago, responsible for pollinating numerous crops and wildflowers. (Photograph by Lena Dempewolf.)

For most people, when they hear the word "bee," a single species comes to mind, the nonnative European honey bee. However, Trinidad and Tobago is home to more than 150 species of native bees. Additionally, a large number of flies, butterflies, beetles, wasps, birds and bats also pollinate a range of plants. Roughly one third of crop production and about 85 percent of the earth's flowering plants rely on pollinators to set seed and fruit.

In recent years, research has shown that native species are highly valuable for crop pollination, and in many cases they can be more efficient at pollination than honey bees. This is especially relevant today as the honey bee industry continues to struggle internationally with pests, diseases, pesticide exposure, habitat loss, and the phenomenon termed "Colony Collapse Disorder." Together, these threats combine to cause beekeepers to lose 25–35% of their hives each winter since 2006.

The Trinidad and Tobago component of BES-Net Phase II, or BES-Net TT Project, implemented by the United Nations Development Programme (UNDP) and executed by the Ministry of Planning and Development of Trinidad and Tobago, seeks to address the science, policy and practice of pollination and pollinator management in Trinidad and Tobago. Issues facing pollinators in Trinidad and Tobago largely stem from a lack of data, a lack of public awareness and a lack of pollinator-appropriate management. This project aims to address these challenges by engaging a broad range of stakeholders through public awareness and citizen science initiatives, identifying knowledge gaps, encouraging and supporting scientific research, facilitating collaboration and improving livelihoods, and reviewing policy. It is expected that because of these activities, knowledge and understanding of pollinators and their threats and management options among the general public increases; management of pollinators improves, particularly among food producers; a number of tools are made available to present and future generations.

The Xerces Society for Invertebrate Conservation has partnered with the Natural Resources Conservation Service (NRCS), Soil and Water Conservation Districts (SWCDs), Bureau of Land Management (BLM), Forest Service (USFS), Port Authorities, and landowners throughout the United States of America to protect, restore, create, and enhance native bee and butterfly habitat on the lands they manage. Since 2006, the Xerces Society and their university research partners have used professional,

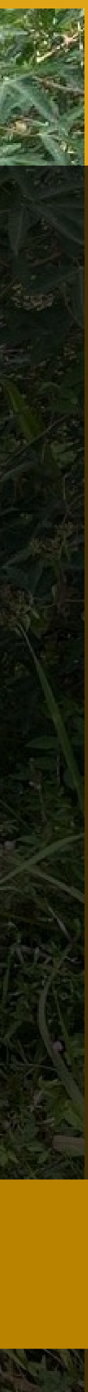
Figure 2: The pollen carried on flower-visiting insects is an essential link in the web of life. This Leafcutter Bee (Megachilidae) is visiting cucumber flowers. (Photograph by Mace Vaughan.)

standardised monitoring protocols to document how bee and butterfly communities respond to restored pollinator habitat. To complement this professional monitoring, they with partners at the University of California– Berkeley to develop a simplified bee monitoring protocol for California and trained citizen scientists to observe and identify morphogroups of bee species (that is, sets of species that look similar and, in some cases, are closely related). Comparative analysis of the data gathered by these citizen scientists and data gathered by experts suggests that the morphogroups used by citizen scientists are effective at detecting community level changes in bee abundance and richness."

The majority of the native insect pollinators in the Caribbean can only be identified to species by looking at the specimens under a microscope and there are only a handful of taxonomists who can accurately identify all bees to this species level! However, don't despair! By using the observation protocol and identification keys found in this guide and by practicing observations with experts, citizen scientists can learn to identify and monitor some of the most common species and morphogroups found in Trinidad and Tobago.

Scientist Monitoring Protocol

Figure 3: Monitoring of pollinators usually requires nothing more than careful observation of what the insects on flowers are doing and what they look like. By following the same procedure each time, you can build up a valuable record of which pollinators are most abundant at your site and changes in their populations over time. (Photograph by Kelly Gill.)



Monitoring Pollinators

The primary purpose of this monitoring protocol is to provide a method the public and land managers can use to measure the relative species richness and abundance of pollinators in a specific area, and to record changes in their populations over time. This information may be useful if land managers are working to increase the numbers and types of pollinators in an area by enhancing floral resources and/or nesting sites. Monitoring allows for the documentation of how restoration practices are affecting these communities. Furthermore, if nearby crops need insect pollination to set fruit, monitoring pollinator visitation on these crops will give valuable information about the service provided by local pollinator communities.

The bee monitoring protocol in this guide has been adapted from a standardised method of collecting bee data and setting up monitoring plots that was developed by bee biologists .

Butterfly monitoring, and that of other pollinator groups, uses a different protocol and cannot be completed at the same time as bee monitoring.

Pollinator communities vary depending on the quality of the immediate and surrounding habitat. Documenting changes in these communities using this protocol will allow you to assess the efficacy of best management practices aimed at increasing pollinator abundance and richness. Best management practices may include enhancing floral resources, nest sites and host plants, reducing tillage, changing mowing regimes, and reducing the non-target impact of pesticides. Alternatively, using this protocol to monitor pollinators in field crops or orchards can provide insights into which native species provide farmers with free pollination services.

To develop an accurate picture of how communities are changing, however, it is important to keep in mind the following points:

- Because one of the primary goals of monitoring is to get comparative data about changes in richness and abundance over time, consistency in using the monitoring protocol is crucial.
- Populations vary depending on the time of year, time of day, and weather patterns. Because of this it is important to survey several times in a given season, and gather a few years of data before coming to any conclusions.
- While this approach is geared towards those who are not experts in animal identification, accurate monitoring does require training and practice in identifying the broad morphogroups detailed in this guide.

Overview of Techniques and Guidelines

The groups addressed in the identification guide are for use in the Trinidad and Tobago, although there are strong similarities with pollinator groups from other Caribbean islands. As Trinidad and Tobago still lacks considerable data regarding pollinator species, particularly insects, you may come across species that do not fit into the categories found in this guide.

Standard monitoring techniques used by the research community to measure richness and abundance include collecting floral visitors with nets and using pan traps (bowls of soapy water) or blue vane traps. In those cases, specimens are collected, pinned, and then identified to species by a taxonomist. While these collection techniques provide the most refined data, they can be labour intensive, expensive, and require very specific expertise. Additionally, if not carried out properly, they can lead to over-collecting. Collecting observational data on floral visitors is an economical and effective alternative way to monitor pollinator populations. This protocol focuses on collecting observational data; however, it can also be useful to build a local reference collection of the species you find at flowers. Building a reference collection will help you learn the floral visitors on-site and will be a useful tool for training future observers.

The Citizen Scientist Pollinator Monitoring Guide can be used to collect consistent observational data on pollinator communities. Guidelines in this publication include information on: (1) setting up monitoring transects, (2) sample timing, (3) appropriate weather conditions for monitoring, (4) observing organisms at flowers, (5) recording data, (6) analysing data, and (7) identifying groups of floral visitors.

This monitoring tool is designed to be used after training with Xerces Society staff or professional scientists familiar with this monitoring guide. Training is important because consistently and accurately identifying even broad categories of bees based on their appearance takes some practice and feedback from experienced people.

Setting up Transects in Monitoring Plots

The goal of this monitoring protocol is to identify specific associations between pollinators and their habitat. Therefore, monitoring transects should be located within a relatively uniform habitat type, such as a field, tropical forest environment, or crop.

Transects should be equally spaced throughout the study area. For areas less than two acres (0.8 ha) in size, a single transect through the middle of the site should be sufficient. A transect length of at least 75 m is ideal, although in smaller areas this may not be possible. For areas that are greater than two acres (0.8 ha) in size, two to three transects should be used for a total length between 180 – 225 m ' (for example, three transects ' 60 – 75 m long, or two transects 90 – 110 m long). If multiple transects are used, they should be positioned 30 m apart, or as far apart as possible while still being in the interior of the plot (ideally at least .

For monitoring linear habitats like hedgerows or roadsides, transects should be at least 60 m long and spaced evenly along the length of the habitat. If sampling both sides of a hedgerow, transects should be at least 8 m apart.
It is important to map the study area and transect points. This will allow other researchers to monitor that area in the future. If possible, take coordinates using a GPS unit or phone. If no GPS is available, mark the study area and transects on a topographic map, aerial photo, or Google Earth. It is also helpful to stake and flag monitoring transect points before monitoring to ensure a consistent and efficient monitoring scheme. Tall stakes (e.g., bamboo) with bright flagging are more visible as vegetation grows, and will help observers walk in a straight line a long the transect.

Sample Timing

Weather and seasonal changes affect when and where pollinators forage for pollen and nectar; consequently pollinator communities may vary greatly between samplings. While some bee groups appear consistently during every sample session, other groups are abundant only at certain times of the year (or day, or under specific conditions). For this reason, it is ideal to monitor a study site monthly (or even more frequently). At a minimum, monitoring should occur at least twice throughout the course of the year, in the rainy season and in the dry season.

Whichever method you choose for your site, consistency is very important. Once dates (and times) and frequency of monitoring are selected, they should be repeated as closely as possible from one year to the next.

Appropriate Weather Conditions and Time of Day

Weather conditions strongly affect animal behaviour. For example, generally speaking, bees avoid cold, windy, or overcast weather. To optimise bee sightings, conduct observations when the temperature is at least 15.5° C (60° F), wind speeds are less than 10 km/h, and when there is enough sunlight to see your shadow. These conditions usually exist between 7 am and 5 pm. It should be noted though that bees have been observed to be most active in the morning period in Trinidad and Tobago.

In order to monitor during optimal and consistent conditions, the time of day when monitoring occurs can be adjusted for the season and daily weather patterns. To determine wind speed, you can use an anemometer for a precise measure (available at some outdoor outfitters), check the nearest weather station on your phone, or you can use the Beaufort Wind Scale (Table 1, below) to come up with an estimate.

Table 1.
Beaufort Wind Scale

WIND (km/h)	CLASSIFICATION	APPEARANCE OF WIND EFFECTS
0	Calm	Smoke rises vertically
1–5	Light air	Smoke drift indicates wind direction, still wind vanes
6–10	Light breeze	Feel the wind on your face, leaves rustle, and wind vanes begin to move
11–16	Gentle breeze	Leaves and small twigs will be in constant motion, light flags extended

Figure 4: Wasp and beetles simultaneously visiting flowers. Species outside of your target group may be visiting flowers during your survey, and should be recorded if possible. Record your target group first, then others. (Photograph by Lena Dempewolf.)

Observing Organisms at Flowers

It is important to keep the following points in mind when collecting observational data on floral visitors:

Only collect data on insects visiting the reproductive parts of the flower:
These insects likely will be collecting either pollen or nectar, and may include bees and non-bees (Figure 4). During the sampling period, don't focus on insects sitting on leaves, petals, stems, etc. (Figure 5) or visitors flying around the area. This also applies to larger pollinators, such as bats and birds.

Look at all flower types:
Pollinators may visit flowers that are less noticeable to people—such as flowers that are quite small or green. They may also forage in deep flowers (Figure 6). For example, many small bees forage inside tubular flowers. Avoid focusing on only one or a few flower types.

Be careful not to disturb organisms visiting flowers before you get a chance to observe them well:
Walk slowly, avoid sudden movements, and do not stand too close to the flower you are observing. Also, insects respond to shadows passing overhead; if possible walk so that your shadow trails you, rather than advances in front of you. If two people are monitoring together, it may be best for one person to observe and the other to record, with the recorder lagging behind so as not to further disturb pollinators.

Observe and identify insects as best you can and only to a level at which you are confident:
Pollinator groups and especially bee groups can be difficult to discern. Even noting whether a visitor is a honey bee, native bee, fly, wasp, butterfly or moth, is useful information. If you are particularly interested in monitoring native bees, it will be important for you to learn to distinguish, at minimum, honey bees from native bees. If possible, you can also take pictures and post them on iNaturalist or send them to experts. If you add pictures to iNaturalist, please join and add to the project "Pollinators and pests of Trinidad and Tobago (https://www.inaturalist.org/projects/pollinators-and-pests-of-trinidad-and-tobago) as this helps us track pollinators on a national level.

Be patient:
If you are monitoring a newly planted area be aware that it may take a few years for the plants to get established before you see an increase in pollinator activity.

Recording Data

Figure 5: Pollinators that are not visiting flowers during the sampling period should not be recorded. However, if the insect is a unique pollinator—like this unidentified sweat bee—not yet seen at the site, it could be noted in the additional data for your site. (Photograph by Lena Dempewolf.)

This monitoring protocol can be implemented with either a one- or two-person observer team. When using two observers, one person should make observations while the other records those observations. At the beginning of data collection, record all of the required information on the datasheet found at the back of this guide, please photocopy the datasheet as needed; we recommend doing double-sided copies). This information includes the location, time, and date, as well as weather conditions.

When monitoring a transect, citizen scientists should pace themselves so that they move along a transect at an average rate of about 3m per minute. For example, a 75 m transect should take about 25 minutes to monitor. Floral density may affect the pace of monitoring within a transect. For example, although the average recommended pace is 3m per minute, observers may slow the pace in portions of a transect with particularly high floral density and increase it where blooming plants are absent. Use a timer to help keep track of how quickly you are moving through the site (and how much time you have left). Do not stop the timer when you are looking at the floral visitors you are identifying and counting.

Transect width may vary depending on the site characteristics and plant community, but should be about 1m on each side of the observer. The goal is to establish a standard sampling duration and effort for each transect based on the size of the sampling area. This sample duration stays the same for each site and for each sample period and year, regardless of floral or insect density, in order to standardise a consistent level of effort. This could mean that the observers won't cover the whole transect (although, every effort should be made to cover the whole designated area at least once), or may need to backtrack if they complete the plot or transect before the allotted time is up.

For each floral visitor observed, the citizen scientist should record the following data: an identification of each floral visitor (only to the level at which the observer is confident), a description of the insect or pollinator group, and the number of times an individual of this insect or pollinator group was seen during the monitoring period.

