



CALIFORNIA BUMBLE BEE ATLAS

Participant Handbook- 2025



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Introduction

Bumble bees are charismatic and easily recognizable insects due to their large size and distinctive hair color patterns, usually featuring contrasting yellow, black, red, and white stripes. As plant pollinators, they play an important role in maintaining ecosystem function and crop production.

In recent years, the importance of pollinators and their contribution to the agricultural economy has been recognized, as has their vulnerability, in large part because of widespread losses of bees. Declines of both managed and wild bee populations are alarming, yet until recently, reports of declines in managed hives of the introduced western honey bee due to pathogens, pesticide exposure, and other stressors has dominated news coverage. Equally important, but less well understood or publicized, is the parallel decline of native bee populations, particularly bumble bees. A recent study led by the IUCN Bumble Bee Specialist Group, supported by studies led by Dr. Sydney Cameron, and a status review by Dr. Robbin Thorp and the Xerces Society, demonstrated that around $\frac{1}{4}$ of North America's approximately 50 species of bumble bees are undergoing worrying population declines. Some of these species, including Franklin's bumble bee (*Bombus franklini*), may already be on the brink of extinction.



Figure 1. Black tail bumble bee (*Bombus melanopygus*) queen nectaring at buttonbush (*Cephalanthus occidentalis*). Photo: L. Richardson.

The causes of these declines are not fully understood, but the following likely play a role: loss and fragmentation of habitat, pesticide exposure, climate change, overgrazing, competition with honey bees, low genetic diversity, and perhaps most significant, the introduction and distribution of bee pathogens into the environment from commercial pollinators. Regardless of the ultimate cause of bumble bee declines, protecting existing habitat and creating and maintaining new habitat are some of the most immediate and productive steps that can be taken to conserve these important pollinators. This will require widespread participation and collaboration by landowners, agencies, and scientists. The Xerces Society and others have already begun this effort, but more work is needed.

In addition to habitat, we need a better understanding of where these animals are living in order to conserve them, and to protect habitat in the best places. While there is a gross understanding of bumble bee distributions in California, more detailed and current information will generate better conservation recommendations. The state is home to around 25 species of bumble bees, and several of them face an uncertain future. The western bumble bee (*B. occidentalis*) has declined dramatically, especially in the western portion of its range, and species like Morrison's bumble bee (*B. morrisoni*) and Suckley cuckoo bumble bee (*B. suckleyi*) appear to be in decline.

The California Department of Fish and Wildlife and the Xerces Society for Invertebrate Conservation have partnered to support bumble bee conservation through a statewide

community science project to collect information on the distribution of the state’s native bumble bees. This project builds on successes of the ongoing Pacific Northwest Bumble Bee Atlas undertaken by the Xerces Society and its partners in Washington, Oregon, and Idaho, which has provided important baseline information on the status of bumble bee populations. The missing partner is you—become a community scientist and join us! California is a large state with a diversity of bumble bee habitats, so we need many trained community scientists equipped with cameras and nets to survey its bees, collecting high-quality data about their occurrence and releasing them unharmed.

We invite citizen scientists to join in the project:

1. Register for the California Bumble Bee Atlas [at our website](#) and sign up for a [Bumble Bee Watch account](#).
2. [Familiarize yourself with our protocols](#). The best way to do this is by [attending a training](#).
3. Pass a short quiz to be added to The Xerces Society’s Scientific Collecting Permit.
4. [Adopt a grid cell](#) - you can do this alone, or with a group of friends or family (bumble bee watching is more fun with friends!).
5. Survey for bumble bees in your grid cell. Please visit your adopted grid cell twice (or more if you are willing!) per summer and use our standardized protocol (see below) to collect data about bees and their habitats.
6. Submit your [data online using our website](#) and [Bumble Bee Watch](#).

What you will need to participate:

1. Transportation to your grid cell (or choose an area in which you live or work).
2. Insect net, collection vials, and a chilled cooler.
3. A smartphone or camera to take high quality pictures.
4. Access to a computer or smart phone where you can upload photos to [Bumble Bee Watch](#) and track your progress.

