UCLA Sustainability Action Research

2023 SAR Native Bees Team: Preserving and Increasing Native Bee Populations on UCLA's Campus

SUSTAINABILITY ACTION RESEARCH: FINAL REPORT

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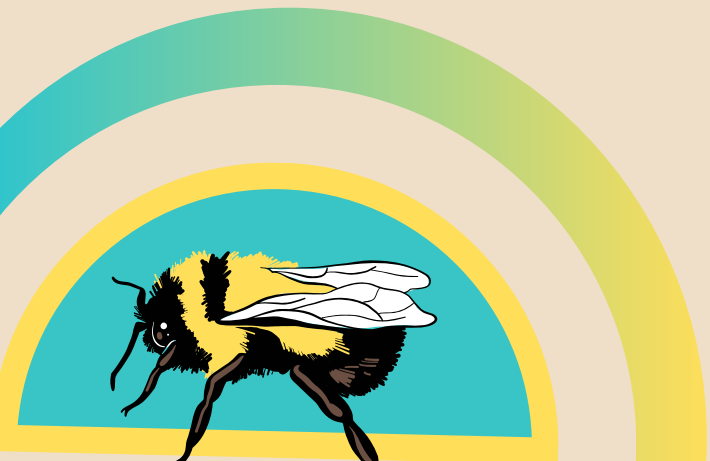


Abstract

Our research question addresses the lack of data on native bee species by identifying which species are present on UCLA's campus. We investigated what type of plants they prefer and how our research can educate the student body and provide best practices for landscaping maintenance. In order to achieve this, we developed a multifaceted methodology to achieving our team goals, including using a map of UCLA's campus divided into sixteen sections, a comprehensive Native Bee Guide, a Google Form Bee Survey, and individual assessments of Sage Hill and the Botanical Gardens. Despite the odd weather observed this spring, the team was able to do a complete surveying of UCLA's Botanical Gardens and Sage Hill, where we observed 14 unique species with the majority being within the *Bombus* genus. Future research should prioritize the other quadrants of the campus to increase our understanding of existing species on campus. Additionally, this observational study should be repeated throughout the year and span multiple years, so that UCLA is able to better understand how the native bees on campus are changing over time with alterations to landscaping and management practices.

Introduction

California is a native bee diversity hotspot, as it is home to over 1,600 species out of the total 4,000 species native to the United States. While there has been a push for bee-centered conservation with the height of the "Save the bees!" campaign, the face of the movement is the invasive and non-endangered European honeybee. Native bees are responsible for pollinating a large portion of agricultural crops as their pollination success rate is two to three times more effective. Native bee populations have declined due to habitat destruction, insecticide usage, a decrease in native vegetation, and competition with honeybees. There is currently no research on

native bee populations on UCLA's campus, so our project's purpose is to gather as much information on their presence and ways we can support them. Our project's research questions are: Which native bee species are present on UCLA's campus? What are their preferred plants? What makes an optimal habitat for them, and how can UCLA support this through landscaping practices and educational opportunities? With our collected data, we hope to identify and increase native bee populations as well as facilitate that information to the student body and landscape maintenance. We hypothesized that there was a higher likelihood of bees frequenting the Mildred E. Mathias Botanical Gardens or Sage Hill due to the density and availability of native plants. This makes it an ideal spot to conduct our initial habitat assessments.

Background

When approaching our research on native bee populations on campus, it was imperative we addressed some key characteristics of native bees that would influence our research approaches. Firstly, native bees are diurnal in nature, meaning they are active during the day and less active at night. In terms of activity, we were focused on their pollination activity as native bees are pollinators of plants, both native and non-native. Additionally, based on our literature review, it was evident that native bees preferred fair, sunny weather over high levels of precipitation or a heavily overcast sky. Additionally, on a phenotypic level, native bees are small and elusive creatures with quick aerial movements that allow them to detect apparent threats with ease. Finally, native bee species vary in phenotypic features; however, these features are difficult to differentiate at times, leading to difficulties in identification.

To address these characteristics and behaviors of the native bees on campus, we held daytime field assessments primarily in Sage Hill (Quadrant 2) and the Mildred E. Mathias

Botanical Garden (Quadrant 13). Additionally, because of the elusivity of native bees and their agile nature, we focused on obtaining video evidence rather than photographs as this allowed us to digitally capture the bees without concern about the bee being focused in the image. Additionally, based on time and resource constraints alongside the delicate nature of the bees, we did not physically capture the bees and instead focused on the digital evidence of their presence. Additionally, because of the pollinator nature of the native bees and their preference for certain flowers as learned from the literature review, we also recorded and identified any native plants that we found the bees on (UC Berkeley Urban Bee Lab). If our team was unable to identify any bees or plants, we uploaded our data to iNaturalist for identification and corroboration.

Methods

The procedures behind our methodology were focused on two separate categories: data collection and data assessment. In terms of data collection, we conducted field surveys in order to collect the data. By running weekly field surveys in the Botanical Garden (Quadrant 13) or Sage Hill (Quadrant 2), we practiced our individual identification skills. During these field surveys, primarily held at the Botanical Gardens or Sage Hill, our team would record any bee sighting and associated plant on our community science survey that served as a database for our observations. We also took note of the weather conditions, temperature, wind level, and number of bees that were present. This process is discussed in the Observation Assessment and Habitat Assessment portion of our Native Bee Guide (see Appendix C). This was important as it added to the amount of data we had, as well as taught us how to properly distinguish between species. Additionally, to bolster the identification portion of our data, we held informational interviews to gain identification and data storage techniques, including how to distinguish between native bees

and other insects as well as suggestions for storing data on google sheets. By looking to professionals for help, we learned important tips and tricks to identify each species correctly. Our data collection also included utilizing equipment such as a telephone or camera to capture the bees. Finally, we applied to The Green Initiative Fund (TGIF) in order to obtain detachable phone camera lenses and jeweler's loupes, among other equipment. Using proper equipment such as hand lenses increased the accuracy of our identification, due to our enhanced ability to see intricate details of each bee.

Our survey was open to the community in order to maximize our data. In order to ensure our survey contained data with limited bias, the questions we developed focused on objective observations (see Appendix A). Outreach was also an important component of our project. We ran informational booths, hung up flyers, and posted infographics to the SAR Instagram to promote the importance of native bee populations on campus and increase participation in our survey. At events such as the Pollinator Palooza and the Earth Day Fair, our posters and various games, pins, and prizes served as methods to engage with and educate the campus and the larger LA community. When we weren't directly sharing our research with people, we posted infographics that both physically and virtually served as outreach.