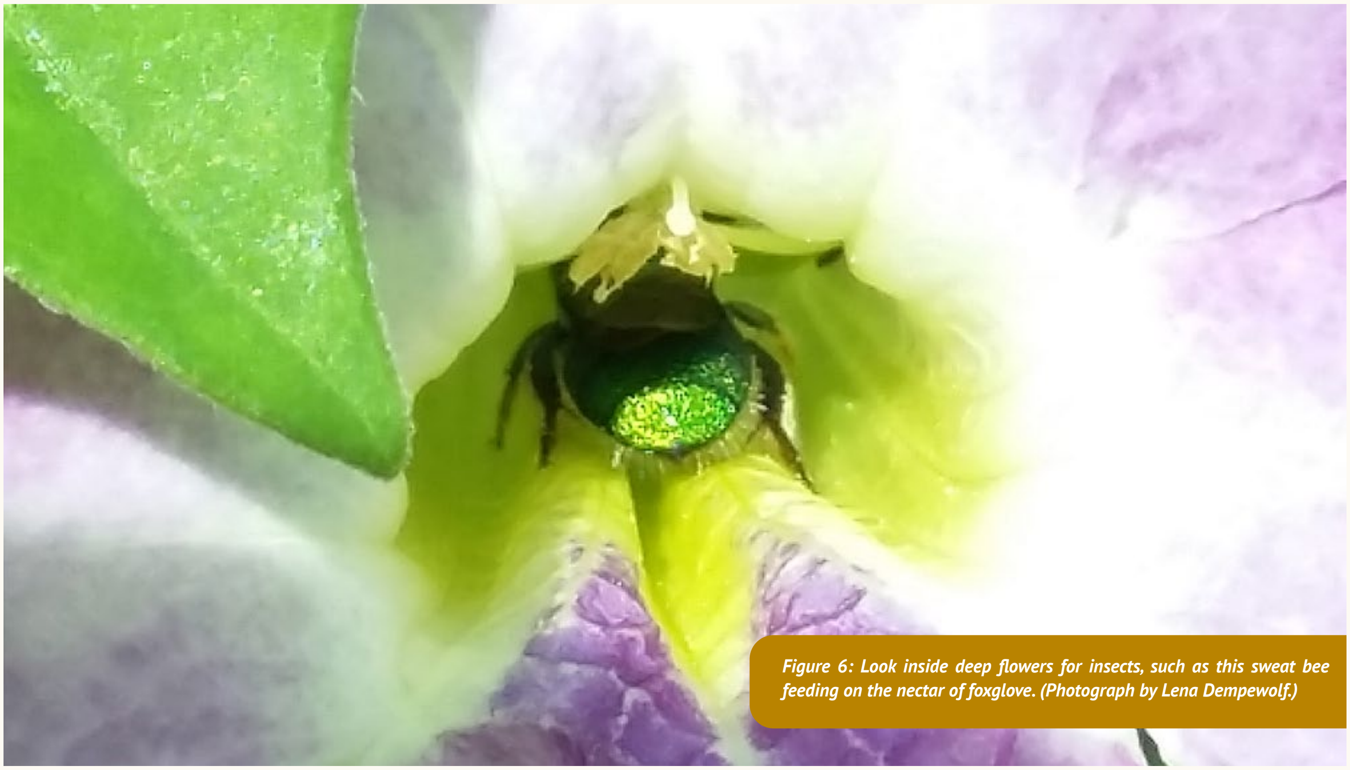


Figure 6: Look inside deep flowers for insects, such as this sweat bee feeding on the nectar of foxglove. (Photograph by Lena Dempewolf.)

Figure 7: Transects should be marked at each end with a tall stake and colourful flagging. High visibility, even as the vegetation grows, will help observers find the transect and move in a straight line through the transect. (Photograph by Emily Krafft).

If the observer is comfortable with plant identification, it is also important to note which flower species each pollinator is visiting (see Additional Data to Collect, below). If using a two-person team, the observer dictates the floral visitors and their descriptions, while the observer's partner records this information on the datasheet.

Additional Data to Collect

As noted above, it is also valuable to collect data on the floral associations of pollinators at your site. This information will help improve your understanding of which plants are important for each pollinator group; which plants are visited in each season; and how pollinator preferences may change over the years as a restoration project progresses. For restoration sites, the lists of species that were planted on site should be available. You may also need to bring plant identification guides with you. Keep in mind that it is important to document blooming plants that are not being visited, as well as those that are. All plants (native or nonnative) blooming in the transect during the time of the survey should be recorded.

It can also be valuable to collect site specific data such as changes in land management techniques, additions to habitat structure, extreme climatic events, and anything else of ecological importance that might shed light on changing site conditions and animal richness and abundance.

Plotting Your Data

In order to draw meaningful conclusions about the effects of habitat on bee abundance and richness, data should be collected in a consistent manner over several years. To determine changes in abundance over time, tally the number of individual specimens observed during each monitoring event. These numbers could be averaged for each year (for example, combine results from the rainy and dry seasons into a single average figure for the year) and plotted on a graph or table to show change between years. Alternatively, you could total the number of individual specimens observed during each monitoring event or period, and look at each sampling period individually (for example, you could examine changes in the total number of bees observed during the dry season sampling from year 1 to year 2, etc.).

Note: For an analysis of bee abundance, you may want to exclude honey bees because the placement of even a couple of hives within a few miles radius of the study site could dramatically increase the overall number of bees observed.

Similarly, to calculate a measure of species richness for each sample period or year, you could tally the total number of the different morphogroups represented in the Monitoring Guide that were observed. Once again, the richness could be plotted to record changes over time, either comparing the average or total number of groups observed across all sample periods for each year, or comparing the total number of groups observed during the same sample period from year to year.

It is important to note that pollinator populations can vary greatly from season to season as well as from year to year, even in areas where the habitat is essentially unaltered. Thus, the number of species represented and the number of individual pollinators observed within a study area are likely to be highly variable. It is for this reason that monitoring should be conducted for many years in a row in order to draw any substantial conclusions. Sites should be monitored for a minimum of three years, and ideally five. The longer surveys are conducted, the more meaningful the results. In areas where specific habitat and management improvements have been made to attract and protect pollinators, there should be an upward trend in both pollinator abundance and richness over the course of several years. If possible, when habitat improvements are planned, it is useful to acquire baseline data on the pollinator community on site. before enhancing the habitat.

Table 2a.

Example Data Spreadsheets

(A)	Individual Bees Observed		
YEAR	**DRY SEASON**	**RAINY SEASON**	**AVERAGE**
2019	Date: 5th March	Date: 20th September	**19**
	Bees: 14	Bees: 28	
2020	Date: 17th February	Date: 3rd October	**15.5**
	Bees: 16	Bees: 15	
2021	Date: 20th March	Date: 28th September	**43**
	Bees: 40	Bees: 46	
2022	Date: 2nd April	Date: 1st November	**49.5**
	Bees: 65	Bees: 34	

Table 2b.

Example Data Spreadsheets

(B)	Bee Groups Observed		
YEAR	**DRY SEASON**	**RAINY SEASON**	**AVERAGE**
2019	Date: 5th March	Date: 20th September	**2.5**
	Groups: 2	Groups: 3	
2020	Date: 17th February	Date: 3rd October	**3**
	Groups: 3	Groups: 3	
2021	Date: 20th March	Date: 28th September	**6.5**
	Groups: 8	Groups: 5	
2022	Date: 2nd April	Date: 1st November	**8**
	Groups: 7	Groups: 9	

Figure 8a. Example Graph Showing Bee Community Changes

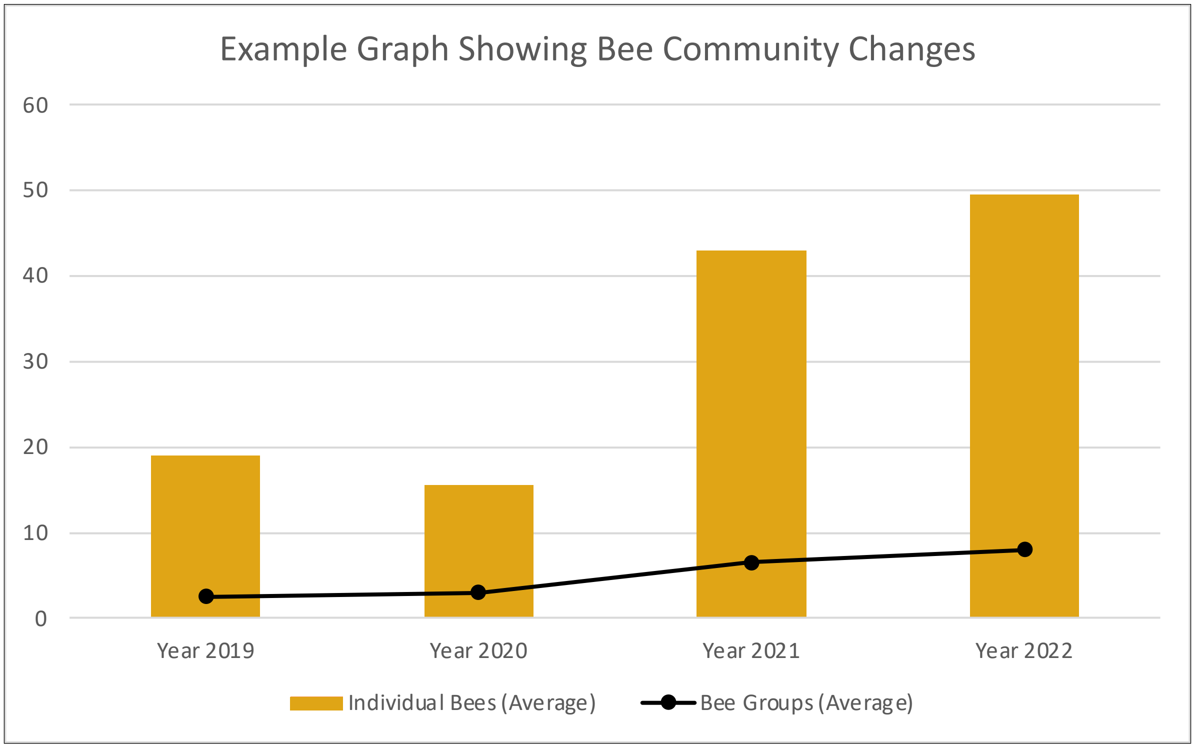
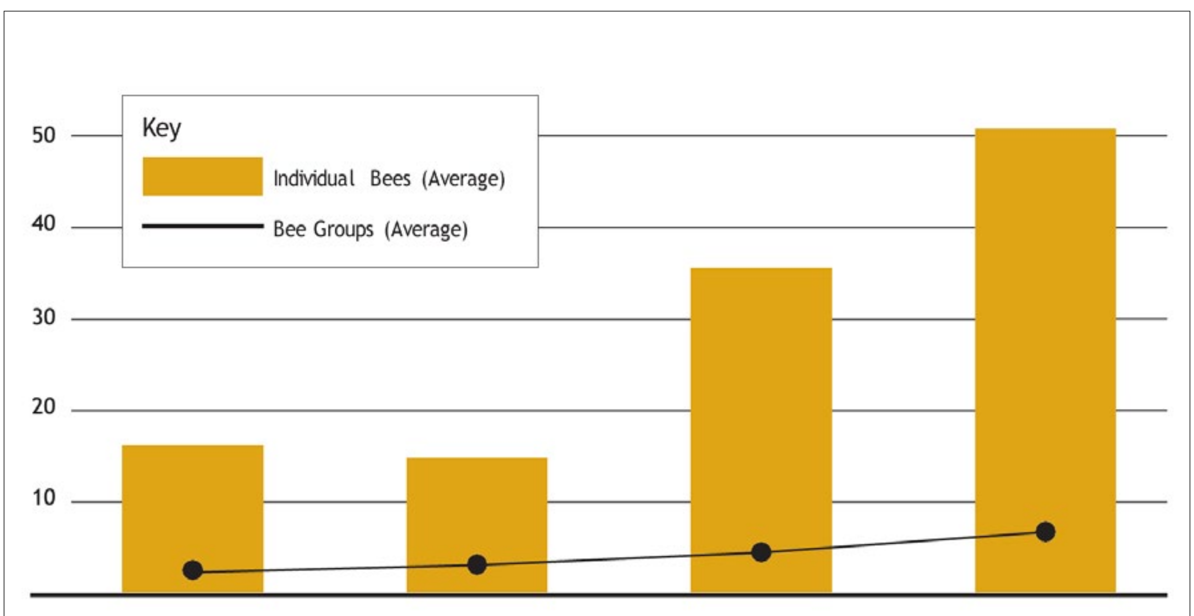


Figure 8b. Example Graph Showing Bee Community Changes



In order to analyse how bee communities change over time it is important to standardise the monitoring protocol, sampling effort, and weather conditions. Specifically, monitoring should occur at roughly the same time every year, for the same amount of time, over the same area, and under similar conditions using a standardised protocol. Once a protocol has been established for a site, it should be clearly written out so that it may be referenced in future years or easily replicated by a different trained .

SECTION 2
Identifying Floral Visitors

Distinguishing butterflies, moths, or spiders from bees is simple. Separating bees from wasps or flies—especially those that mimic bees—can be harder.

The following pages provide more information on how to identify the principal groups of bees and key characteristics to look for when identifying specific bee groups.