What is helpful to participate:

1. Basic knowledge of wildflowers and where to find them!
2. Local plant identification field guides.
3. Bumble bee field guides ([Bumble Bees of North America](#); [Bumble Bees of Western North America](#))

Bumble Bee Biology

Bumble bees are social insects that live in family groups with a division of labor, where most bees do not produce their own offspring, instead benefiting when related individuals—mainly the queen—successfully reproduce. Bumble bee colonies are similar to those of honey bees, except that they are usually much smaller (50-500 individuals as compared to 10,000+) and lack highly developed “eusocial” behavior such as ability to communicate direction and distance to food sources outside the nest. Bumble bees have an annual rather than perennial colony cycle, persisting through just one growing season and not needing to store honey and pollen for consumption during winter, as is the rule with honey bees. The only bumble bees that survive into winter are queens produced the previous growing season and who have mated and stored sperm through hibernation. These bees emerge from hibernation in spring, foraging for pollen and nectar while searching for nest sites. Nests are often located

belowground in abandoned rodent nests, or aboveground in tufts of grass, old bird nests, cavities in dead trees, and under rock piles.

After the queen finds a nest site, she builds irregular cells known as “pots” from wax secreted from glands on her abdomen. After provisioning these structures with nectar and pollen, she lays eggs on a pollen mass and begins to incubate eggs and the larvae that grow from them. The queen divides her time between foraging trips, incubation, and egg laying over the next 4-5 weeks, until emergence of the first adult offspring. These newly emerged adult females, known as workers, become the colony’s workforce to gather nectar and pollen. The queen now stays in the nest, where workers care for her as she attends to her sole responsibility, laying eggs (Figure 2).

At some point, depending on the species and habitat conditions, the colony switches from producing non-reproductive workers to rearing reproductive members of the colony, the new queens (also known as ‘gynes’) and males. After leaving the nest, newly emerged queens usually mate with one male, then consume nectar and pollen in preparation for winter. Following environmental cues, the mated queens create shallow hibernacula belowground in which to spend a period of dormancy. The remainder of the bees in the natal colony, including the foundress queen, die before winter.



Figure 2. A captive common eastern bumble bee (*Bombus impatiens*) nest, with queen and worker-caste bees tending larvae and pupae. Photo: L. Richardson.

In general, bumble bees forage on a diverse group of plants, although individual species may show preferences for certain plants due to floral architecture or other factors. For example, some bumble bees have long tongues and preferentially forage on plants such as penstemon and monkshood that have longer corolla tubes. By contrast, species with short tongues tend to forage on smaller flowers with an open structure, such as sunflower and asters. In addition, short-tongued bumble bees will sometimes engage in “nectar robbing” from flowers with a long corolla tube by biting holes at the base of the corolla and drinking the nectar from the outside of the flower. While this behavior causes damage to flowers and appears to be antagonistic, outcomes for plants are variable, and some bumble bees are pollinators of the plants they “rob” of nectar in this way. The western bumble bee (*Bombus occidentalis*) is a California native that often forages as a nectar robber.

Studies of flight distance show that bumble bee species vary in how far they typically forage from the nest, with estimates ranging from 275m (900ft) to 750m (2,460ft, nearly 1/2mi.), considerably further than most other native bees. Some bumble bees have been shown to fly as far as 10km when displaced from the nest, but such foraging distances are probably unusual. Body size has been shown to be positively correlated with bee flight distance, so larger bees tend to be able to forage further from the nest than smaller. Presence of high quality foraging habitat near the nest may reduce the distance bees must fly to forage, but

numerous studies have shown that bumble bees may avoid foraging on resources close to the nest, perhaps in an effort to avoid nest detection by predators. Overall, theory predicts that bumble bees should seek to minimize the costs associated with foraging while maximizing the return of calories.