Data assessment included the storage of our data in the community survey and the corresponding sheet. By allowing community scientists to submit their own bee data through a Google Form, we increased the reach and scope of our data collection. We utilized iNaturalist to corroborate our identification of native bees and plants, utilizing the secondary confirmation of professional scientists to ensure the accuracy of our data and mitigate errors. Additionally, iNaturalist served as a vault of extra data we pulled from for our map and graph developments that are further discussed in the deliverables section. As a supplement to our data assessment, we

developed a bee guide of the populations on campus containing information on identification, different native bee species, and the plants they are associated with (see Appendix C). This data can be utilized by Groundskeeping and future landscaping projects at UCLA (see Appendix).

Equity, diversity, and inclusion was an important aspect of SAR, and something we kept in mind throughout research. By creating a Google Form that was posted to Instagram, shared at tabling events, and promoted around campus, we encouraged a diverse group of people to participate in our data collection. To ensure that all of our team members could be included in proper data collection, we applied for TGIF funding to secure necessary field survey materials for everybody. The infographics we posted to the SAR Instagram to raise awareness about our project included alt text. This way, our posts were accessible to a wider audience, as those who were unable to see the visuals could still read what was presented in them. As with any research, it is important to ensure that the findings and process are accessible to as many people as possible.

Challenges

The biggest challenge that our group faced while conducting our research was effectively and efficiently conducting fieldwork. As nonprofessionals with limited to no previous experience finding and identifying bees, we had to form our own methods for field surveillance. While through informational interviews and our own research, we were able to learn the basics of bee identification, we were completing these processes for the first time. Learning to both find and clearly photograph native bees proved to have a learning curve, and so our data collection began to pick up in the later part of our research project.

Additionally, as we are only a team of six with packed schedules, we were only able to evaluate a small portion of the campus for a relatively short period of time. Soon after we began the project, it was clear that we would not be able to survey each quadrant of campus as we originally wished, so we chose to focus on the Botanical Garden and Sage Hill, where flowers and plants are cultivated and left to grow. While our team located and documented a number of native bees in these areas, data is still yet to be collected on the native bees in areas of campus that are more groomed and regulated by landscaping and therefore which would benefit from this type of data.

Lastly, the weather in Los Angeles this year has been much more cool and overcast than years prior. Since bees prefer warmer, sunnier weather, we would expect to see a different number of bees in a warmer spring. Our data for this year is unique to the weather pattern, and further research on native bee populations during the spring of a warmer year is needed to fully understand native bee patterns here on campus.

Results

In conducting our surveys, we were able to collect over 60 observations around the UCLA campus of native bees, gathered mostly from our team, but also supplemented by submissions to our Google survey from the community. We also collected photo and video information of each sighting, in order to help us in understanding which plants these bees are seen most frequently on, as well as to aid in our identification and verification of bee species.

Of all our bee observations, we saw twice as many native bees on native plants than on non-native plants. Notably, the most common native plants that we saw were of the genera *Ceanothus* (California lilacs), *Salvia* (sages), and *Arctostaphylos* (manzanitas). In addition, of the

non-native plants, *Vicia villosa* (hairy vetch) was the most common one on which native bees were observed.

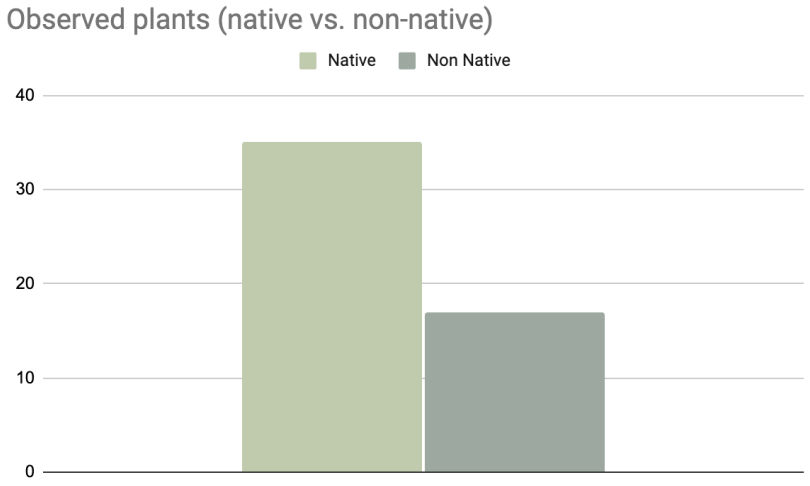


Figure 1: *A comparison of the presence of bees on native vs. non-native plants using survey data.*

The most frequently seen bees were of the genus *Bombus*, which is part of the *Apidae* family. *Bombus* species we identified included *Bombus melanopygus* (black-tailed bumblebee) and *Bombus sonorus* (Sonoran bumblebee). In total, we found 14 unique species across 3 different families. Another species we saw with high frequency was *Xylocopa sonorina* (valley carpenter bee).

In addition, we analyzed the data from iNaturalist in the UCLA area to compare our results with the observations seen by other people before we began surveying the campus for bees. We saw similar outcomes, where our data and iNaturalist data aligned in that *Bombus* species and the valley carpenter bee had the highest instances of observation.