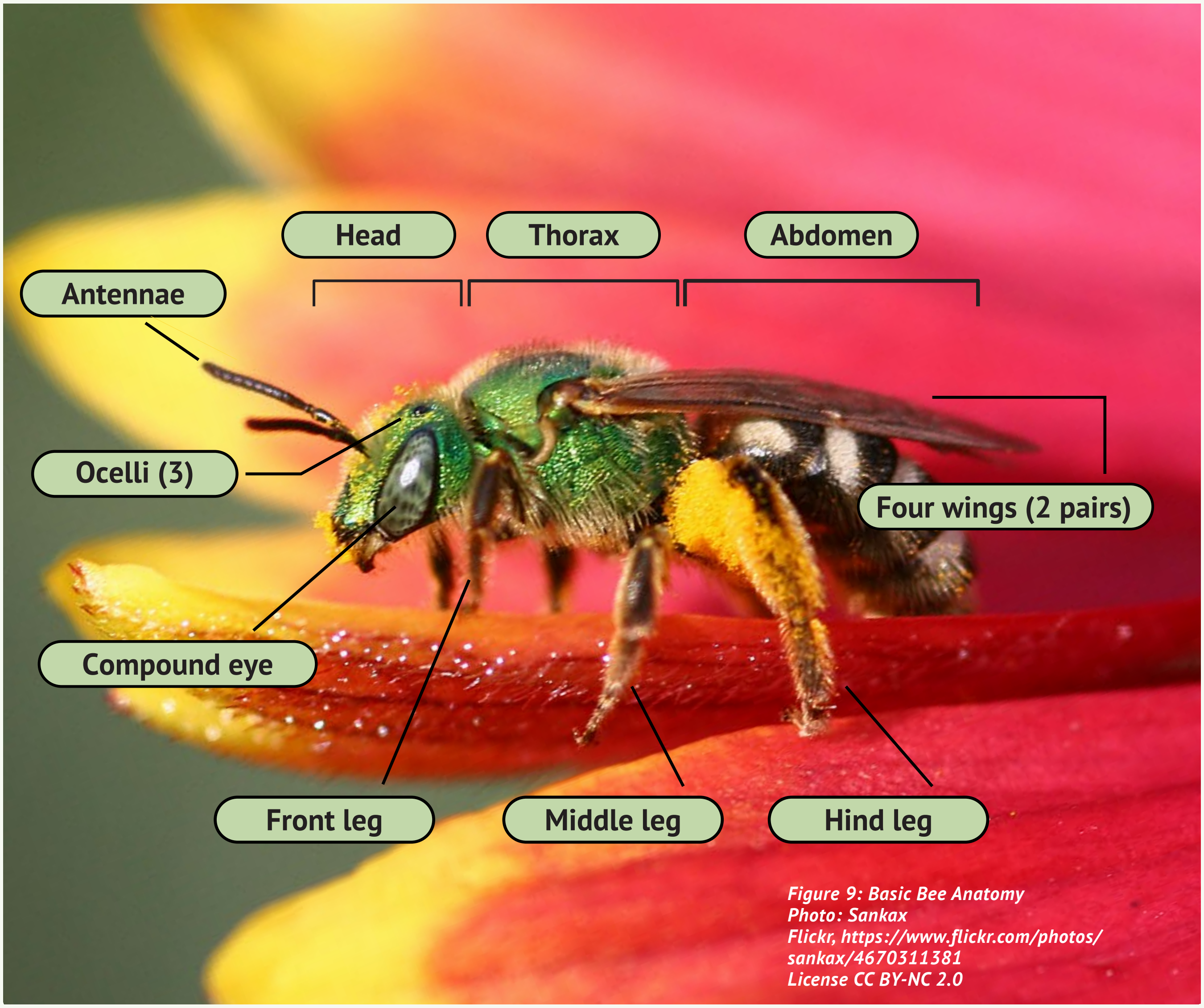


Figure 9: Basic Bee Anatomy
Photo: Sankax
Flickr, https://www.flickr.com/photos/sankax/4670311381
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Basic Bee Anatomy

*Note: it can be difficult to see all four wings because sometimes the wings are held on top of each other.

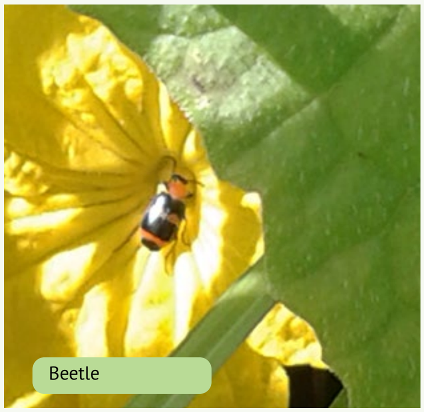
Non-Bee Quick Reference

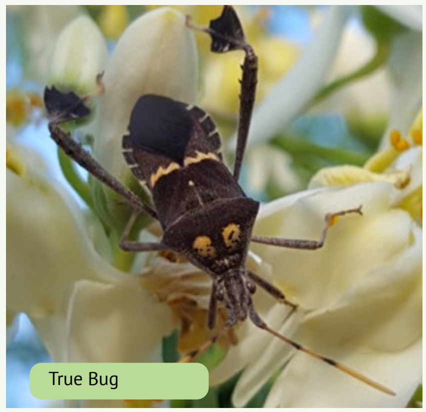
Bees, in general, have evolved to be the most efficient pollen transporters. However, many other animals that visit flowers have the potential to pollinate as well, and may also be indicators of a healthy ecosystem. For this reason, you may wish to note all floral visitors.

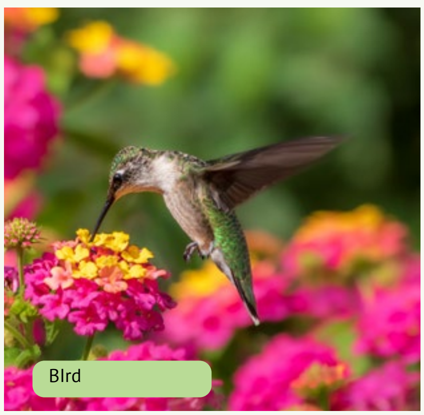
Figure 9:


Butterfly

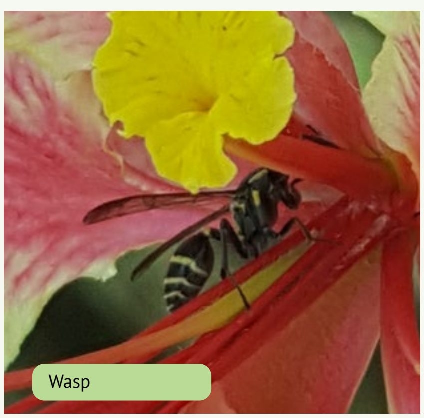

Moth


Beetle


True Bug


BIrd


Fly


Wasp


Spider

Bees

KEY CHARACTERISTICS:

- Bees have two pairs of wings (difficult to see when held over the body).
- Bees have large eyes located on the sides of their heads.
- Bees are typically more robust (i.e., rounder bodies) than wasps and flies. Abdomen usually looks broad near thorax compared with wasps.
- Bees have antennae that are long and bent.
- Most bees are hairy, especially on their legs and/ or on their abdomen.
- Female bees can carry large loads of pollen, either on their legs or on their abdomen in a "scopa" or "corbicula."

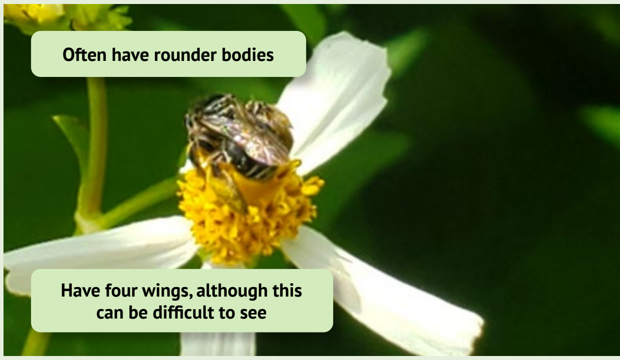
SIZE	**Can range from less than 0.3 cm to 3 cm**
COLOUR	**Can be black, brown, grey, orange, red, silver, or metallic blue, green, or copper-coloured and sometimes yellow.**
STRIPES	**Stripes can be formed by the hair colour (e.g., yellow, orange, white, black, or brown) as well as the colour of the exoskeletcon (body covering). Many bee species do not have stripes.**

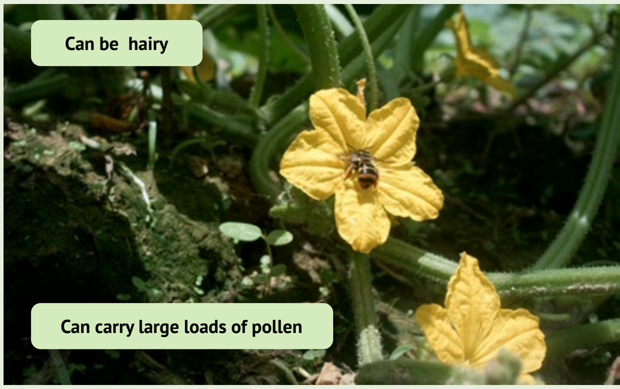
A NOTE ABOUT STINGS:

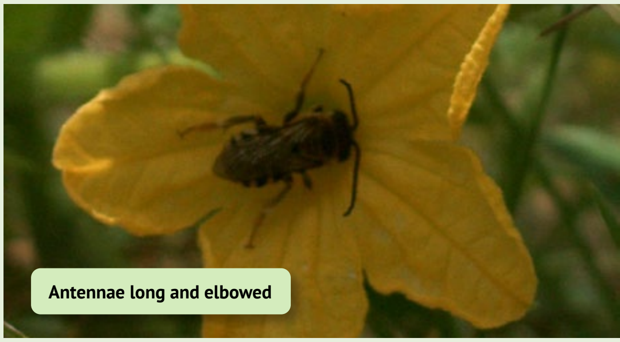
When working around bees (and wasps) there is always a risk of getting stung. Most bees are not aggressive and will not sting unless handled improperly. Bees are very docile when visiting flowers. Most wild native bees are far less defensive than honey bees or social wasps.

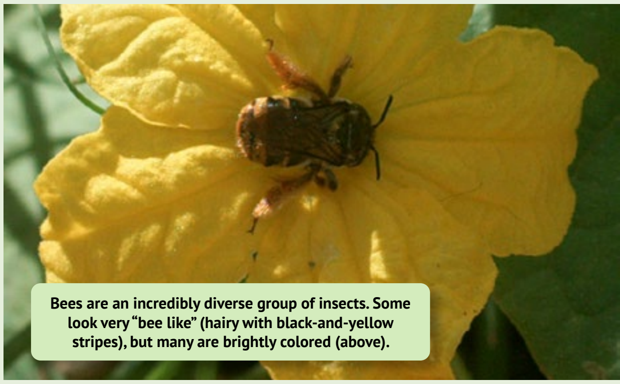
Should you be stung by any bee (or wasp) while out in the field, try to identify the type of bee (or wasp) that stung you and let someone know so they can help watch for symptoms. Most people have mild reactions to bee and wasp stings and exhibit a reaction only at the site of the sting (mild swelling, redness, itchiness, or mild pain). However, it is important to monitor yourself after a sting for signs of a more severe reaction.

Symptoms of a serious reaction include swelling elsewhere on the body, vomiting, dizziness, hoarseness, thickened speech, or difficulty breathing, and should receive prompt medical attention from a physician.

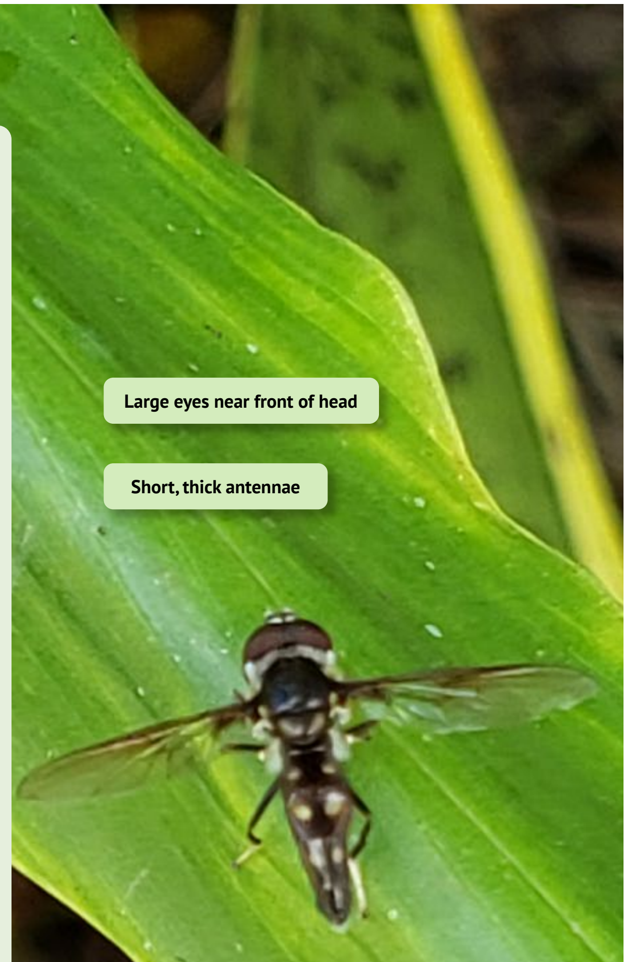








Flies vs. Bees



KEY CHARACTERISTICS:

- Flies often have short thick antennae (sometimes difficult to see).
- Flies often have very large eyes near the front of their head, usually converging on the top of the head.
- Flies only have one pair of wings.
- Flies are usually less hairy than bees.
- Many flies can hover (most bees are not able to hover, except for orchid bees where hovering is common).
- Many flies do not carry large loads of pollen although some grains may stick to their bodies. They do, however, make up for the lack of hairs by moving between flowers very quickly and frequently.

SIZE	Range similar to bees: from 0.3 cm to 3 cm””
COLOUR	Can be black, brown, yellow, or metallic blue or green.
STRIPES	Can have stripes, usually from exoskeleton colour.

NOTE

Many hover/syrphid/flower flies, bee flies, and robber flies are convincing mimics of bees and wasps. Look carefully at the eyes, legs, wings, antennae, and behaviour to distinguish these look- alikes. Syrphid flies are frequent floral visitors that are impressive honey bee mimics.

Wasps vs. Bees

Narrow body, constricted abdomen

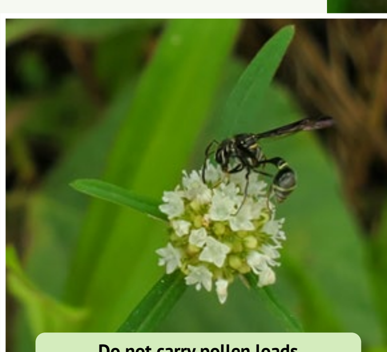
KEY CHARACTERISTICS:

- Wasps, like bees, have four wings (two pairs; often folded lengthways), but it can be hard to see them
- Wasps usually have narrower bodies and a very constricted (pinched) abdomen where it connects to the thorax (more obvious than in bees)
- Wasps tend to have more extensive and obvious colouration and patterns on their exoskeleton (bee markings are usually coloured hairs)
- Wasps are generally not hairy
- Wasps do not carry pollen loads, although some pollen grains may stick to their bodies
- Some female wasps have long, obvious ovipositors

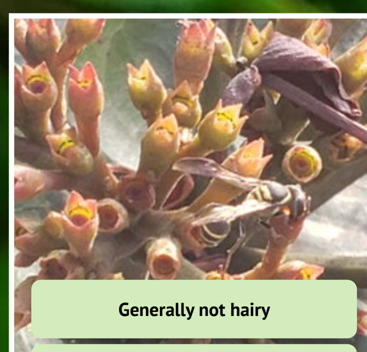
SIZE	**Can range widely in size.**
COLOUR	**Can be black, brown, red, orange, yellow, white, or metallic blue, green, or copper.**
STRIPES	**Can have body stripes or colouration patterns on their exoskeleton that closely resemble a bee. Stripes and markings are usually not from hair patterns.**

Stripes are colors on their exoskeleton, not hairs

Can have long ovipositors



Do not carry pollen loads (some grains may be stuck to body)