Bumble bees evolved in cold, montane areas of central Asia, and many species' current distributions reflect this climate affinity, as they occupy higher latitudes and elevations compared to other bees. Their large body size and tendency to be densely hairy allow bumble bees to forage at cooler temperatures than many other bees can tolerate. In addition, they are warm-blooded, and can raise their body temperature well above ambient conditions, allowing foraging, brood care, and other behaviors below the thresholds at which other bees may be active. These adaptations allow certain California bumble bee species (e.g., high country bumble bee; *Bombus kirbiellus*) to tolerate the extreme cold found at high elevation in the Sierra Nevadas and other mountains. By contrast, other bumble bees have adapted to life in warmer, drier environments, and some of these are typical in low elevation California ecosystems. Taken together, this diversity of life history contributes to high species diversity in California, where 25 bumble bee species are native. The purpose of this project is to collect information on all of the state's varied bumble bees to produce a better understanding of their habitat and conservation needs.

Project Design

To conduct the California Bumble Bee Atlas we divided the state into approximately 250 grid cells of equal size (50 km x 50 km or 2,500 km²). In the first year of the atlas, we asked volunteers to select cells from a subset that we identified as “priority,” and from 2023 forward we are considering all cells as priorities for survey. We are asking volunteers to adopt one of these grid cells, then visit it to conduct two or more **point surveys** for bumble bees over the growing season (March-September, depending on location). In addition, we provide volunteers the flexibility to instead survey along road transects (**roadside surveys**) or haphazardly in any area when they see and photograph bees (**incidental surveys**).

Tracking Your Efforts

First, thank you so much for participating in this project. We are thrilled to have you on board and could not do this important work without your help. Because community scientists are such an integral part of this project, we would like to know all about your efforts—what does it really take to gather this information? We're working hard behind the scenes to provide you with the resources you need to make this project successful, but also want to be able to talk about the amazing efforts of our volunteers as they travel throughout the region capturing and identifying bumble bees. Because of this, we ask that you track your efforts and share them with us when you [submit your data](#)—thanks!

How to Participate

Step 1: Register

1. You will need a Bumble Bee Watch account to participate. If you do not yet have one, please [create an account](#). It takes about five minutes. When registering for an account, please be sure to select 'Bumble Bee Atlas' as your default project at the bottom of the page (do not select anything else as your default project!). This will help us keep track of user participation and data for the project.
2. If you already have an account, head over to Bumble Bee Watch (www.BumbleBeeWatch.org), log in, click 'Your account' at the top right, and choose 'My Profile,' which will take you to your profile page. In the upper right of that page, click "Edit account information." Here you can edit your contact information, email address and other details. Note that the home page shows a summary of your submissions to Bumble Bee Watch, and now includes a fun 'year in review' feature. Try it out!
3. ****In either case, please make a note of your Bumble Bee Watch username and password. You will use these credentials throughout the project.****



Figure 3. Identifying bumble bees at a San Diego field event.

Step 2: Training

Before beginning your work, you must attend a training workshop with project staff. In spring 2025, we are offering three of these training opportunities via remote webinar. If you can't join us on any of these dates, you can always watch a pre-recorded training, which we'll post to the website: <https://www.cabumblebeeatlas.org/training-videos.html>. We'll also be offering a variety of in-person field events in 2025 (Figure 3)! These are optional but very worthwhile opportunities to meet project staff and fellow participants, as well as to learn more about bee identification and project methods. You can find more information and register to attend a training or field event on our website: <https://www.cabumblebeeatlas.org/events.html>.

Step 3: Scientific Collecting Permit

The California Department of Fish and Wildlife (CDFW) requires a Scientific Collecting Permit (SCP) for handling of species on their list of Terrestrial Invertebrates of Conservation Priority, which includes six bumble bee species. This regulation helps ensure that research activities like ours are conducted in a manner that reduces impacts to these sensitive invertebrates while providing information that can aid their conservation. The Department issued the Xerces Society an SCP which allows trained volunteers to handle bumble bees as part of the California Bee Atlas. Because changes to some bumble bee species' conservation status have taken place during the life of our SCP (i.e., four species are now candidates for listing under the state's endangered species statute), CDFW has also issued the project a Memorandum of Understanding (MOU) that governs our handling of those species.