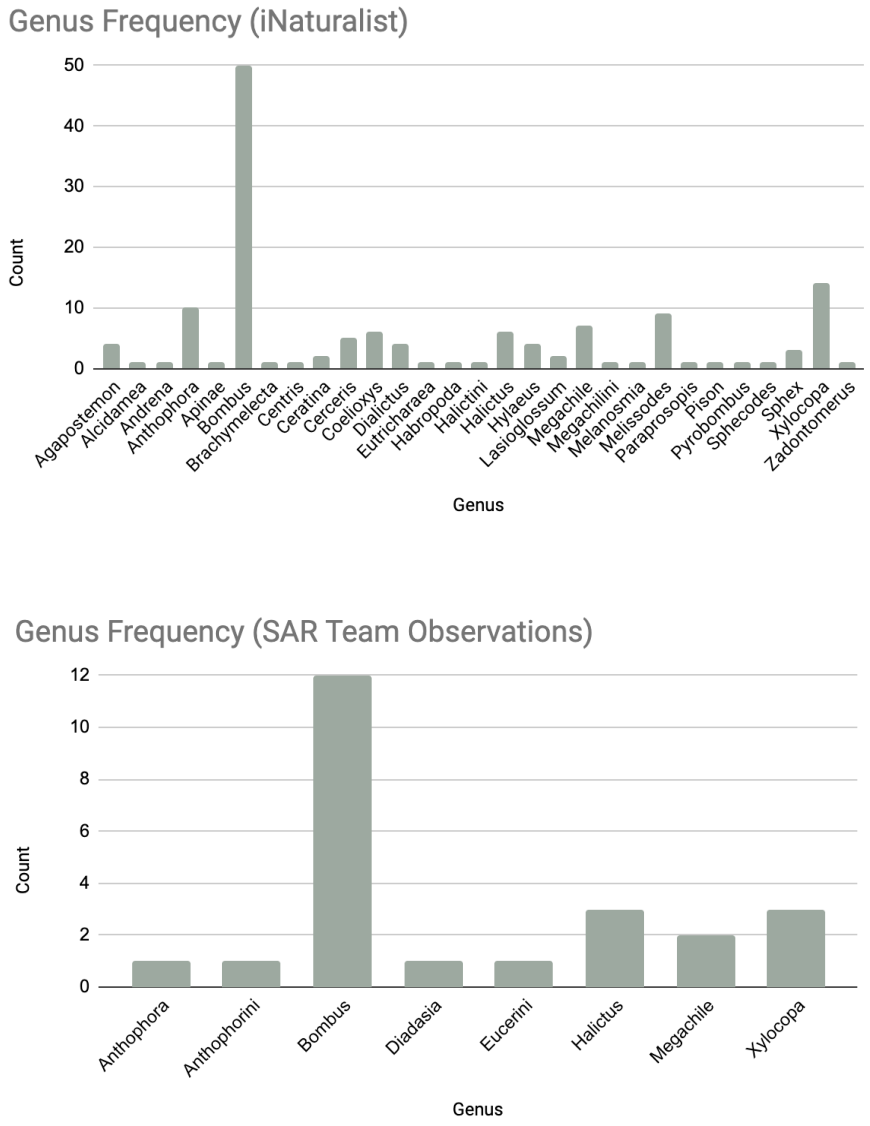


Figure 2: *A comparison of iNaturalist and Field Survey Bee Observations (excludes sightings of the European honeybee, Apis mellifera) based on genus identification and frequency.*

In order to analyze our data, we developed an ArcGIS map (link) that aggregates all the observations and maps them relative to UCLA's campus, sorted by genus or tribe, whichever could be determined more specifically. This map is overlaid with a depiction of data provided by UCLA on rankings of areas of land based on their usage and plant breakdown (native vs. non-native), with greener areas denoting regions that have higher plant coverage. These, in

conjunction with the areas where we identified native plants and native bees, would be of greatest interest to future study on the population of native bees, and even other insects, on UCLA's campus.

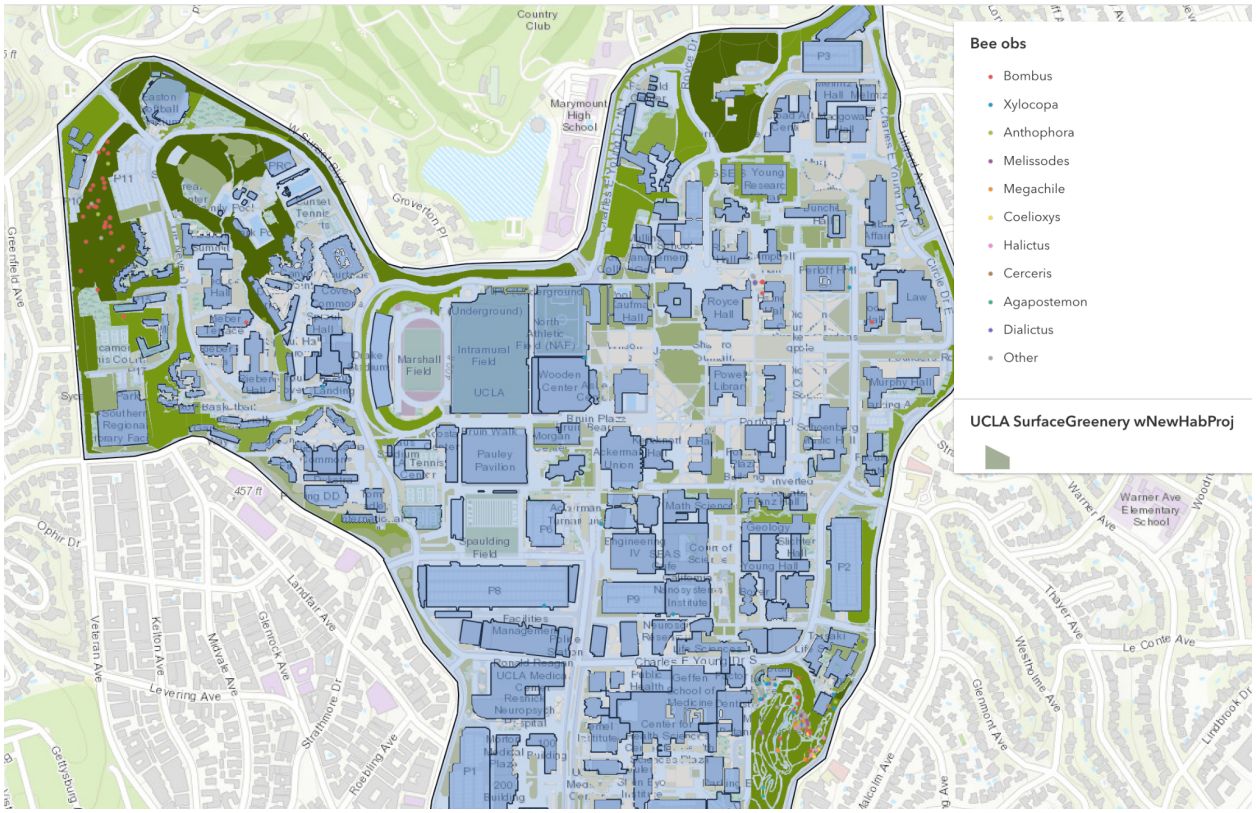


Figure 3: *Aggregate map of all native bee observations on campus (iNaturalist and field survey data, with different genera marked by color). Greenest areas denote areas of highest plant coverage.*

It is worth noting that, given our limited time frame, our team chose to conduct surveys in the Sage Hill and Botanical Garden areas of campus, so we cannot conclude with certainty that these are the places with the most bees on campus. However, given the behavior of the bees we have seen in these areas and our background research, it makes sense that these populations of bees are concentrated in areas with high native plant population density.

Discussion

Landscaping and grounds management

In our research, we were able to learn how to create and maintain native bee habitats. As stated by both Krystle Hickman and Rey Soto, native bees do best when left alone. However, due to the activity and land use of campus, natural vegetation has been and will continue to be disturbed. Therefore, we have compiled information to best inform future landscaping management. Native bees often live and hibernate underground. As so, leaving areas of bare dirt and mulch undistributed is vital. It is recommended to leave the soil surrounding the stem of a flowering plant bare in a 6-12 inch diameter. Additionally, if branches are being cut back, do not cut back more than 12-18 inches. Areas of flowering plants could be sectioned off by large logs of wood so as to prevent people from walking over the plants and disturbing the ground nests. Pre-made holes in these logs can also be used by some native bees for nesting. These pieces of wood can be reused by UCLA facilities management to reduce waste and costs. It is recommended that an ideal habitat would provide a variety of surface cover, including bare dirt, dead branches, native grasses, rocks, and light leaf cover. If mulch is used, it is recommended to be less than 2-3 inches deep. It would be best if groundskeeping planted a variety of native plants so that the blooming seasons of all these plants are varied. This way there can be many types of native flowers to attract native bees with varying and specific flower preferences. To understand which native plants best support native bees, reference Appendix C.