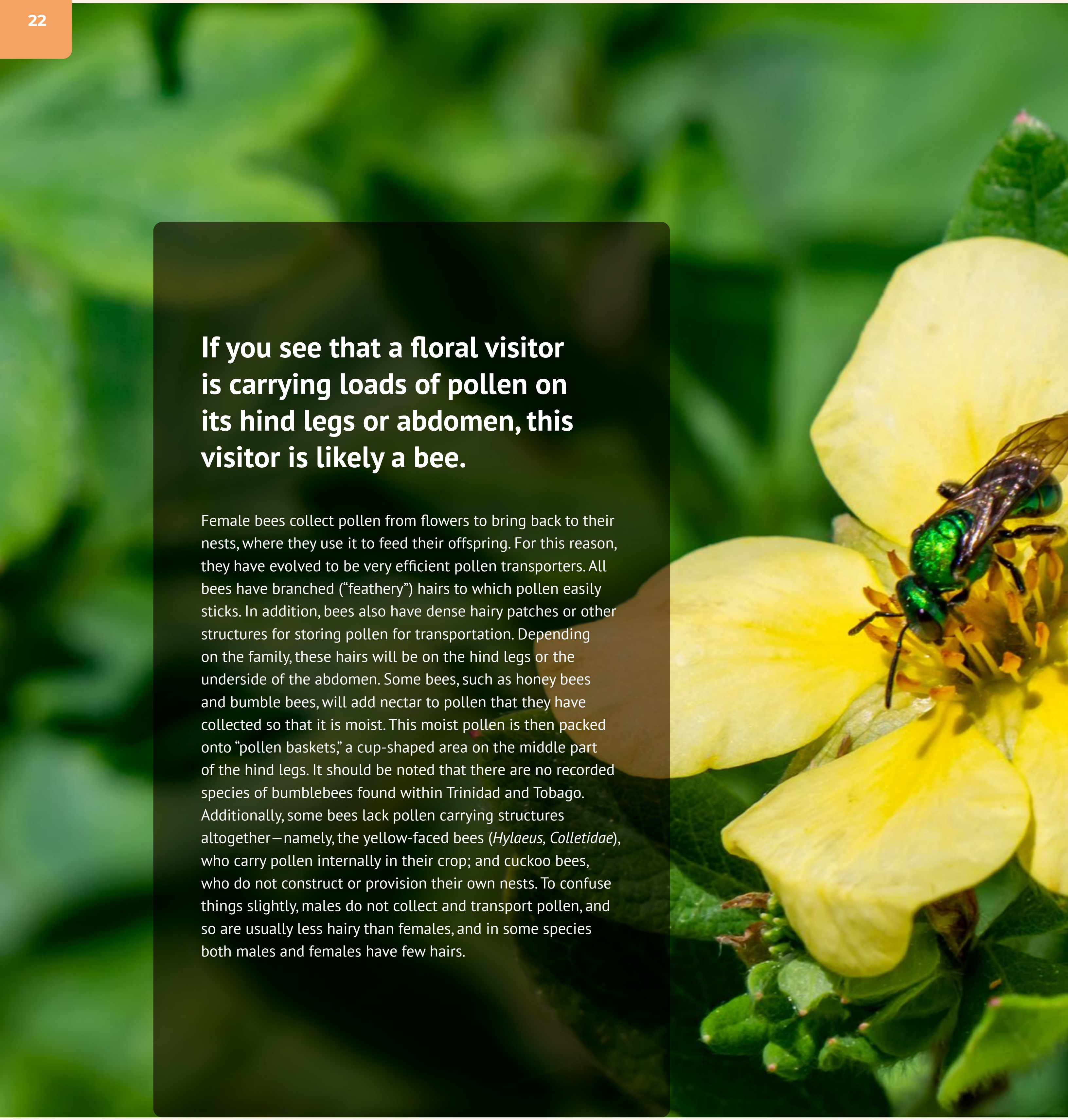


Generally not hairy

Four wings (folded lengthways)

SECTION 3
Understanding Bees

This section describes the key characteristics that identify different bees. You can then use these to help you navigate the key found on page 33.



If you see that a floral visitor is carrying loads of pollen on its hind legs or abdomen, this visitor is likely a bee.

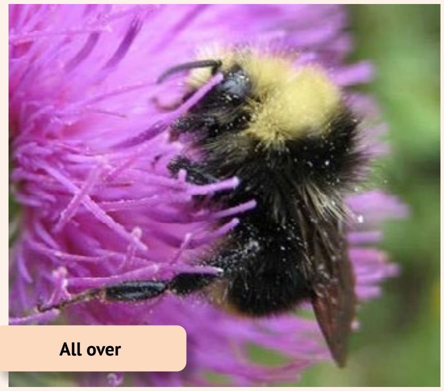
Female bees collect pollen from flowers to bring back to their nests, where they use it to feed their offspring. For this reason, they have evolved to be very efficient pollen transporters. All bees have branched ("feathery") hairs to which pollen easily sticks. In addition, bees also have dense hairy patches or other structures for storing pollen for transportation. Depending on the family, these hairs will be on the hind legs or the underside of the abdomen. Some bees, such as honey bees and bumble bees, will add nectar to pollen that they have collected so that it is moist. This moist pollen is then packed onto "pollen baskets," a cup-shaped area on the middle part of the hind legs. It should be noted that there are no recorded species of bumblebees found within Trinidad and Tobago. Additionally, some bees lack pollen carrying structures altogether—namely, the yellow-faced bees (*Hylaeus, Colletidae*), who carry pollen internally in their crop; and cuckoo bees, who do not construct or provision their own nests. To confuse things slightly, males do not collect and transport pollen, and so are usually less hairy than females, and in some species both males and females have few hairs.

Hair

KEY CHARACTERISTICS:

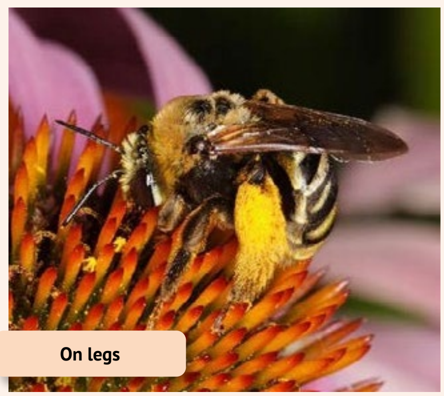
Is the bee hairy?

If so, **where** is it the **most hairy**?



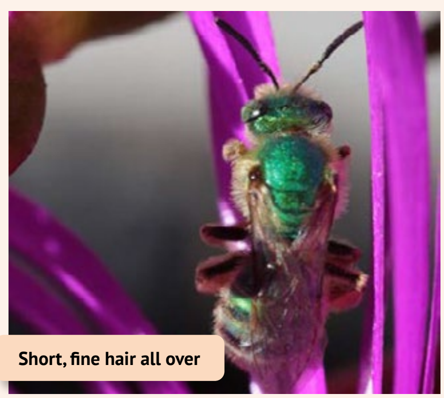
All over

Under abdomen



On legs

Head and thorax



Short, fine hair all over

Almost no hair

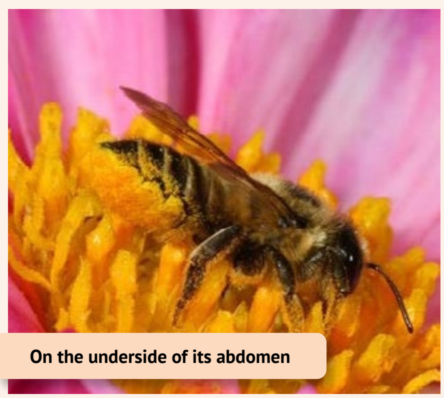
Pollen

KEY CHARACTERISTICS:

Does the bee have pollen on its body

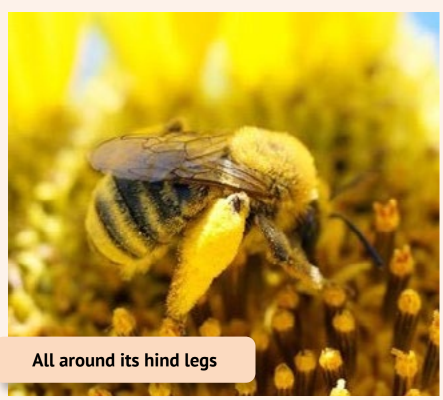
- If so, **where**?
- Does the pollen look **moist and packed**, or **dry and loose**?

Packed on the outside of the bee's hind legs

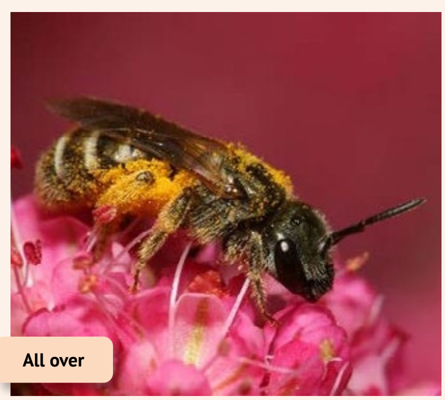


On the underside of its abdomen

All over its legs and at the base of its thorax



All around its hind legs



All over

Size and Shape

KEY CHARACTERISTICS:

What size is the bee

Perdita minima, the smallest bee in North America, placed on the face of one of the largest, *Xylocopa varipuncta*.

EXTRA-LARGE
(16–25 mm)

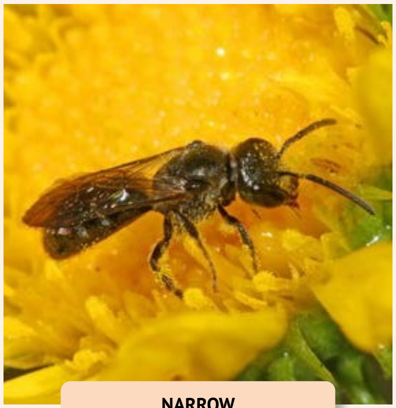
LARGE
(13–16 mm)

MEDIUM
(9–13 mm)

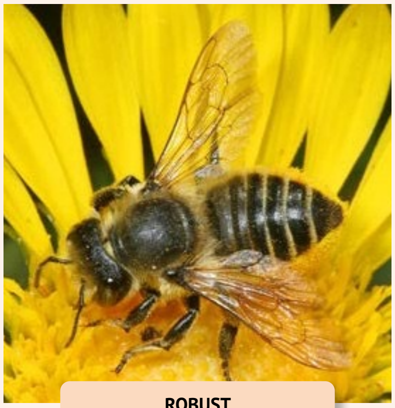
SMALL
(7–9 mm)

TINY
(<7 mm)

What shape is the bee?



NARROW



ROBUST

Antennae

KEY CHARACTERISTICS:

Does the bee have long or short antennae relative to the size of its body?

Photograph by Matthew Shepherd.

Photograph by Sara Morris.

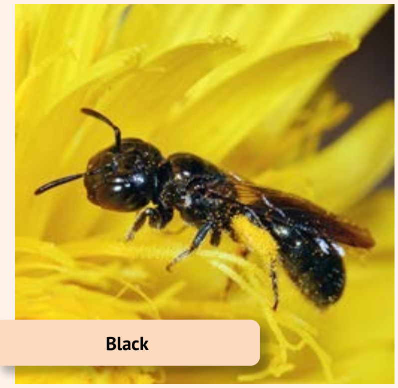
Colour

KEY CHARACTERISTICS:

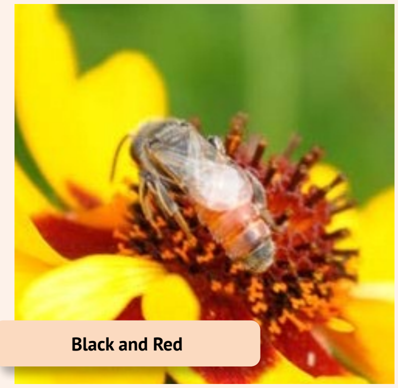
- **What are the predominant colour(s) of the bee?**
  (Note: predominant colours could come from either the hair or the exoskeleton)
- **Are the head, thorax, or abdomen different colours?**
- **Is it metallic?**

White Stripe

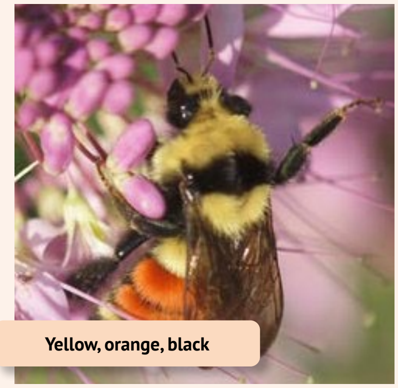
Grey



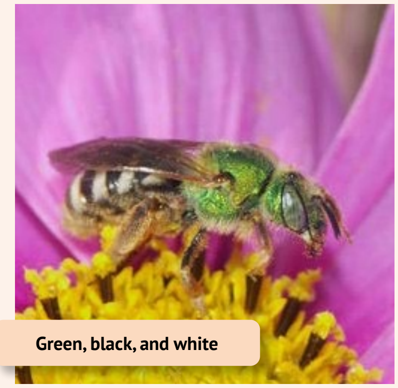
Black



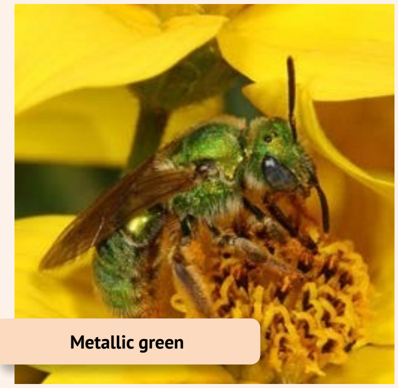
Black and Red



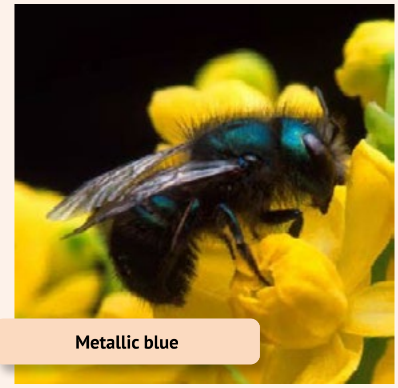
Yellow, orange, black



Green, black, and white



Metallic green



Metallic blue

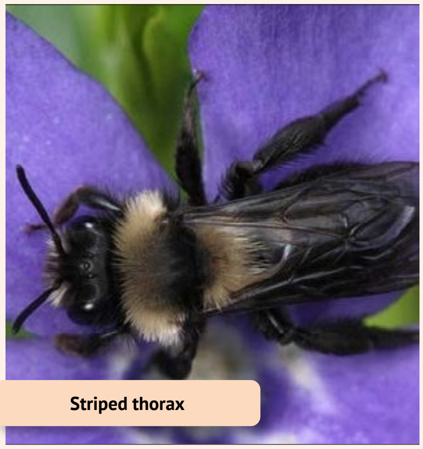
Red

Stripes

KEY CHARACTERISTICS:

Does the bee have stripes on its body? If so, where?