To be added to the list of permittees on the SCP, you'll need to attend a training workshop (or watch a prerecorded version of the workshop:

<https://www.cabumblebeeatlas.org/training-modules.html>), then take a short quiz (<https://tinyurl.com/cabumblebees>) which demonstrates that you understand the

environmental compliance concerns we have for handling of sensitive bumble bee species, as well as working around other sensitive wildlife species and their habitats. Once you have passed the quiz, Xerces will send your information to CDFW. Once approved, Xerces will notify you and provide a copy of the SCP. Project staff will separately provide the MOU to you before the March 15th start of the season. Please read through the SCP and MOU when you receive them, and make sure you understand what this permitting allows us to do. **You must carry a digital or paper copy of the Scientific Collecting Permit and the MOU with you while you survey.**

Please note, this SCP and MOU will *only* cover your survey activities while you are conducting surveys for the California Bumble Bee Atlas in a manner consistent with the permit conditions. If you need to survey for bumble bees for any other reason (e.g., regulatory surveys), you *must* obtain your own permits from CDFW. Even if you plan to submit bumble bee observations from such regulatory surveys to Bumble Bee Watch, you must have your own permits!

Step 4: Adopt a Grid Cell

Before you start work, you'll need to "adopt" one or more grid cells in which you agree to collect bumble bee data for the project. **Adopting a grid cell means that you have agreed to conduct at least two surveys each year in that cell for bumble bees using our standardized protocols.** To meet this requirement, you can visit two different locations within your cell on

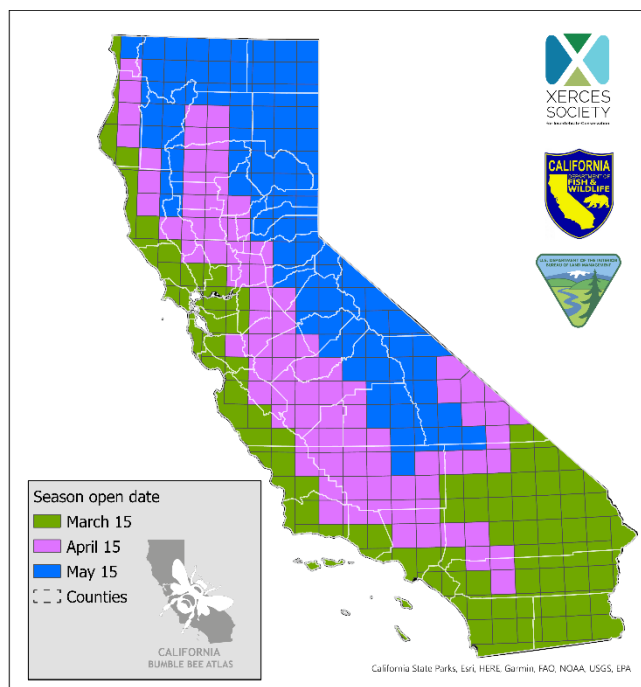


Figure 4. Launch dates for the Atlas vary by location, and are designed to maximize the abundance and diversity of bees in our surveys.

the same day, or revisit the same location on two different days separated by at least three weeks. It's okay if two or more volunteers adopt the same cell.

Please use the interactive map and sign-up form at the project website to find and adopt your grid cell: <https://www.cabumblebeeatlas.org/adoptagrid.html>. Also please note that due to the diversity of bumble bee habitats around the state, we are launching the project on three different dates, depending on climate and elevation (Figure 4). Surveying on or after these dates will give you the best chance to document the full diversity of species present in your chosen grid cell, as well as protect queen-caste bees in early spring (i.e., before our season opening dates) as they initiate nests.

Step 5: Conduct a Survey

Plan your visit

The best places to survey for bumble bees are areas that have an abundance and diversity of flowering plants. This can include grasslands, roadsides, developed parks, open forests, and coastal vegetation. Please note that availability of floral resources for bumble bees varies across the growing season, so you'll need to consider seasonality, ongoing drought, and other factors as you plan your field work. High quality bumble bee habitat may be found on both public and private lands. When selecting a site to survey, ensure that you have permission to conduct your activities. Unless you have explicit permission from a private landowner, stay on public lands and public rights-of-way (roadsides). Note that many public lands require a permit for research activities; project staff will secure statewide permits for National Parks, National Forests, BLM lands, and California State Parks. When you receive these permits, please read them carefully, noting any restrictions on or special practices related to your visit and research.