Lastly, there are many gardening and landscaping practices to be avoided in order to properly maintain a space for native bees. First, leaf blowers can disturb nesting bees as well as their habitat. It would also be best to avoid insecticides, as they can be harmful, as well as over-watering or over-mulching nesting areas, paving nesting areas, or planting non-native

plants. These practices can be summed up in one of our educational infographics (Appendix B, Infographic 4).

Native bee box installation

In our research about urban native bee population research, we learned about the role of bee boxes in bee population growth and education. Many types of bees nest in pre-made burrows, including many species in the Megachilidae family (Hickman, 2023). Bee boxes have been used to host native bees in urban environments. It should be emphasized that native bee boxes do not replace native habitat, which is the most important factor in native bee abundance and diversity, but provide additional shelter and serve as a way to learn about and interact with native bees. The boxes need maintenance at least once a year, if not more. Native bees are vastly understudied, especially populations in urban areas. By observing which species and how many individuals utilize the bee box, and continuing observational population research, we may be able to understand more about the nesting behavior and population patterns of native bees. This is why we purchased and are planning to install four native bee boxes on campus in Summer 2023. The informational and educational value of these bee boxes is promising.

If additional supplementary bee boxes want to be installed on campus, it is important to know that bee boxes for native bees require cleaning, should not be made of bamboo, require a depth of at least six inches, and should have a drawer to store cocoons. A structure can be assembled using biodegradable straws as long as it fits the listed requirements. For more information about the native bee boxes, see Appendix E.

Future research

The survey and observational monitoring methods used in this study will continue to be used by Bruin Beekeepers and future native bee researchers on campus. The data collected

during this program will also serve as a baseline for future observations and guide future decisions regarding native bee research and landscaping practices. With information about the existing species in the Botanical Gardens and Sage Hill, we have better knowledge of our campus biodiversity and ecosystem health. Additionally, now that we know that a majority of native bee species observed on campus are in the *Bombus* genus, we can begin to assess why that is.

Future research can compare regions of campus based on the species observed and how the grounds are managed and if and what native plants exist there. The methods used in our research can also be repurposed to do larger-scale insect biodiversity surveys on campus. Gathering this data, especially over time as the campus expands its areas of native landscaping, will be useful knowledge to campus stakeholders and urban ecologists about the success of turf conversion and the role of urban landscaping. In addition to observational surveys, future native bee researchers on campus can improve their population research by looking for ground nests (typically underneath a plant, 6-12 inches from the stem) using UV pigment and UV light, utilizing nets and a cooler to produced better quality images, and finding tree burrows. Future researchers can also improve their outreach and education by involving a variety of campus demographics. For example, future native bee researchers can employ the help of art students to create art pieces out of reused material that can also serve as a habitat in native landscaped areas. This could increase the reach and inclusivity of the project as well as drive the desire to learn and care about native bees. These strategies may highlight areas of improvement on campus that could better serve and protect our native biodiversity.

Appendix A

Outline of Google Survey titled “SAR Native Bees Community Science Data Collection”

Section 1. “Upload a video of the bee (a photo is ok, but video is preferred).”

Section 2. “How many bees of the same species were present?”

Options: “1, 2-4, 5, 10+”

Section 3. “Time of Sighting:”

Section 4. “Temperature (F°)”

Section 5. “Level of wind”

Options: “Still, Light breeze, Windy, Very windy”

Section 6. “Sky”

Options: “Clear, Partly cloudy, Mostly cloudy, Overcast”

Section 7. “Quadrant bee was found in”

Options: 2-16 (Photo of campus map is present with corresponding section numbers)

Section 8. “Photo of plant/habitat bee was found in”

Section 9. “OPTIONAL: If you are familiar with native bee species of Southern California, what species of bee do you think this is?”

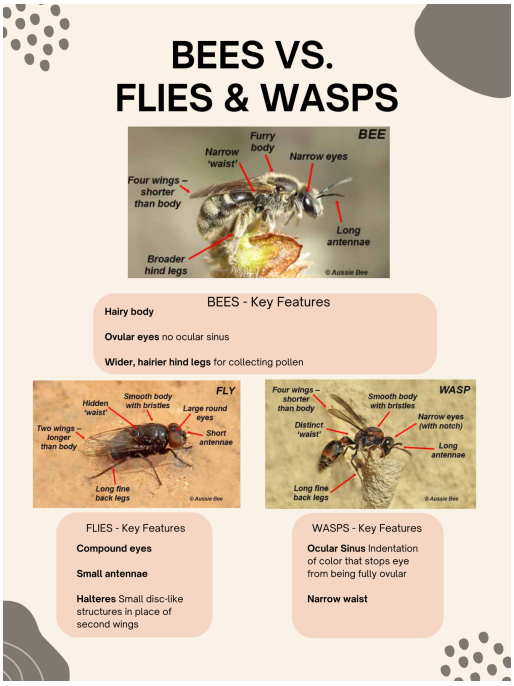
Section 10. “Any additional notes?”

Appendix B

Deliverable educational infographics

Infographic 1. “Introducing the Native Bees of UCLA”

Infographic 2. “Bees vs. Wasps vs. Flies”



Infographic 3. “Which native bee are you?” Quiz

Infographic 4. “Making an ideal native bee habitat”

Appendix C

Special Plant and Native Bee relationships

- California Poppy (Eschscolzia californica)-Has a specialist relationship by providing pollen to Perdita bees.
- Popcorn flower (Cryptantha)- Has a specialist relationship by providing nectar to Perdita bees.
- Squash (Cucurbitaceae)- Has a specialist relationship with squash bees pruinosa.
- Morning Glory (Calystegia)- Sweat bees will sleep inside the flowers when they 'close'.
- Mallow (Sphaeralcea, Abutilon)- Male Diadasia bees will sleep inside the flowers.
- Penstemon (Penstemon spectabilis)- Used by sweat bees.
- Nightshade (Solanum): Requires buzz pollination conducted by bumblebees.
- Redbud tree (Cercis canadensis): Carpenter bees utilize the foliage.
- Elderberry tree (Sambucus): Used by cavity nesting bees for it's pithy stems.
- Mariposa Lily (Calochortus eurycarpus)- Used by sleeping bees.