Striped abdomen

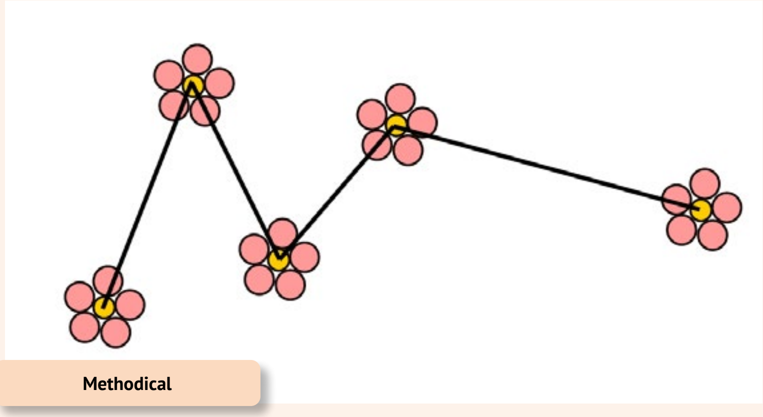


Striped thorax

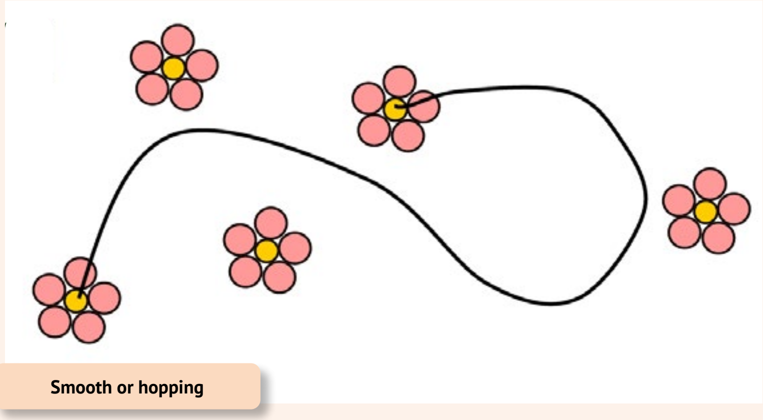
Flight

KEY CHARACTERISTICS:

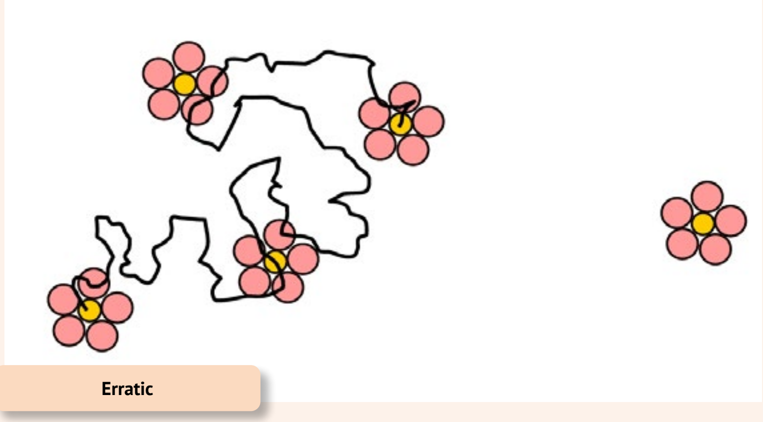
- **Does the bee fly fast or slow?**
- **Is it noisy or quiet when it flies?**
- **What kind of movements does it make when it flies?**



Methodical



Smooth or hopping



Erratic

SECTION 4
Guide to 11 Groups of Bees

Roughly 150 species of bees can be found in Trinidad and Tobago. It is worth noting that there are likely many more species than we currently know of.

This guide will help you identify some of the most common bee morphogroups. The photos on this page illustrate some of the diversity of these bees.

Remember, this guide is not exhaustive, so if you observe a bee that does not fall into an identified morphogroup, note the bee as “Other bee” and describe it thoroughly in the observational notes. Even if you can’t identify the bee precisely, it is important to document that it was observed.

In particular, it is important to distinguish the honey bees, which are nonnative, from native bees. Whenever possible, attempt at minimum to distinguish honey bees from the rest of the bee categories. Before monitoring, study the “honey bee” page carefully.

Major Bee Groups found in Trinidad and Tobago

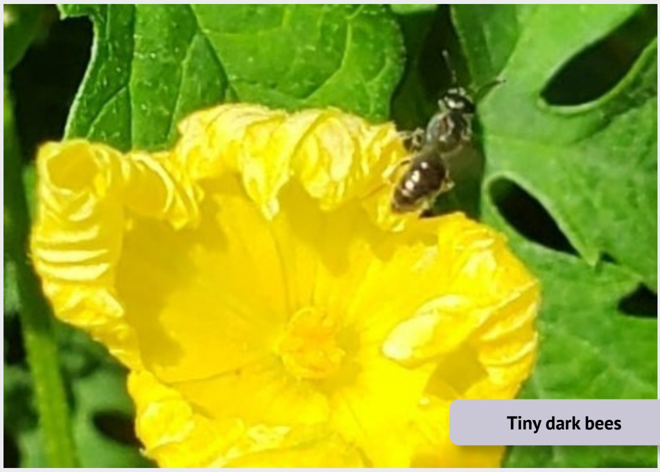

Honey Bees


Hairy-legged bees


Medium dark bees (excluding stingless bees)


Metallic green bees (excluding orchid bees)


Striped sweat bees


Tiny dark bees


Leafcutter Bees


Cuckoo bees


Large carpenter bees


Stingless bees


Metallic orchid bees


Striped orchid bees

Key to Identifying Floral Visitors

- **Non Bee**
  - **Bird**
  - **Butterfly**
  - **Moth**
  - **Fly**
  - **Wasp**
  - **Spider**
  - **Beetle**
  - **True Bug**
- **Bee**
  - Pollen carrying structures on legs (except for yellow-faced bees which are mostly hairless)
    - **Honey bee (p. 34)**
    - **Hairy-legged Bee (p. 36)**
    - **Medium Dark Bee (except stingless bees) (p. 37)**
    - **Metallic green bee (except orchid bees) (p. 38)**
    - **Striped Sweat Bee (p. 40)**
    - **Tiny dark bee (p. 42)**
    - **Large Carpenter Bee (p. 46)**
    - **Stingless Bee (p. 47)**
    - **Metallic Orchid Bee (p. 49)**
    - **Striped orchid bee (p. 50)**
  - Thick pollen- carrying hair on underside of abdomen
    - **Leafcutter Bee (p. 44)**
  - Mostly Hairless
    - **Cuckoo Bee (p. 45)**

Identify bees to the most specific group possible.

For example, if you do not know what type of bee you see, but you know that it is not a honey bee, note only that “it is not a honey bee.” In some cases it will be possible to distinguish species within a bee group.

Honey Bees

Family: Apidae
Species: *Apis mellifera*

For most people, it is the honey bee that comes to mind when they hear the word "bee."

Moist clumps of pollen on upper hind leg

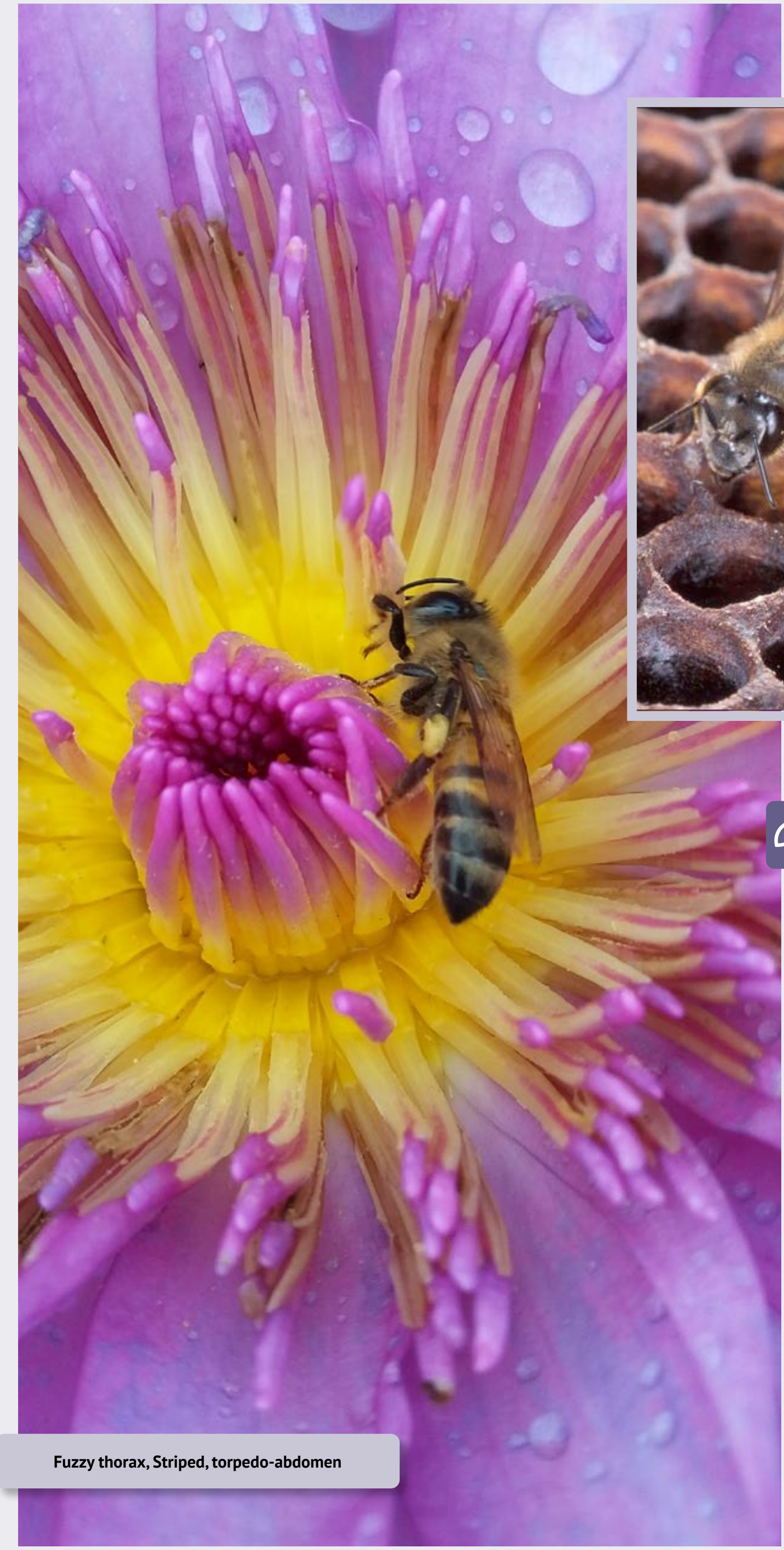
KEY CHARACTERISTICS:

SIZE AND SHAPE	Medium to large with torpedo shaped bodies.
COLOUR AND HAIR	Amber-brown to nearly black; moderately fuzzy thorax and head, legs and abdomen less hairy.
STRIPES	Abdomen tri-toned with black, pale and orange-brown stripes.
CORBICULA	Enlarged, flattened plates fringed with hairs on hind legs to carry moist pollen.

SIZE RANGE:
12–15mm

NOTE:

Makes buzzing sound when flying and often flies methodically from flower to flower.



Fuzzy thorax, Striped, torpedo-abdomen

Color variation: dark to pale
Enlarged, flat plates on hind legs shaped to carry pollen

IMPORTANT:

Honey bees are not native to the Caribbean, whereas most other wild bees are. During monitoring, distinguishing between honey bees and the rest of the bee categories is the most important observation you can make.

Hairy-legged Bees

Family: Apidae
Genera: *Melissodes* (Long-horned bees), *Peponapis* (Squash bees), *Centris, Exomalopsis, Melitoma* and others

KEY CHARACTERISTICS:

SIZE AND SHAPE	Medium to large, robust.
COLOUR AND HAIR	Dark with white, yellow or brown hairs; often very hairy—especially on thorax—with short, dense, velvety hair. Some species may be solid black or grey, usually with lighter hairs on their legs or scopae (females).
STRIPES	Often with bands of pale hair on abdomen.
SCOPA	Carries dry pollen on noticeably dense hairs on lower hind legs, but pollen is often on the whole body.

SIZE RANGE:
8-20 mm

NOTE:
Antennae are typically longer than most other bees, especially on males. The legs of males are not as hairy as the legs of females because males do not transport pollen. Some fly fast (usually in smooth motions that almost look like they are tracing a figure 8) and can visit flowers rapidly.

Medium Dark Bees
(excluding Stingless Bees)

Family: Colletidae (Polyester bees)
Genera: *Colletes, Ptiloglossa*

KEY CHARACTERISTICS:

SIZE AND SHAPE	Small to large; relatively narrow to moderately robust.
COLOUR AND HAIR	Most Colletes species are dark-bodied with a moderately hairy thorax and face.
STRIPES	May have bands of pale hair on abdomen.
SCOPA	Carries pollen on upper hind legs and back of thorax (armpits).
FACE	Heart shaped (Colletes)

COLLETIDAE
(7–18 mm)

Carry large amounts of pollen on the upper hind legs, as well as under the 'armpits'

Photograph courtesy of Rod Gilbert.

May have light-and-dark stripes on abdomen
May have a smooth, "shiny" black abdomen

Photograph by Sara Morris.