Here is a list of land jurisdictions for which project staff will have secured permits before our season starts. For most of these places, you'll need to carry the permit with you (paper or digital copies) when surveying. Project staff will clarify details of individual permits as the collecting season gets underway.

- National Parks
- National Monuments
- US Forest Service (national forests)
- Bureau of Land Management
- California State Parks

Other public lands, such as regional park districts, ecological reserves, or wildlife areas owned by the California Department of Fish and Wildlife, may also require a letter of access. It is your individual responsibility to verify that you have permission to sample in these locations, and project staff are also available to assist you in this if necessary. The bottom line is that you always have to have permission to survey for bumble bees. Here is a list of some other types of sites to consider:

- Your backyard
- Private land (if you have permission to enter)
- Local parks
- Natural Areas or open spaces
- Public beaches

- Roadsides (please practice safety along roads)

If you don't already have a location in mind when you adopt your grid cell, we encourage you to take some time to investigate the different areas contained within it. Grid cells are large with varied habitat, terrain, and land ownership. Although you can survey anywhere in the grid cell for bumble bees, taking time to select potential locations and access routes will help decrease travel time while maximizing the time you can dedicate to bumble bee surveys. We suggest you start with the project map, Google Maps, Apple Maps, Google Earth, or other maps that utilize aerial photography to flag potential sites and plan travel routes. Getting familiar with your sites using maps will also help you when it comes time to submit your data; accurate locations are important!

Here are a few mapping resources to help you plan your trip (**Note:** we do not guarantee the accuracy of any of these resources):

- Project map (created using Google My Map): <https://www.google.com/maps/d/u/0/edit?mid=1F16oY52iNJWptb9UmeX0AGGn4yii0gaf&usp=sharing>
- Google Earth: <https://earth.google.com/web/>
- Apple Maps: <https://www.apple.com/maps/>
- Open Street Map: <https://www.openstreetmap.org/#map=5/39.309/-124.893&layers=Y>
- Gaia GPS: <https://www.gaiagps.com/map/?loc=5.0/-119.5751/37.3685&layer=GaiaTopoRasterFeet>
- USGS Topo Maps - available from outdoor retailers and as digital downloads
- DeLorme State Atlas & Gazetteer Paper Maps

Check road conditions! Be sure to consult with locals about road surfaces and do not always rely on GPS or Google/Apple Maps for travel planning. For example, many roads on Forest Service lands are narrow dirt single tracks with limited turn-around space. They may also require high clearance vehicles. They are sometimes trafficked by logging trucks. Due to these conditions, they may increase the time needed to reach locations. Please use care and caution when driving on roadways that are new to you.

Environmental Compliance

As a California Bumble Bee Atlas volunteer it is important that you collect your data without impacting sensitive natural resources, including both bumble bees and other organisms that may be protected by state or federal law. As described above, Xerces has been issued a Scientific Collecting Permit by CDFW which will include the names of all trained volunteers. We will cover all of this material in the training workshop you attend, and you'll need to pass a short quiz about the safe survey methodology before CDFW can add your name to the permit. In general, we ask that you be aware while conducting field work of the potential for rare, threatened, or endangered species to occur in the area where you are working, and that you avoid potential impacts to them. There may also be sensitive or rare natural communities, such as vernal pools and certain types of wetlands, that we need to avoid impacts to. As a general rule, please tread lightly as you conduct your surveys. In addition, you will need to consider the following environmental compliance concerns.

Eagles—both bald and golden eagles are state and federally protected (Figure 5), therefore we want to ensure that our bumble bee surveys do not negatively impact them. Eagles

incubate their eggs and fledge their young during the prime bumble bee surveying season. Loud noises or human presence can cause them to abandon their nests. If you encounter a nest during the courtship (December–January) or breeding season (April–August), move to a new site that is at least 1 mile from that location. If you encounter a nest during after the breeding season (Figure 6; September–November), you should move 0.5 miles away. Because it is hard to know whether an eagle might be present at a site, it is best practice to always select a back-up location or two when planning your survey visit just in case you happen to encounter an eagle nest. For details on specific sites or more information, please contact Hillary Sardiñas: hillary.sardinias@wildlife.ca.gov.