Plants that support Native Bees

Spring

- Blue-eyed Grass (Sisyrinchium bellum)
- Coast Live Oak (Quercus agrifolia)
- California Buckwheat (Eriogonum fasciculatum)
- Desert Lavender (Condea emoryi)
- Common Manzanita (Xylococcus bicolor)
- Blueblossom Ceanothus (Ceanothus thyrysiflorus)

Summer

- Black Sage (Salvia mellifera)
- White Sage (Salivia apiana)
- California Aster (Corethrogyne filaginifolia)
- Golden Yarrow (Eriophyllum confertiflorum)
- Silver Lupine (Lupinus albifrons)
- Purple Nightshade (Solanum xanti)

Fall

- California Sunflower (Helianthus californicus)
- Clustered Tarweed (Deinandra fasciculata)
- Longstem Buckwheat (Eriogonum elongatum)
- Douglas' Groundsel (Senecio flaccidus var. douglasii)
- De La Mina Verbena (Verbena lilacina)
- Pitcher Sage (Lepechinia fragrans)

Appendix D

SAR Native Bees Team
Bee Guide

Team Co-Leaders: Brooke Borders and Ogechi Hubert
Team Members: Catherine Hu, Grace Miller, Juliet Hagar, and Ryan Shelburne
Stakeholder: Bonny Bentzin

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Importance of Native Bees

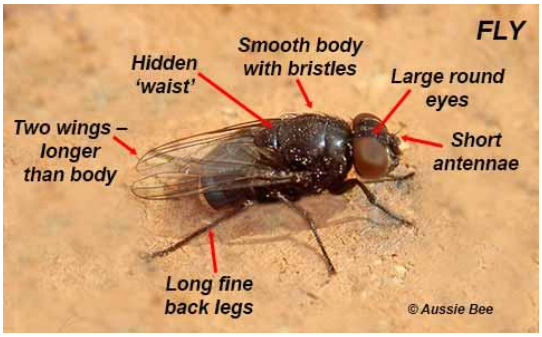
Generally, native species allow ecosystems to thrive by fulfilling important niches in the community and increasing biodiversity. Pollinators are particularly important species as they spread pollen from plant to plant as they travel, increasing plant populations and subsequently improving the biodiversity of the ecosystem as a whole. Diverse ecosystems are stronger and allow for many species to interact with each other. Due to the importance of native pollinators, our SAR topic looks at the native bee populations at UCLA, focusing on researching habitats and developing effective education materials in hopes of increasing both the presence and knowledge of native bees on campus. Increasing the numbers and diversity of native bees on campus strengthens the ecosystem, encourages the growth of natural plants, and promotes biodiversity. Additionally, while honeybees are generalist, originally invasive pollinators that only successfully pollinate 5% of the plants they interact with, many native bees are specialist pollinators that do a much better job at pollination.

Differences Between Bees, Wasps, and Flies

When looking to identify native bees, it can be difficult to determine what is a bee versus a wasp or a fly, as they have similar features and can have similar colorations. Our meeting with Krystle Hickman, as well as learning through observation of native bees, allowed us to properly distinguish between bees and native species. To help with future identification, follow the tips below to determine whether or not you are looking at a native bee.

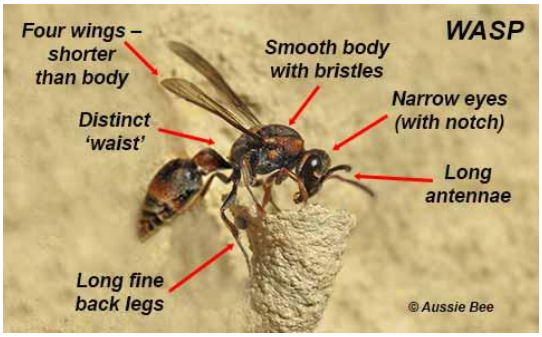
Flies

Unlike bees, flies have large, compound eyes, and small antennae compared to the longer, 12-or-13 segmented antennae of bees. Additionally, flies have halteres, or small disc-like structures, in place of a second set of wings. When looking at fly versus bee wings, bees have far more venation in their wings, while flies have more transparent space.



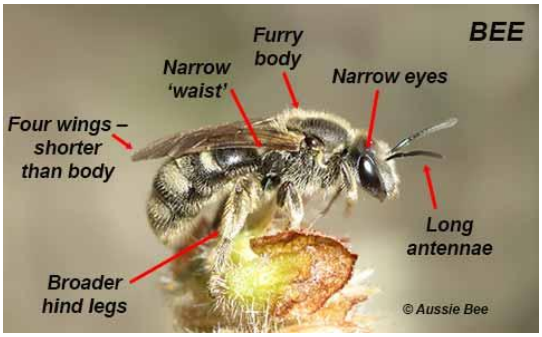
Wasps

Wasps have an ocular sinus, which is a slight indentation of color encroaching on the eye that stops it from being completely ovular. Wasps can have over 20 antennae segments, compared to less in bees, and have narrow waists in proportion to the rest of their bodies. Behaviorally, wasps sleep in a perched position rather than grasping a stem like a bee, and they are parasites of other creatures, while bees are usually parasites of other bees.



Bees

Bees are typically hairy, with narrow, ovular eyes, minus the ocular sinus. They have antennae that are usually broken into 12 or 13 segments, and wider, hairier hind legs that are used for pollen collection. Compared to the two wings of the fly, bees have four wings that are shorter than their bodies.



Observation Assessment

We worked with Krystle Hickman, a bee expert, to help with differentiating between bee species. She provided insight into identification methods, helping us determine the family or sometimes species of bee we were looking at.

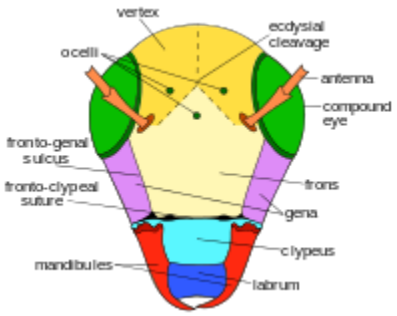
First, there are four main angles used to identify a bee: lateral, face, dorsal, and posterior. Each angle has specific characteristics that differ between species. It's helpful to know what these features are in order to identify what species of bee you are looking at.

Lateral

On a bee, the antennae can be used to determine gender. Females have 12 antennae segments, while males have 13. When looking at the bees' hind legs, females typically have pollen on their back legs attached to the hair. Male bees have hair on their middle and back legs.

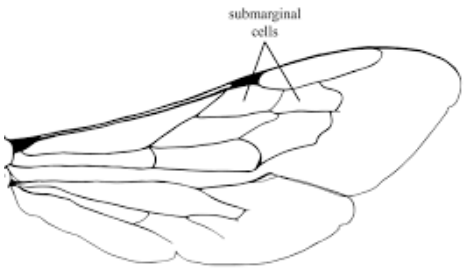
Face

Looking at the facial region (clypeus) of a bee can help narrow down which species of bee you at looking at. It's important to look at the bee's clypeus head-on, rather than from the side. Some bees have a furry clypeus, while others have a facial plate.