Thorax and head are typically moderately hairy
Hair may be sparse
Hairs may be long and dense
May have short, velvety hair all-over

Photographs courtesy of Rollin Coville

NOTE:
Nest in the ground, often in large aggregations. The species represented here are not found in Trinidad and Tobago

Metallic Green Bees
(excluding orchid bees)

Can have striped abdomen

Family: Halictidae

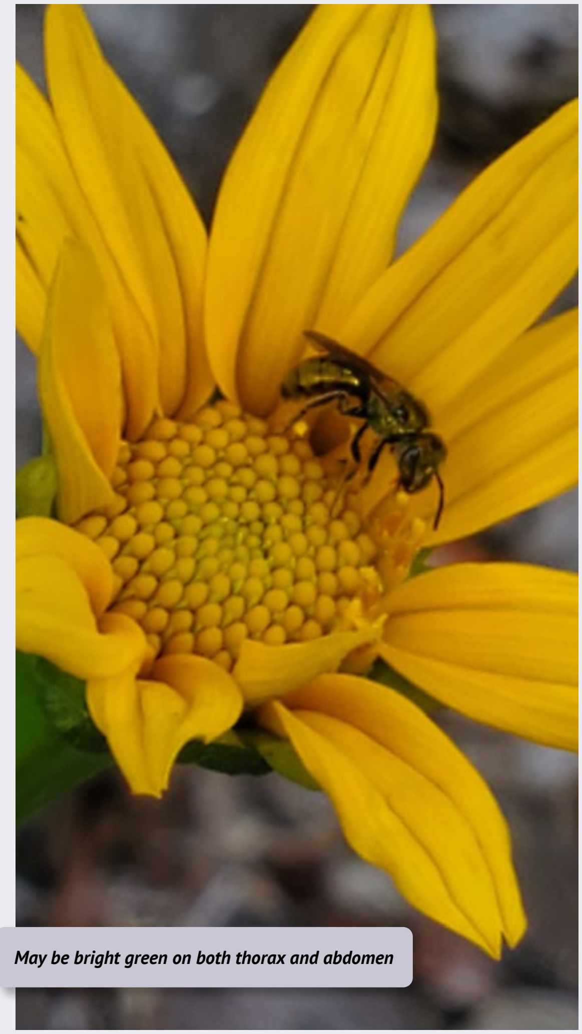
Genera: all members of the *Tribe Augochlorini*, including *Agapostemon, Augochlora*, and *Megalopta*; in addition to *Lasioglossum* [in part], among others

KEY CHARACTERISTICS:

SIZE AND SHAPE	Medium sized, narrow bodied.
COLOUR AND HAIR	Bright metallic green; abdomen can be green like the thorax, dark with stripes (Agapostemon) or light brown (Megalopta); body covered in pale hairs that are less noticeable.
STRIPES	Some with yellow and black striped abdomen, most do not have stripes
SCOPA	Carries dry pollen on hairs on hind legs, less noticeable than other bees, unless covered in dry pollen.

SIZE RANGE:
AGAPOSTEMON
(9–11 mm)

NOTE:
Relatively fast flying and numerous. Antennae are short on females and longer on males.



May be bright green on both thorax and abdomen

Megalopta sp - light brown abdomen with pale green head and thorax

BEWARE! Chrysidid cuckoo wasps can be very similar to metallic green bees in size and colour, but appear more "armored" and lack hairy legs.

CAUTION:

Some cuckoo wasps (Chrysididae) are metallic green and very easy to confuse with metallic green bees. Look to see whether the green visitor is a bee or not, and also check where it is carrying pollen or where it is hairy. Sweat bees carry pollen on their hind legs.. In addition, it is important to note if the green visitor has stripes on abdomen (characteristic of some metallic green bees, but not chrisid wasps or mason bees).

Further to this, orchid bees of the genus *Euglossa* also sport iridescent colours, but these bees are not included here. They are recognised by their robust bodies and hovering flight patterns (see section below).

Additionally, two genera should be noted that are included here even though their bodies are not entirely green and shiny - Megalopta and Agapostemon. Their thorax is usually shiny and green or green-brown, with a light brown abdomen in Megalopta (see top right image) and a striped abdomen in Agapostemon males. Females are all green.

Striped Sweat Bees

Family: Halictidae
Genera: *Halictus, Lasioglossum* (in part)

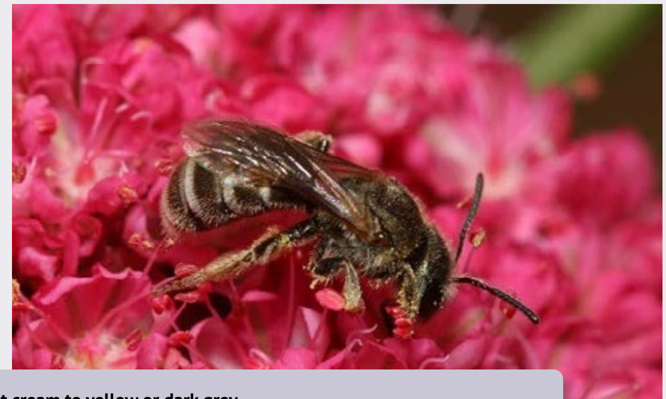
An example of a native Lasioglossum

KEY CHARACTERISTICS:

SIZE AND SHAPE	Small to medium, narrow bodied.
COLOUR AND HAIR	Usually dark with bands of pale hairs on abdomen.
STRIPES	Stripes on abdomen may appear faint and vary in colour from creamy to dark gray.
SCOPA	Brush of hair on upper part of hind legs, sometimes loaded with pollen.

SIZE RANGE:
7–15 mm

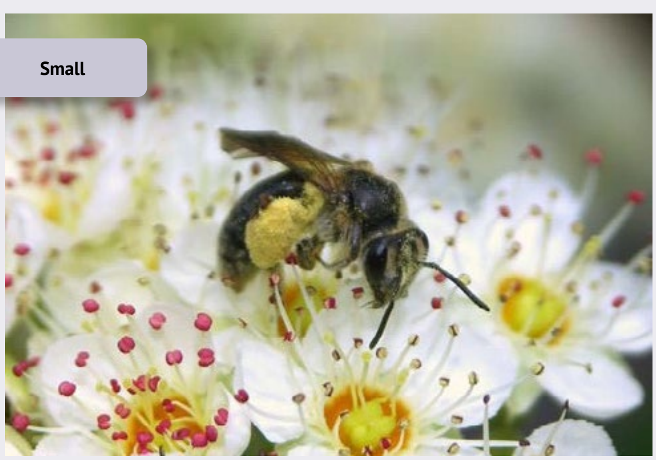
NOTE:
May crawl around the base of flowers or inside flowers. Fast moving; sometimes with jagged movements.



Stripes vary in colour from bright cream to yellow or dark grey

Whitish-yellowish stripes on abdomen

Brush of hair on hind legs; may be loaded with pollen



Small

Medium

Tiny Dark Bees
(excluding Stingless Bees)


An example of a native Lasioglossum

Families Halictidae, Apidae, Colletidae

Genera: *Lasioglossum* (Small sweat bees), *Ceratina* (Small carpenter bees), *Hylaeus* (Yellow-faced bees), and others

KEY CHARACTERISTICS:

SIZE AND SHAPE	Tiny and narrow bodied.
COLOUR AND HAIR	Can be dull black/brown, pale golden, metallic black/brown or blue/green. Sometimes with white or yellow markings on face. Body sparsely covered in pale hairs that are less noticeable, but some with dense patches of hair on abdomen.
STRIPES	Faint stripes on abdomen, if any.
SCOPA	Small carpenter bees (*Ceratina*) and sweat bees (*Lasioglossum*) have brushes of pollen collecting hairs on hind leg. Yellow-faced bees (*Hylaeus*) carry pollen in a crop and lack external scopa

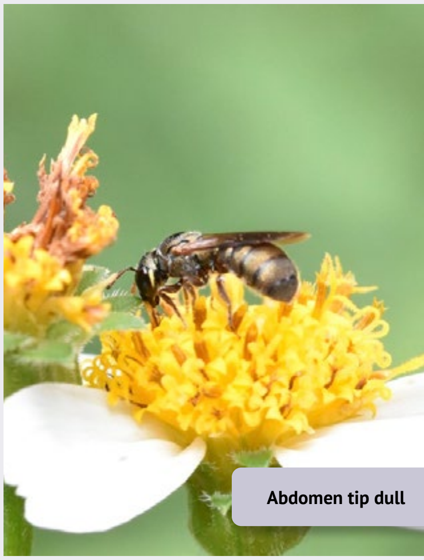
SIZE RANGE:

LASIOGLOSSUM
(4–7 mm)

HYLAEUS
(5 mm)

CERATINA
(4–8 mm)

NOTE:
Often crawl deep into flowers. Can move fast– some with jagged movements. Members of this morphological group are not closely related and have different life histories and habitat needs (e.g., *Ceratina* and *Hylaeus* are stem nesting, whereas *Lasioglossum* is ground nesting). As such, if you are comfortable distinguishing these genera, you may wish to record them separately in your data sheet

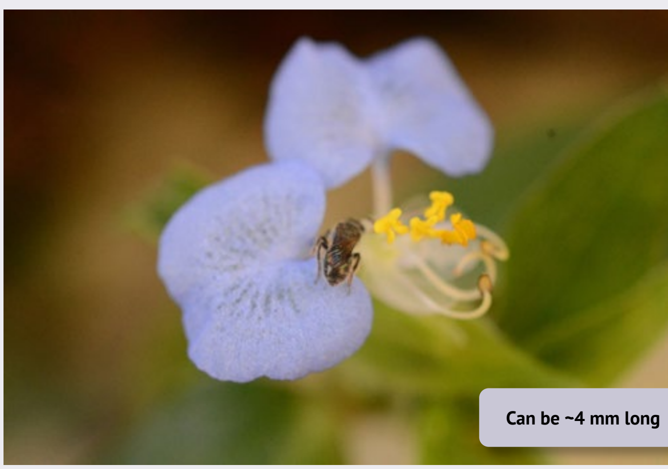


Abdomen tip dull

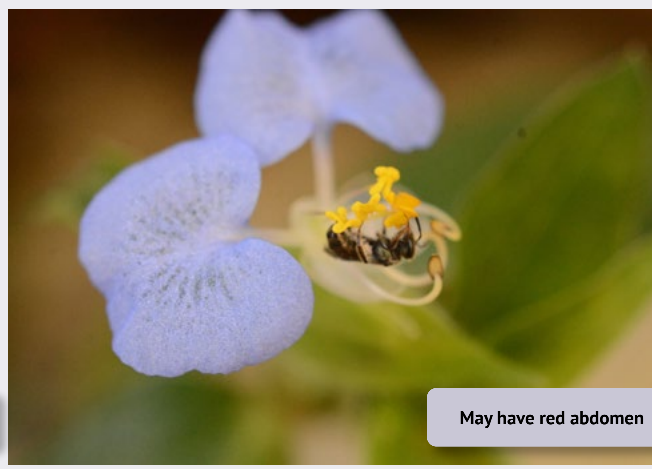
Dark blue-green

Small carpenter bee (pointed abdomen with shield-like tip)

Carry large loads of pollen in scopae and under ‘armpits’



Can be ~4 mm long



May have red abdomen

Leafcutter Bees

Family: Megachilidae

Genera: ***Megachile*** **(Leafcutter bees),** ***Hypanthidoides, Loyolanthidium, Anthidiellum, Callomegachile, Dicranthidium, Hoplostelis*****, among others**

KEY CHARACTERISTICS:

SIZE AND SHAPE	Small to medium and typically very robust. Often with a broad head and strong jaws used to cut leaves for nesting materials.
COLOUR AND HAIR	Black with thorax and head covered in silver, white, orange or yellow hairs OR black with yellow markings on exoskeleton
STRIPES	Abdomen has light hairs that create stripes, or markings are on exoskeleton.
SCOPA	Females carry dry pollen on thick hairs on underside of abdomen.

SIZE RANGE:

8–12 mm

NOTE:

When visiting flowers, these bees often elevate abdomen, revealing pollen underneath.

Cuckoo Bees

Family: Megachilidae

Genera: *Megachile* (Leafcutter bees), *Hypanthidoides, Loyolanthidium, Anthidiellum, Callomegachile, Dicranthidium, Hoplostelis*, among others

Cuckoo bees are a very diverse group of bees united by similar life histories—they lay their eggs in other bees' nests. Because they do not provision their own nests, they lack pollen-carrying structures.

KEY CHARACTERISTICS:

SIZE AND SHAPE	Small to large, often narrow bodied.
COLOUR AND HAIR	Variable, can be shiny black, cream, red, or yellowish. Can have red or black legs. Usually not very hairy.
STRIPES	Can have wasp-like markings made from short, thick hairs.
SCOPA	Lack pollen carrying structures. This can help differentiate *Sphecodes* from some *Lasioglossum* species (p. 28).

SIZE RANGE:

NOMADA
(9–12 mm)

NOTE:
These bees are not key pollinators, since they do not actively collect pollen and are generally not very hairy. However, their presence can indicate healthy populations of native bees. During the day, they fly low to the ground searching for nests to parasitise. They are also often seen on flowers, looking for nectar in the evening when their hosts have stopped foraging and returned to their nests.

Cuckoo bees tend to look very wasp-like and may be difficult to identify in the field. Generally, when comparing with wasps, look for shorter legs, elbowed antennae, and more bee like body stature. It may also be wise to learn the patterns and shapes of some of the most common cuckoo bees in your region (e.g., those shown here). If still unsure, mark in the "other" category and report your suspicion of a cuckoo bee.

Large Carpenter Bees

Family: Apidea
Genus: *Xylocopa*

Large Carpenter Bees are common and easily distinguished from other bee groups largely by their size. While these bees are often mistaken for bumble bees (which are not currently found to inhabit Caribbean islands), they are larger, shinier, and less hairy. Bees of the genus *Xylocopa* are by far the largest bees that you are likely to encounter.

Xylocopa sp foraging on Allamanda sp)

Xylocopa sp foraging on cucumber flowers

KEY CHARACTERISTICS:

SIZE AND SHAPE	20mm or larger
COLOUR AND HAIR	Black, golden-brown, or a combination thereof. Some species can appear to have a tinge of blue. Generally not very hairy. Male and female bees of the same species are often highly sexually dimorphic (that is, males and females appear substantially different from one another). Males of many species are golden-brown in colour, whereas the females are often black or bluish-black.
STRIPES	Some species possess a striped abdomen.
SCOPA	Female bees have brushes of hair on their hind legs for pollen collection.

NOTE:
Male *Xylocopa* bees can be territorial and may follow you around, but are generally harmless (they cannot sting). Female *Xylocopa* bees tunnel into wood to create nests. These bees are important pollinators of passion fruit and barbadine, and can be useful in tomato pollination as well. In some species, a special depression on the top of abdomen is present which houses mites. The mites are beneficial to the bees as these feed on fungus that may develop in the brood cells.

Stingless Bees

Family: Apidea

Tribe: Meliponini

Genera: *Melipona, Nannotrigona, Trigona, Partamona, Lestrimelitta, Frieseomelitta, Plebeia, Trigonisca* and others

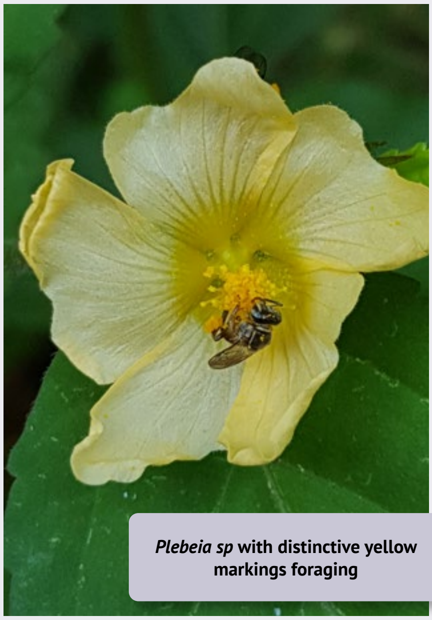
Stingless bees (Tribe Meliponini) are social, construct hives and produce honey, and are historically kept and managed for this reason. The honey, while also eaten, is often reserved for medicinal use. Stingless bees are so named due to their inability to sting – the stinger is much reduced and cannot be used for defensive purposes. The tribe Meliponini comprises the largest group of eusocial bees on Earth, with a reported 417 species from the Neotropics alone and more than 550 species recorded globally. While they may range in size and appearance, there are certain key characteristics by which they may be distinguished.