Figure 5. The golden eagle (left) is a large brown raptor whose range covers all of California. Adult bald eagles (right) have distinctive white heads, while juvenile bald eagles have a more mottled white and brown appearance. The bald eagle is present in most of California featuring bodies of water (ocean, rivers, and lakes). It is absent from swaths of the Central Valley and eastern desert regions (e.g., Mojave). Photo credits: USFWS; M. Thomson.



Figure 6. Eagle nests are often made of sticks or small branches. Golden eagle nests are most commonly found on cliffs but can also occur in trees or on human-made structures. Bald eagle nests are most often found in treetops high off the ground. Photo credits: NPS; USFWS.

Rabbit Hemorrhagic Disease—Rabbit Hemorrhagic Disease, Virus Serotype 2 (RHDV2) is a virulent and highly contagious disease of lagomorphs, the mammal group including rabbits and their relatives. RHDV2 is reported to afflict domestic and wild rabbits, jackrabbits, hares, and possibly pikas. Mortality rates of 5-80% of wild rabbit populations have been reported. To comply with our Scientific Collecting Permit, we must incorporate safety measures into our

field work to slow the spread and help inform disease tracking and management actions.

RHDV2 can be transmitted through contact with an infected lagomorph, its blood or feces, or contaminated objects. The virus is hardy, and can remain viable on meat, fur, clothing, or equipment for up to 15 weeks. **RHDV2 does not pose a health risk to humans** or non-lagomorph animals, however, humans and other animals can inadvertently spread the virus.

To avoid spread, follow these three safety measures when out in the field:

1. Report observations of unexplained mortality of wild lagomorphs here:
 - a. <https://wildlife.ca.gov/Conservation/Laboratories/Wildlife-Health/Monitoring/Mortality-Report>
2. Do not touch, move, or salvage live lagomorphs, their carcasses, or feces.
3. Disinfect boots and any gear that touched the ground using a fresh 10% bleach solution when moving from one field site to another, particularly if you work in an area of known RHDV2 occurrence or encounter sick or dead lagomorphs. This is always important as it also reduces the spread of soil-borne pathogens like the fungus responsible for sudden oak death. Look up recent reports before you go into the field:
 - a. <https://usda-aphis.maps.arcgis.com/apps/webappviewer/index.html?id=37791da88ef04cd08404a5794aaf0be3>

Useful links:

https://www.cdffa.ca.gov/AHFSS/Animal_Health/RHD.html

https://www.aphis.usda.gov/animal_health/downloads/rhdv-cleaning-guidance.pdf

Conduct your survey

Before you head out on your survey, let someone know your travel plans, including expected return time/date. When surveying, please follow all rules, regulations and posted signs; respect private property and take all necessary safety precautions. You can find some helpful videos for this process here: <https://www.cabumblebeeatlas.org/training-modules.html>.

Unfortunately, despite your best planning, it is possible that conditions when you arrive are not optimal. We encourage folks to be flexible and opportunistic while staying within their assigned grid cell. As such, bring resources with you to help with navigation, including printed maps as cell service is not available in many parts of the California.

What you need to bring:

- Paper maps
- Insect net
- Insect vials
- Small cooler with ice or ice packs
- Water, food, sunscreen, hat
- Timer (smart phone or watch)
- Camera with macro capacity (smart phone or dedicated camera)
- [Data sheets](#) and pencil/pen
- Water, food, sunscreen, hat

What you may want to bring:

- Field guides (bees and plants)
- Hand lens

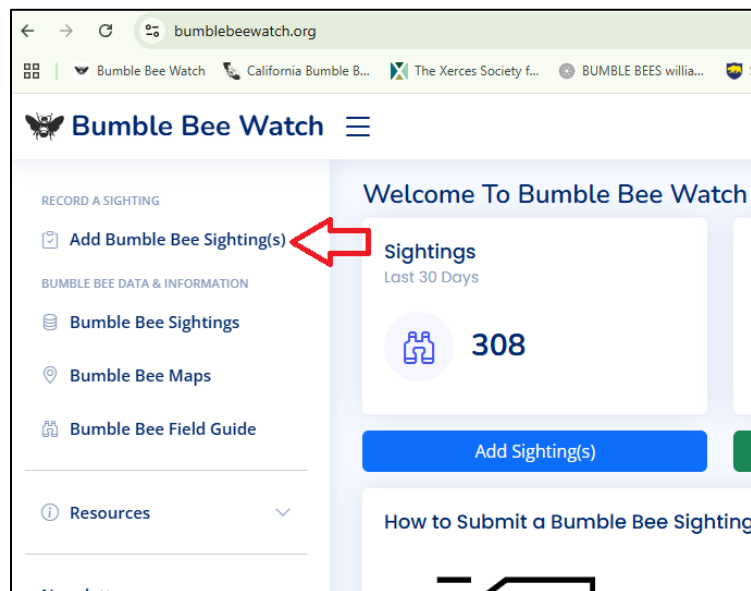
- Field notebook
- Friends!

Step 6: Submit your data

In the field, for each point survey, you will complete a field data form to document 1) the sites and habitats where you collected; and 2) the bees you observed in them. Now, you'll transfer this information to our website for curation of project data, Bumble Bee Watch (<https://www.bumblebeewatch.org/>). The data entry process is summarized here, and you can find more detail on our website: <https://www.cabumblebeeatlas.org/submit-data.html>. *Please note, if you have previously submitted data to Bumble Bee Watch, we launched an improved version of the site in 2024, and some of the details around data submission have changed.*

1. Curate your photos and gather your data. Make sure you know which photos belong to each individual bee you recorded on your field forms. You may submit up to five photos for each bee record; please include a photo of the host plant if possible as one of these five!

2. Login to [Bumble Bee Watch](#).
3. Choose 'Add Bumble Bee Sightings' (Figure 7). Then, if you are submitting a point or roadside survey, choose 'Bumble Bee Atlas' as your project. If you're submitting an incidental/casual observation, instead choose 'Bumble Bee Watch' as your project. Do not choose any other projects from the dropdown list!



4. If you chose 'Bumble Bee Atlas' as your project, this takes you to a page where you will transpose the information directly from your field form into text boxes. The first step is to describe the location of the survey you are entering. If you previously entered data from this site, you can choose it from the 'Choose from your locations' dropdown menu; if not, use the tools to add a new location (=survey site) with a unique name of your choosing. You will next transcribe information you recorded about the survey, including date, weather conditions, habitats, and evidence of disturbance factors such as wildfire. Near the bottom of this page, you'll find a question asking whether this was a 'null' survey, that is, a survey in which you did not find any bees. If your survey was a null survey, answer "yes" here and you are done entering that survey! However, if you caught bees, answer "no" to this question, then click "Proceed," which will take you to the page where you enter bee photos and associated data.

Figure 7. From the Bumble Bee Watch homepage, select "Add Bumble Bee Sightings" to begin uploading your data.

5. To add your bees to the survey, click “Add Sighting,” then follow the prompts to upload photos and enter other data about the bees. Most of this should be self-explanatory, but please contact project staff if you have questions.

6. When you are done with habitat information, for each bee you collected during this survey, upload up to 5 photos, provide a species identification, and specify the host plant (Figure 8). If you don’t know how to identify bumble bees, use site tools and the field key at the end of this document to make your best guess (we’ll verify this later). Click “add another” to add more bees. When you have added all bees from this survey, click “save.”