Dorsal

The dorsal region encompasses the wings. The submarginal cells, delineated by thin, vein-like structures in the wings, can vary from species to species. Some have 2 submarginal cells, while others have 3. While this alone cannot pinpoint the exact species, when coupled with other features, such as the clypeus and lateral region, it will help you hone in on what species it could be.



Posterior

The posterior region encompasses the abdomen. There can be different amounts and colors of hair bands on the posterior, which often differentiate between families and species.

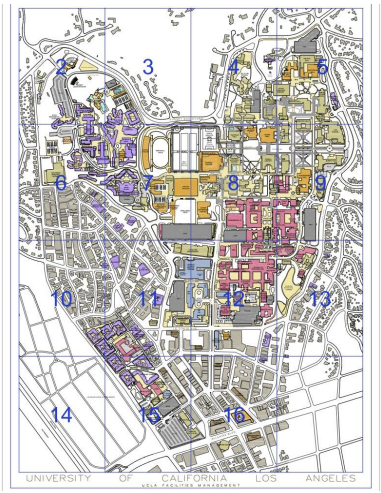
Additionally, Krystle offered insight into how to properly go about field surveys, in order to get the most accurate data and identifications. She suggested using a cell phone, rather than an actual camera to take recordings of the bees, as they move quickly and sometimes a camera can't capture images and videos that quickly. We learned that videos work better than photos, as it captures the bees' behavior and movement, which can differ between species. When observing, it's important to get as close as possible and observe first, as bees have behavioral patterns on flowers. Then, wave your hand over the flower, and after some bees scatter, take recordings of the ones that stay. Additionally, to help distinguish between native bees and honeybees, she told us that native bees typically fly differently, while honeybees stay on the flower longer.

Krystle introduced us to the net and cooler method, which we didn't employ in our research, but would be helpful for future years of SAR Native Bee Research. In this method, the bees are captured in a net, preferably one that extends 2-6 feet, then placed in a cooler for 30 seconds, which renders them immobile, but safe, for a short period of time. Then, the bees can be placed on white paper, and their features examined. It is helpful to get a cloth, or a silk net for these field surveys, and cleaning the net from area to area so as not to spread pathogens is important as well.

Finally, Krystle suggested keeping a spreadsheet of all of our bee observations. This would include the common name, scientific name, time, date, flowers nearby, weather, time, precipitation, and any additional notes. Not only does this keep track of our data collection and help us identify bees, but it also provides information on their preferred weather and behavior. Additionally, we uploaded photos and videos of our identified bees to iNaturalist to confirm our guesses or help us identify species we were unsure about.

Habitat Assessment

When addressing habitat assessment for native bee populations, it is important to understand a few general characteristics native bees exhibit. Firstly, native bees are diurnal creatures, meaning they are active during the daytime. Additionally, native bees generally preferred fair, sunnier weather when collecting nectar and pollen from plants. As a result, we held our field assessments during the day when bees were most active. While our community science survey was accessible to anybody at any time of the day when they saw a bee, our team assigned each individual member a certain day and location to conduct studies, mostly centered in Quadrants 13 and 2 which were the Botanical Garden and Sage Hill respectively.



UCLA Facilities Management. *Campus Utilities Map.* (May 2016)

Allocating particular times allowed our team to cover a variety of weather conditions when assessing the activity of the native bee populations on campus. Additionally, in carrying our research for an extended period of time, we tracked bee populations and their relationship with the blooming and dormancy of particular flowers throughout the spring season. Native bees have a mutualistic relationship with various plants across campus: understanding these relationships is vital in maintaining their populations. In our habitat assessment portion of the field survey, we took note of the date, weather conditions, temperature, plant the bee was found on, time of day, quadrant (location), the level of wind, and number of that species present. This methodology allowed us to address the numerous variables that affect the activity and presence of native bees, ultimately serving as the data backbone for our map development.

Informational Interviews

Our team conducted various informational interviews to better understand the mechanics and behaviors of native bees and proper identification methods. As previously mentioned, we interviewed Krystle Hickman, a prominent community scientist and conservation photographer that provided us with indispensable information regarding identification methods and data storage. Another important individual that helped us with our understanding of bumblebees on campus was Andy Kleinhesselink, a restoration ecologist and the Managing Director of Sage Hill. He took us on a tour of Sage Hill and taught us of various native plant species that were accompanied by the presence of numerous native bee species, including the oval-headed sweat bee and various members of the Apidae family. Additionally, Leif Richardson of the Xerxes society also provided us with invaluable information regarding native bee species identification in Southern California. Thanks to these individuals, we were able to carry out our project with a foundational understanding of bee identification.


Krystle Hickman


Andy Kleinhesselink


Leif Richardson

Black-Tailed Bumble Bee (*Bombus melanopygus*)

Black-Tailed Bumble Bees are a common native bee species here at UCLA. Found both at Sage Hill (Quadrant 2) and the Botanical Garden (Quadrant 13), they pollinate a variety of species. There are two varieties, red form and dark-colored form, however, only the dark-colored form appears in Southern California.

Black-Tailed Bumble Bee pollinating a Hydrangaeceae (*Carpenteria californica).*

Habitat: Wide range of habitat, including agricultural and urban areas. They can nest underground or above the ground.
Pollination Habits: Workers and males are active March-September, while queens are active from February to August. Pollinate a wide variety of plants.
Preferred Plants at UCLA: Black Sage, Hydrangeaceae, Purple Nightshade, and Hairy Vetch (non-native).

Black Sage (*Salvia mellifera*)

Purple Nightshade (*Solanum xanti*)

Hairy Vetch (*Vicia villosa*)

Identification Tips: These bees are round, with the second and third abdomen segments being black. The other segments are yellow in color. They have round, slightly opaque wings. They are 10-16 mm long, with the queens being 16-19 mm long. Fringed hair on hind legs forms a pollen basket to carry pollen from flower to flower.

Diadasia Bee (*Diadasia)*

The diadasia bee, commonly referred to as the “cactus bee” or “chimney bee”, is a genus of bee that is also present around UCLA’s campus, particularly the Botanical Garden (Quadrant 13).

A female *Diadasia ochracea*

A male *Diadasia tropicalis*

Habitat: Prefer a drier and arid habitat, such as a desert meadow or dry grassland ecosystem. They develop vertical, shallow burrows for nesting and have even been noted to soften the earth they use with nectar to make burrowing easier. They are regarded as solitary bees but often develop communities of nest during the springtime, peak burrowing season.
Pollination Habits: Males tend to appear before females appear during the pollination season. The bees tend to spend the winter underground and come up in early spring for nest development and pollination.
Preferred Plants at UCLA: Diadasia range in terms of plant specialization; however, the Diadasia we found at UCLA was found on a Palmer’s Indian Mallow, a plant that the species *Diadasia tropicalis*, *Diadasia diminuta*, *Diadasia ochracea*. An important thing to note is that while *Diadasia tropicalis* is a mallow specialist, *Diadasia diminuta* and *Diadasia ochracea* both prefer mallow plants but are not mallow specialists as they are also fond of other plants as well.