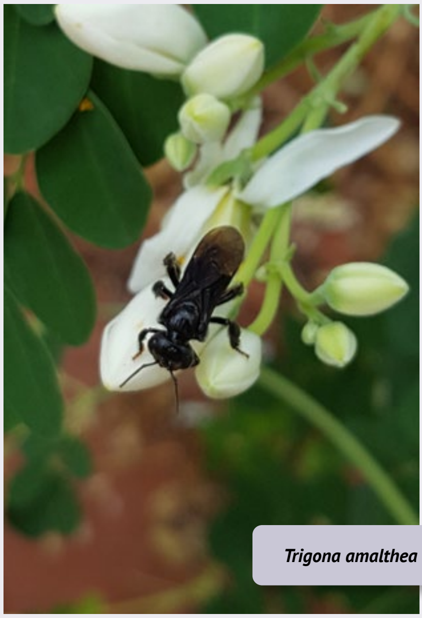
KEY CHARACTERISTICS:

SIZE AND SHAPE	Small to medium (3 – 15mm), size varies depending on species. *Melipona* are by far the largest, whereas *Plebeia*, *Trigonisca* and *Nannotrigona* are some of the smallest stingless bees found in Trinidad and Tobago.
COLOUR AND HAIR	Variable, ranges from entirely black (*Trigona*, *Partamona*), to brown (*Nannotrigona*, *Melipona trinitati*s, some *Plebeia*), to having a brown, hairy thorax, alongside a distinctly yellow and black striped abdomen. Hairiness varies, with the larger species tending to possess more hair than the smaller ones.
STRIPES	Distinctive stripes are only present in *Melipona favosa* (yellow and black abdomen), some species may have subtle stripes (e.g. *Nannotrigona*).
CORBICULA	Meliponini bees possess well developed corbiculae (pollen baskets), which serve to collect pollen, as well as resin, wax, mud, and other building materials. Hind legs therefore usually appear well developed in relation to body size.

NOTE:
More information on Meliponini biology and management of local species can be found in the Guidelines for Sustainable Meliponini Management in Trinidad and Tobago.


Nannotrigona sp at hive entrance


Plebeia sp with distinctive yellow markings foraging


Trigona amalthea


Nannotrigona sp foraging


Melipona trinitatis at hive entrance


Distinctive facial markings of *Melipona favosa* at hive entrance

Metallic Orchid Bees

Family: Apidae
Genera: *Euglossa, Exaerete*

Orchid bees are usually quite distinctive in appearance. Orchid bees in this category boast of a bright, iridescent colouration. The bees are robust. Male orchid bees are attracted to orchids and collect scents for the purpose of attracting females. Male orchid bees also collect scents from rotten fruit and other items. Females appear to be attracted to the complexity of the odours presented to them. Orchid bees also have very long tongues and can access a variety of flower shapes as a result. Additionally, their flight patterns give them away as these bees are known to hover in flight.

Even though bees of the genus Exaerete are cuckoo bees, they have been included in this section due to their robust body, bright colours and other features that make them easily recognisable as orchid bees. Exaerete possess cone-shaped abdomen, which indicates their parasitic nature. These bees parasitise nests of other orchid bees.

KEY CHARACTERISTICS:

SIZE AND SHAPE	Robust, medium sized bees (usually 15-25mm)
COLOUR AND HAIR	Blue, green, purple, copper, or gold. Bees are somewhat hairy, the extent of which depends on the species.
STRIPES	Stripes are usually absent
SCOPA	Hind legs of orchid bees are particularly wide – females possess large corbiculae, while the hind tibiae of males are unusually large for the purpose of scent collection.

Euglossa sp, **displaying the characteristic long tongue and particularly large hind legs**

Exaerete sp

Striped Orchid Bees

Family: Apidae
Genus: *Eulaema, Eufriesea*

Members of the genus Eulaema are not shiny, but instead resemble bumblebees in their colouration. These bees are black with yellow or orange bands, although some bees can be entirely black. Striped orchid bees are quite robust and large, and also possess particularly long tongues. Males of the genus Eulaema also collect scents in order to attract females.

On the other hand, members of the genus Eufriesea usually possess at least some shiny features, but species found in Trinidad and Tobago will mostly possess some sections of black on their abdomen, giving a striped appearance, especially in conjunction with orange.

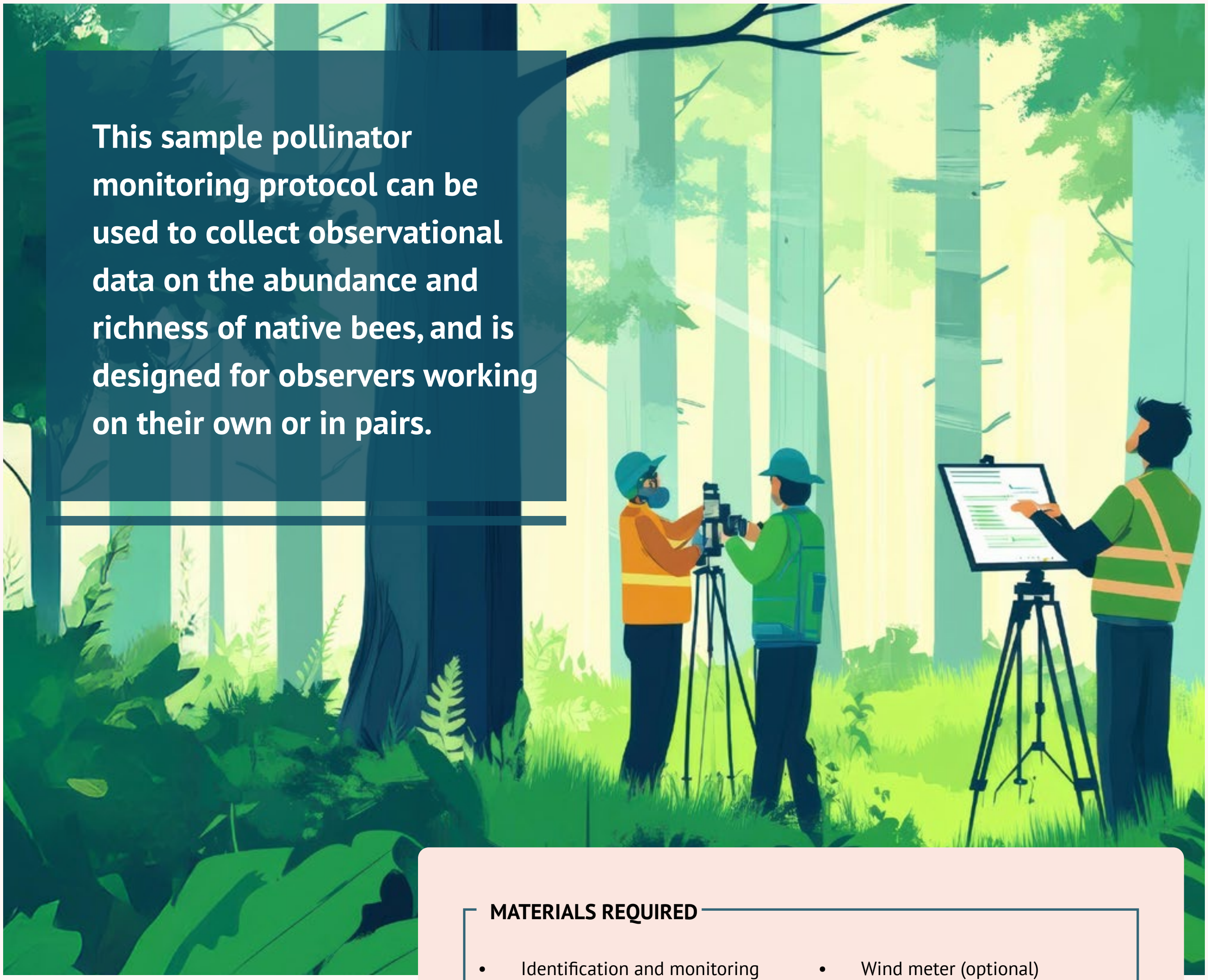
Eulaema sp

KEY CHARACTERISTICS:

SIZE AND SHAPE	Large (18 – 30mm) and robust
COLOUR AND HAIR	Unlike their shiny counterparts, these orchid bees can be quite hairy. They are usually black, with yellow or orange bands present on their abdomen.
STRIPES	Stripes are usually present (orange or yellow)
SCOPA	Female bees possess large corbiculae, while the hind legs of male bees are considerably enlarged for scent collection

Eufriesea pulchra

SECTION 5
Bee Monitoring Protocol And Datasheet



This sample pollinator monitoring protocol can be used to collect observational data on the abundance and richness of native bees, and is designed for observers working on their own or in pairs.

EXAMPLE OF APPLYING THE PROTOCOL

Note: This is an example; the exact timing may vary depending upon weather and the size of the site being monitored.

SETTING UP A SITE

Prior to conducting site monitoring, transects need to be established. It is also important to map the site or take GPS coordinates of transect end and start points. If GPS is not available, mark the transect(s) on an aerial photo or using Google Earth.

MATERIALS REQUIRED

- Identification and monitoring guides (Citizen Science Pollinator Monitoring Guide)
- Clipboard
- Pencil
- Datasheet(s)
- Permits (if necessary)
- Timer
- Thermometer
- Wind meter (optional)
- Sunscreen
- Hat
- Water
- First aid kit (including an Epi-Pen or other appropriate medicine if allergic to bees)
- Site specific monitoring protocol
- Optional: Plant list for the site or plant identification guide

TO SET UP TRANSECT, BRING:

- Measuring tape (30-45m) or wheel
- Stakes and flagging to mark the transect end
- Aerial photo or map to document location of transect
- Optional: GPS or phone to record the start and end points of the transect.

Monitoring a site

8:00 AM—ARRIVE AT SITE

- Set up thermometer in the shade, and fill out the site/ date information in the data sheet.

8:10 AM—RECORD START WEATHER DATA AND DETERMINE SAMPLE DURATION

1. **Shade temperature**
2. **Wind speed:** average wind speed over one minute (at shoulder height, facing the wind) should ideally be less than 10 km/h
3. **Cloud cover:**
   - Clear—clouds rarely/ never cover sun
   - Partly cloudy—clouds cover sun sometimes
   - Bright overcast—even haze/ clouds, but sun or light shadows are visible
   - Overcast—more overcast than bright overcast; no shadows are cast

   NOTE: Do not sample in rainy, or excessively windy conditions.

4. **Sample duration:**
   - To determine the number of minutes you need to sample your site divide the total length (in meters) of the transect(s) by ten.
   - Record this number of minutes on the top of the data sheet.

8:20 AM–9:20 AM—OBSERVATIONS

1. Set timer to 60 minutes. Note start time and then start timer.

2. Begin walking the transect through your study area. Pace yourself. Try to cover the study area (transects) as evenly as possible—it is important not to rush through the area, but it is also important to keep moving (i.e., do not spend more than a couple of observational minutes at any flower or group of flowers). Remember to look at a diversity of flowers, and not just the showy ones. It is also important to be as consistent as possible each time you visit a site so that you collect data with the same level of effort. This will allow you to more reliably compare data from year to year.

3. When you see an animal visiting the reproductive parts of a flower:
   - Observe, identify and note the animal(s) as best you can until you are satisfied with your identification or until the visitor flies away. The recorder should note your observations, including flower species if that is part of your methods.
   - If you see more than one floral visitor on a single flower, first note the number of visitors and then identify them.

4. Begin walking again and continue with your observations until your sampling time is finished.

5. Note end time.

9:20 AM—RECORD END WEATHER DATA

- See above.

9:25 AM—RECORD ANY ADDITIONAL NOTES ABOUT THE SITE

After you have finished collecting data on the bees, note each additional flower species that is in bloom but did not have floral visitors during your survey. (This could also be noted by either the observer or reporter during the survey if it does not distract from monitoring). You can also record unique insects seen at the site, the intensity of visitation to specific flowers, vigor of the planting, needs for site maintenance, observer contact information, etc.

NOTE:
- This example is based on a 183m long transect.
- During monitoring, the observer and recorder work together to collect observational data for a total of one hour. The observer and recorder should cover the study area (transect) as evenly as possible.

DURING YOUR OBSERVATION

- Only identify and make notes on the animals visiting the reproductive parts of the flower. You do not need to record animals sitting on petals, leaves, stems, etc., or visitors flying around the area.
- Be careful not to disturb insects visiting flowers before you get a chance to observe them well. Avoid sudden movements. Insects respond to a shadow passing overhead by moving away; if possible walk so that your shadow trails you, rather than advances in front of you. Also, do not stand too close to the flower you are observing.
- If you have walked through the entire study area (transect) before the allotted time has expired (in the case of this example, 60 minutes for the whole plot), you may go back to monitor particularly rewarding areas until the time runs out.
- Bee species can be difficult to tell apart. If you are particularly interested in monitoring the native bees on your property, it will be important for you to distinguish, at minimum, honey bees from native bees.

CITIZEN SCIENCE MONITORING DATASHEET:
NATIVE BEES

Photocopy or print copies of this datasheet in advance

STEP 1 - SITE DETAILS

SITE NAME: TRANSECT:

MONITORING TIME*: DATE:

**1 minute per 3m of transect*

OBSERVER: DATA RECORDER:

STEP 2 - SITE CONDITIONS *(Remember to note Observation End Time upon completion!)*

OBSERVATION START TIME: SHADE TEMP:

WIND: Calm | Light Air | Light Breeze | Gentle Breeze
(circle one)

SKY: Clear | Partly Cloudy | Bright | Overcast
(circle one)

OBSERVATION END TIME:

STEP 3 - MONITORING

Set timer and hit start when ready. Note any floral visitors you see and identify to your confidence level. Pace the transect until the time is up.

FLORAL VISITOR CATEGORIES:

BEES:

Honey bee
Hairy-leggedbee
Medium dark bee
Metallic green bee
Striped sweat bee
Tiny dark bee
Leafcutter bee
Cuckoo bee
Large carpenter bee
Stingless bee
Metallic orchid bee
Striped orchid bee

NON-BEES:

Butterfly
Moth
Beetle
True bug
Bird
Fly
Wasp
Spider
Other

OBSERVATIONS:

Important: Remember to look at a diversity of flowers, stand so that you do not cast a shadow, and only ID floral visitors to the level at which you are confident in your identification. In order to track floral attractiveness, tally individual floral visitors from the same species by floral association

#	FLORAL VISITOR	DESCRIPTION (genus, colour, size, etc.)	# OBSERVED (TALLY)	FLORAL ASSOCIATION
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				

#	FLORAL VISITOR	DESCRIPTION (genus, colour, size, etc.)	# OBSERVED (TALLY)	FLORAL ASSOCIATION
23				
24				
25				
26				
27				
28				
29				
30				

STEP 5—NOTES (INCLUDE CHANGES IN WEATHER OR OTHER PERTINENT DETAILS)

EXAMPLE

CITIZEN SCIENCE MONITORING DATASHEET:
NATIVE BEES

Photocopy or print copies of this datasheet in advance

STEP 1 - SITE DETAILS

SITE NAME: Chaguanas

TRANSECT: Pollinator Planting Transect 2

MONITORING TIME*: 1 hour
1 minute per 3m of transect

DATE: May 26, 2024

OBSERVER: Mia Smith

DATA RECORDER: Jason Khan

STEP 2 - SITE CONDITIONS *(Remember to note Observation End Time upon completion!)*

OBSERVATION START TIME: 8:43 am

SHADE TEMP: 30 C

WIND: Calm | Light Air | Light Breeze | Gentle Breeze
(circle one)

SKY: Clear | Partly Cloudy | Bright | Overcast
(circle one)

OBSERVATION END TIME: 9:40 am

STEP 3 - MONITORING

Set timer and hit start when ready. Note any floral visitors you see and identify to your confidence level. Pace the transect until the time is up.

FLORAL VISITOR CATEGORIES:

BEES:

Honey bee
Hairy-leggedbee
Medium dark bee
Metallic green bee
Striped sweat bee
Tiny dark bee
Leafcutter bee
Cuckoo bee
Large carpenter bee
Stingless bee
Metallic orchid bee
Striped orchid bee

NON-BEES:

Butterfly
Moth
Beetle
True bug
Bird
Fly
Wasp
Spider
Other

EXAMPLE

OBSERVATIONS:

Important: Remember to look at a diversity of flowers, stand so that you do not cast a shadow, and only ID floral visitors to the level at which you are confident in your identification. In order to track floral attractiveness, tally individual floral visitors from the same species by floral association

#	FLORAL VISITOR	DESCRIPTION (genus, colour, size, etc.)	# OBSERVED (TALLY)	FLORAL ASSOCIATION
1	Metallic orchid bee	Euglossa sp	卌 卌	Vervine
2	Honey		III	Vervine
3	Leafcutter	not sure what species	I	cucumber
4	Hairy-legged bee	Melitoma segmentaria	卌 IIII	Sida
5	Hairy-legged	very long antennae, male?	卌 I	Mimosa pudica
6	Hairy	hairs and pollen on underside of Abd.	I	barbadine
7	Green bee	striped abdomen, green thorax	IIII	Lantana
8	Cuckoo	black w/ red abdomen	I	vervine
9	Honey		I	ixora
10	Large carpenter bee	Xylocopa	I	Sida
11	Red peacock butterfly		I	Lantana
12	Hoverfly	large, yellow + black	I	Unknown plant (weed)
13	Stingless bee	Bombus	III	coralita
14				
15				
16				
17				
18				
19				
20				
21				
22				

#	FLORAL VISITOR	DESCRIPTION (genus, colour, size, etc.)	# OBSERVED (TALLY)	FLORAL ASSOCIATION
23				
24				
25				
26				
27				
28				
29				
30				

STEP 5—NOTES (INCLUDE CHANGES IN WEATHER OR OTHER PERTINENT DETAILS)

Appendix

Appendix A:
BEE GROUPS & SPECIES OF INTEREST*

GROUP	FAMILY	SPECIES
Honeybees	Apidae	*Apis mellifera*
Hairy-legged Bees	Apidae	*Ancyloscelis apiformes*
		Centris analis
		Centris atra
		Centris braccata
		Centris claripennis
		Centris dichrootricha
		Centris derasa
		Centris decolorata
		Centris fbrevivi
		Centris flavifrons
		Centris longimana
		Centris rufosuffusa
		Centris similis
		Centris smithiana
		Centris smithii
		Centris terminata
		Centris torquata
		Centris varia
		Centris vittata
		Centris xylocopoides
		Epicharis albofasciata
		Epicharis fasciata
		Epicharis flava
		Epicharis rustica
		Exomalopsis (Exomalopsis) sp
		Exomalopsis (Phanamalopsis) sp
		Exomalopsis nigrior
		Exomalopsis pubescens

GROUP	FAMILY	SPECIES
Hairy-legged Bees	Apidae	*Florilegus condignus*
		Lophopedia minor
		Lophopedia pygmae
		Melissodes rufodentatus
		Melissodes tepaneca
		Melitoma segmentaria
		Monoeca sp
		Paratetrapedia lugubris
		Paratetrapedia minor
		Paratetrapedia pygmaea
		Thygater analis
		Thygater palliventris
		Xenoglossa citrullina
Medium Dark Bees (excluding Stingless Bees)	Colletidae	*Colletes sp*
		Ptiloglossa eximia
		Ptiloglossa fulvopilosa
		Ptiloglossa generosa
		Ptiloglossa lucernarum
Metallic Green Bees	Halictidae	*Agapostemon nasutus*
		Augochlora antonita
		Augochlora erubescens
		Augochlorella (Pereirapis) sp
		Augochloropsis (Augochloropsis) sp
		Augochloropsis (Paraugochloropsis) sp
		Augochloropsis trinitatis
		Caenohalictus sp
		Megalopta sp
		Megalopta amoena
		Megalopta ecuadoria
		Megaloptina minuta
		Pereirapis semiaurata
		Pseudaugochlora sp
		Stilbochlora eickworti
		Temnosoma sp.

GROUP	FAMILY	SPECIES
Striped Sweat Bees	Halictidae	*Halictus ligatus*
		Halictus poeyi
Tiny Dark Bees (excluding Stingless Bees)	Apidae	*Ceratina (Crewella) sp*
		Ceratina chloris
		Ceratina minima
		Ceratina muelleri
		Ceratina paraguayensis
	Colletidae	*Hylaeus orbicus*
		Hylaeus dictyotus
	Halictidae	*Habralictus sp*
		Lasioglossum (Dialictus) sp
		Lasioglossum milpa
		Lasioglossum trinidadense
		Neocorynura sp
Leafcutter Bees	Megachilidae	*Anthidiellum apicale*
		Callomegachile sp
		Hoplostelis cornuta
		Hoplostelis bilineolata
		Hypanthidioides (Saranthidium) sp
		Hypanthidium dressleri
		Hypanthidoides insularis
		Megachile (Melanosarus) sp
		Megachile (Moureana) sp
		Megachile (Neochelynia) sp
		Megachile candida
		Megachile cocinna
		Megachile furcata
		Megachile lanata
		Megachile paulista
		Megachile paulistana
		Megachile perochracea
		Megachile poeyi
		Megachile stomatura

GROUP	FAMILY	SPECIES
Cuckoo Bees	Apidae	*Acanthopus palmatus*
		Aglaomelissa duckei
		Epeolus boliviensis
		Mesocheira bicolor
		Mesoplia azurea
		Mesoplia rufipes
		Mesoplia regalis
		Nanorhathymus acuteiventris
		Nomada sp
		Odyneropsis batesi
		Osiris sp
		Rhathymus acuteiventris
		Rhathymus bicolor
		Rhathymus trinitatis
		Sphecodes sp
		Triepeolus osiriformis
	Megachilidae	*Coelioxys (Acrocoelioxys) sp*
		Coelioxys abdominalis
		Coelioxys agilis
		Coelioxys alatiformis
		Coelioxys chacoensis
		Coelioxys clypearis
		Coelioxys clypeata
		Coelioxys cosatricensis
		Coelioxys nasidens
		Coelioxys otomita
		Coelioxys panamensis
		Coelioxys tolteca
		Coelioxys zapoteca
		Odontostelis bilineolata

GROUP	FAMILY	SPECIES
Large Carpenter Bees	Apidae	*Xylocopa (Neoxylocopa) sp*
		Xylocopa fimbriata
		Xylocopa frontalis
		Xylocopa mordax
		Xylocopa muscaria
		Xylocopa transitoria
Stingless Bees	Meliponini	*Cephalotrigona capitata*
		Frieseomelitta nigra
		Frieseomelitta paupera
		Lestrimelitta guyanense
		Lestrimelitta limao
		Lestrimelitta spinosa
		Melipona favosa
		Melipona lateralis
		Melipona trinitatis
		Nannotrigona sp
		Nannotrigona chapadana
		Nannotrigona testaceicornis
		Partamona nigrior
		Plebeia frontalis
		Plebeia tobagoensis
		Trigona amalthea
		Trigona trinidadensis
		Trigonisca pediculana
Metallic Orchid Bees	Apidae	*Euglossa allosticta*
		Euglossa augaspis
		Euglossa chlorina
		Euglossa cognata
		Euglossa cordata
		Euglossa deceptrix
		Euglossa despecta
		Euglossa dressleri
		Euglossa gaianii

GROUP	FAMILY	SPECIES
Metallic Orchid Bees	Apidae	*Euglossa hemichlora*
		Euglossa ignita
		Euglossa imperialis
		Euglossa ioprosopa
		Euglossa piliventis
		Euglossa stilbonota
		Euglossa townsendi
		Euglossa tridentata
		Euglossa variabilis
		Exaerete dentata
		Exaerete smaragdina
Striped Orchid Bees	Apidae	*Eulaema basicincta*
		Eulaema bennetti
		Eulaema bombiformis
		Eulaema cingulata
		Eulaema fasciata
		Eulaema marcii
		Eulaema meriana
		Eulaema nigrita
		Eulaema pseudocingulata
		Eulaema seabrai
		Eulaema stenozoana
		Eulaema terminata
		Eufriesea chrysopyga
		Eufriesea concava
		Eufriesea laniventris
		Eufriesea mussitans
		Eufriesea pulchra
		Eufriesea surinamensis

Appendix B: ADDITIONAL ACKNOWLEDGEMENTS

Photographs

We are grateful to the photographers for allowing us to use their wonderful photographs. The copyright for all photographs is retained by the photographers. None of the photographs may be reproduced without permission from the photographer:

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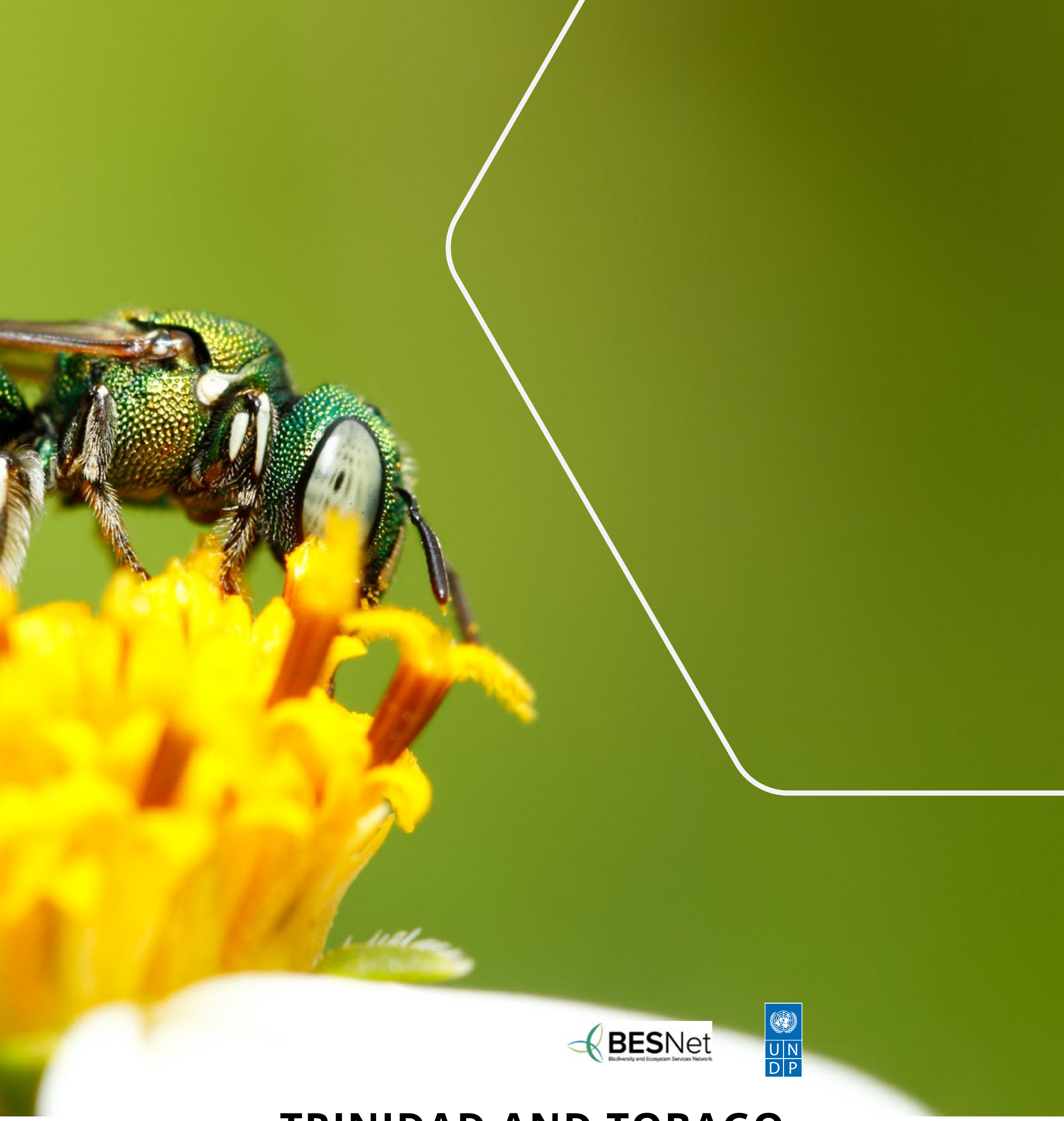

TRINIDAD AND TOBAGO
POLLINATOR CITIZEN SCIENCE MONITORING GUIDE