Palmer’s Indian Mallow (*Abutilon palmeri*)

Identification Tips: Diadasia tend to lean from medium to small sizes, ranging from around 6-12 mm. They tend to retain a tawny color and have either pale gold bands or a pale golden hairs on their abdomens. Females tend to have bushy hind legs to collect pollen with long hairs on their forelegs. Males tend to have hind legs that are more elongated than females.

Leafcutter Bee (*Megachile)*

The genus *Megachile* contains these unique bees that are named for their tendency to cut plant leaves and flower petals. On campus, they were spotted at the botanical garden (Quadrant 13).

Female *Megachile zaptlana* leafcutter Bee

A Male *Megachile chichimeca*

Habitat: Being a wide genus, leafcutter bees are found in a variety of habitats, primarily in areas that would allow them to build their nests, which require a sufficient level of foliage and flora. Dead twigs, tree cavities, and holes in the ground are all viable places for females to develop their individual nests.

Pollination Habits: Leafcutter bees are known in the agricultural sector for their pollination of various industrial crops, including alfalfa, blueberries, and carrots. They are also responsible for the pollination of various native plants, including native lavender.

Preferred Plants at UCLA: At UCLA, the unspecified female leafcutter bee was found on a desert lavender.

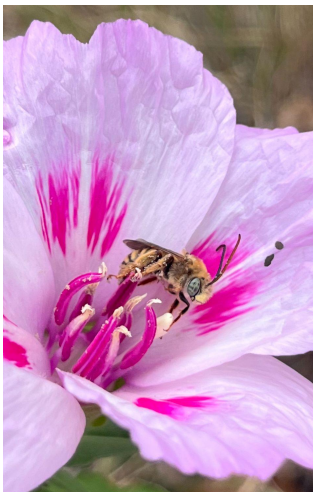
Desert Lavender (Condea emoryi)

Identification Tips: Leafcutter bees are identifiable by their flat abdomens and broad, sculpted heads with prominent mandibles for leaf cutting. Females are identifiable by a prominent amount of scopal hairs on the underside of their abdomens for pollen collection. Males tend to be smaller with more hairs on their heads.

Longhorn Bee (*Melissodes)*

Longhorn bees are a general description of bees that are noted for their long antennae. At UCLA, an unspecified longhorn bee of the genus *Melissodes* was found at the Botanical Garden (Quadrant 13).

Habitat: Longhorn bees build there nests in the ground, usually in shaded areas under shrubbery or wood. The nests they build contain specific compartments for each egg alongside a ball of pollen for the egg's sustenance when it hatches. They are found in rural and urban areas with a moderate to high density of foliage, particularly flowering plants.



A male Longhorn bee (genus *Melissodes*) found pollinating a plant of the genus *Clarkia*

Pollination Habits: Longhorn bees tend to be mostly active in warmer weather, especially in the mid summer to early fall months. Most species are generalists that prefer to pollinate plants in the family *Asteraceae.*

Preferred Plants at UCLA: The Longhorn bee at UCLA was found pollinating a Clarkia plant of the genus *Clarkia* (see image above "pollination habits").

Identification Tips: Typically on the larger side of native Californian bees, male Longhorn bees are marked for the prominently elongated antennae whereas females have smaller, stubbier antennae. Females, like many of the aforementioned native bees, have scopae on their hind legs for pollen collection. Both males and females are particularly hairy. This genus also tends to retain prominent blue/green eyes, as is evident in the above photo.

Oval-Headed Sweat Bee (*Lasioglossum ovaliceps)*

The family *Halictidae* is home to the green oval-headed sweat bees, a faction of tiny, docile bees. At UCLA, the oval-headed sweat bee was found at Sage Hill on a coastal morning glory.

An image of *Lasioglossum ovaliceps*

Habitat: These bees develop their nests underground in shaded areas and tend to live a solitary lifestyle. This species is found primarily in coastal lands and highlands.

Pollination Habits: These bees primarily visit flowering plants during the months of April to August.

Preferred Plants at UCLA: At UCLA, this bee was found on a coastal morning glory.

An image of the coastal morning glory (*Calystegia macrostegia*)

Identification Tips: These bees are most noted for their oval shaped head and tiny frame, about 3-5 mm in length. They are also noted for a dark green tinted metallic body and slightly reddish abdomen.

Sonoran Bumble Bee (*Bombus sonorus*)

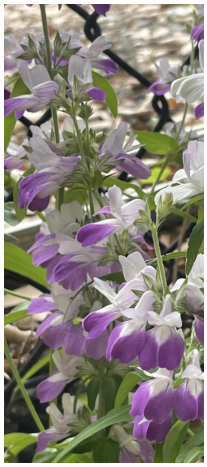
The Sonoran Bumble Bee was found at the Botanical Garden (Quadrant 13). Outside of UCLA, this species resides in the Sonoran desert and large portions of the western United States. These bees are fairly widespread and pollinate a wide variety of plants, such as thistle, clover, and sunflowers.

Sonoran Bumble Bee pollinating a Purple Chinese House (*Collinsia heterophylla*)

Habitat: The Sonoran Bumble Bee lives in low elevations, preferring deserts and valleys. It is common in the Sonoran and Chihuahuan deserts. They are most active from February to October, and they store pollen and nectar in hives with lumpy, asymmetrical cells, whereas the larvae develop in egg-shaped hive cells.

Pollination Habits: These bees fly slowly and noisily from flower to flower. They can sonicate, or "buzz" specific types of flowers. Worker bees bite into the part of the flower that contains the pollen, the anther, and buzz intensely, releasing the pollen for collection.

Preferred Plants at UCLA: Purple Chinese House



Purple Chinese House (*Collinsia heterophylla*)

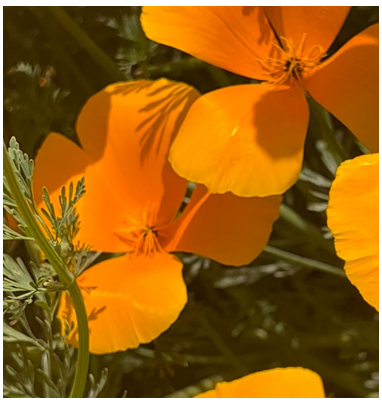
Identification Tips: Worker bees of this species are 14-18 millimeters long, while queens are larger. The bee's head is completely black, while the front and back of the thorax are yellow. There is a wide, black stripe between the wings in the middle of the thorax. The bee's abdomen is fully yellow, save for the last three segments, which are black. This bee is fairly fuzzy, with wide, hairy, hind legs for pollen collection. In terms of distinguishing gender, male bees have thin hind legs that do not carry pollen and long antennae. This differs from the queen bees, who are much larger, and the females, who are worker bees with thick hind legs.

Tripartite Sweat Bee (*Halictus tripartitus*)

The Tripartite Sweat Bee spans eastern Montana to Arkansas, including all the western states. Sweat bees are known for landing on the skin of humans, and drinking the salt out of their sweat. The Tripartite Sweat Bees at UCLA were found in the Botanical Garden (Quadrant 13).

Tripartite Sweat Bee pollinating a Harvest brodiaea (*Brodiaea elegans*)

Habitat: They are semi-social ground nesters. In social colonies, females take care of the larvae and stay in the nest. As they are semi-social, individuals of this species can be seen from spring to the earlier fall months. Nests can be created in the springtime, and produce larvae into the fall months.
Pollination Habits: They prefer composite plants, and are general foragers that can be seen on a variety of flowers. In the Botanical Garden, they were found on flowers that were mostly wide and open, such as the California Poppy.
Preferred Plants at UCLA: California Poppy (*Eschscholzia californica)*, Blue-Eyed Grass (*Sisyrinchium bellum*), Harvest brodiaea (*Brodiaea elegans*)



California Poppy (*Eschscholzia californica)*

Blue-Eyed Grass (*Sisyrinchium bellum*)

Harvest brodiaea (*Brodiaea elegans*)

Identification Tips: The Tripartite Sweat bee is medium sized compared to other species, around 0.2 inches long. The green metallic sheen of *Halictus tripartitus* differentiates it from other sweat bees. On the outer edge of their abdominal section, they have bands of hair, and females have hair, or scopa, on their hind legs. *Halictus tripartitus* have three submarginal cells in their wing, and each venation is of equal strength. *Halictus tripartitus* often gets confused with Lasioglossum, however, the wing veins in the latter are weak. Additionally, in Lasioglossum, the abdominal hair bands are in the inner portion, rather than the outer.

Valley Carpenter Bee (*Xylocopa varipuncta*)

The Valley Carpenter Bee, otherwise regarded as the Teddy Bear Bee, is notable for its fuzzy, orange appearance and large size. At UCLA, it was spotted in the Botanical Garden (Quadrant 13).

A male *Xylocopa varipuncta*

A female *Xylocopa varipuncta*

Habitat: They are often found in suburban gardens, woodlands, and areas with sufficient foliage. They typically nest in the limbs of trees, including coastal live oaks, in a sorority fashion with a mother in protecting the nest alongside a squadron of unmated females.

Pollination Habits: Females somtimes get nectar from flowers by piercing the side of the flower and extracting without getting pollen on its legs. Regardless, for many other plants they are generalist pollinators of native plants. They are most active in April to May.
Preferred Plants at UCLA: These bees were found on a *Petrea volubilis 'Albiflora',* a non-native plant, and a *Pluchea sericea*, a native plant.

Petrea volubilis 'Albiflora'

Pluchea sericea

Identification Tips: They are the largest bees in California, reaching sizes of up to 15-25 mm in length. Females retain large black, metallic with a coppery iridescence. Males have hairy orange-yellow bodies, akin to a teddy bear, with significantly more hairs on the legs and body than females.

Yellow-Faced Bumble Bee (*Bombus vosnesenskii*)

These bees inhabit much of the Pacific Coast, from Canada to Southern California. They are incredibly social and can thrive in urban environments as well as natural ones.

Yellow-Faced Bumble Bee (*Bombus vosnesenskii*)

Habitat: These bees are very social, and therefore live together in colonies. In early spring, the queens begin looking for places to nest, typically selecting hollows in the soil or unused rodent nests. Colonies survive through the fall to the first frost, however, different bees within the colony are active at different times. Drones (male bees) are used in the summer for reproduction with the queen, while the workers (female bees) forage. Only the queen survives the winter period. Colonies are made up of about 200 to 300 bees.
Pollination Habits: When the colony begins, the queen does all of the foraging solo, as well as taking care of the larvae. Then, when the bees mature, they take over for pollination. This species is a generalist, so they pollinate in areas where there is a diverse group of plants. Additionally, their ability to pollinate crops such as potatoes has made them popular in agriculture.
Preferred Plants at UCLA: Similar to other bumble bees, these bees were found around plants of the *Salvia* (sage) genus, including *Salvia leucophylla*.

A *Salvia leucophylla* plant

Identification Tips: These bees have a yellow face, mostly yellow thorax, and a mainly black body, with one yellow segment on the lower abdomen. Typically, males have a bit more yellow on this segment than females. They are hairy, but the hair is short and even throughout their body. Females, or workers, are 8 to 17 millimeters long, while males, or drones, are 10 to 15 millimeters long. Because the females are pollen collectors, their hind legs have special hairs on the pollen baskets, helping them carry pollen once it is mixed with nectar.

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Appendix E

Native Bee Boxes

Background

Many types of bees nest in pre-made burrows, including many species in the Megachilidae family. Bee boxes have been used to host native bees in urban environments. It should be emphasized that native bee boxes do not replace native habitat, which is the most important factor in native bee abundance and diversity, but provide additional shelter and serve as a way to learn about and interact with native bees. The boxes need maintenance at least once a year, if not more. Native bees are vastly understudied, especially populations in urban areas. By observing which species and how many individuals utilize the bee box, and continuing observational population research, we may be able to understand more about the nesting behavior and population patterns of native bees.

Goals

- Encourage native bee population growth on campus
- Establish an ongoing program that will collect information about the success of bee boxes on campus for native bees
- Serve as an educational opportunity for students on campus

Installation

- Place around 3-5 feet off the ground, near the waist to eye-level
- East- or South-facing entrance
    - Native bees typically nest in these directions
- Place near native flowers and landscaping (especially buckwheat and salvia)
- Further from trees and areas of heavy foot traffic
- Do not install in the fall
    - Most native bees are already growing nests at this time
- The best installation time is February-March

Maintenance

- Cleaning is dependent on the type of bee that is inhabiting the box
    - Some have two generations per year
- Once channels are capped up, remove the cocoons
- Cocoons should be cleaned in a bleach bath (to remove pests), rinsed quickly, dried, and placed in the drawer
    - Male eggs are laid near the entrance, don't put them back
- Clean out mud and debris using the brush

For more information, visit https://www.ioes.ucla.edu/project/nativebees2023/

Cleaning Mason Bee Condos by hutchingsbeeservice on YouTube

Cleaning Mason Bee Cocoons by Rent Mason Bees on YouTube

Contact

If damaged, please contact Bonny Bentzin (bbentzin@fm.ucla.edu)

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