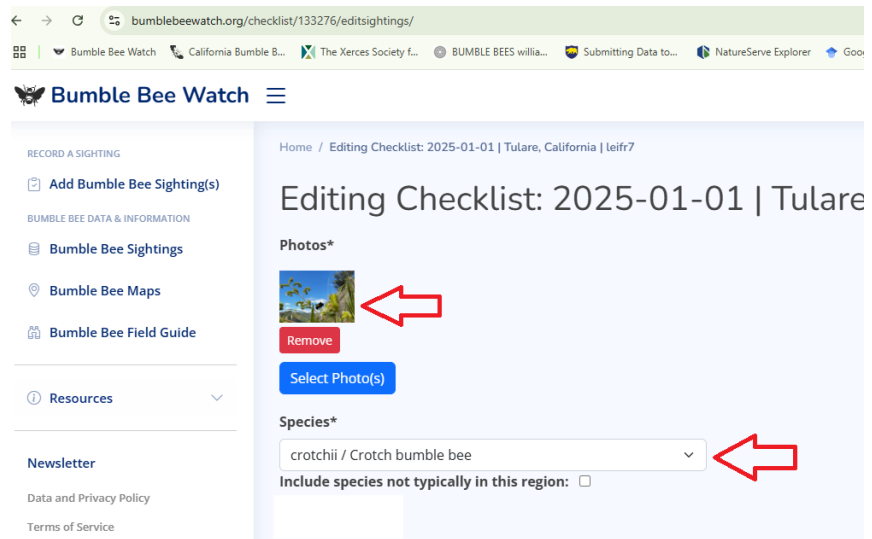


Figure 8. Upload photos of bees and their host plants. Red arrows indicate some key fields you’ll need to fill in.

7. If you need to edit either your checklist (habitat information) or observed bees, you can do this by clicking “Your account” at the top of any page on Bumble Bee Watch, then choosing “My profile,” then choose the survey from the list on this page, and use the editing tools to make your changes.
8. Please don’t forget to fill out the volunteer questions at the bottom of the first page! Your volunteer labor is a significant contribution you make to bumble bee conservation, and we’d like to be able to periodically report summaries of volunteer efforts to our funding agencies.
9. For **incidental observations** (photos of bees made outside of formal point or roadside surveys; see below), at #3 above, choose “**Bumble Bee Watch**” as your project name (*not* “Bumble Bee Atlas” or anything from the dropdown menu). Follow directions for data entry and photo upload. This is a simplified process and you won’t need to have collected extensive field notes. Don’t worry, we’ll make sure this incidental data makes it into our project.

Survey Methods

Survey Timing and Conditions

Bumble bees are generally active during the growing season from early spring to fall. In California, some species begin their life cycles as early as January, and some may be active as late as December. Our objective is to document the greatest abundance and diversity of species that we can, so we’ve timed the project to maximize surveys in that time frame. This timing varies across the state’s varied ecosystems, and we have established three different start dates for the project to reflect this (Figure 4). September 1st is the end of the survey statewide. Please keep in mind that in arid places like California, drought strongly influences the activity of bumble bees. In dry years, bumble bees may only be active until June in some locations, so we recommend that you get going with surveys as soon as you can if you think your sites are especially dry. Bumble bees prefer warm sunny days to forage, so please survey

on sunny (or mostly sunny) days between 60°F and 90°F. Conditions much hotter, cooler, or cloudier will likely result in reduced bumble bee activity. Bumble bees will also avoid very strong winds, so focus surveys on days with low winds. The best sites to find bumble bees will be open (non-forested) areas with an abundance and diversity of flowering resources.

A Word About Coolers

Our survey methods allow us to document bumble bees without killing them, which we think is an improvement over typical entomological practices, especially given that some of the animals we work with are of conservation concern. To vouch for the occurrence of bumble bees without collecting specimens, we need to photograph them, and this requires that we anaesthetize the bees. The best way to do this is by placing them in a vial in a cooler full of ice. As you'll learn in our training workshops, we think you can keep a bee on ice for up to 120 minutes before causing it harm. Removed from the cooler, bees normally "wake up" from chilling within about 10 minutes, flying away unharmed. This system works great when you use ice cubes, crushed ice, or ice packs frozen at temperatures just below freezing (32°F), as in a standard refrigerator freezer. However, many newer freezers allow you to maintain temperatures well below this, which can kill bees. So, we ask that you check to make sure you are not using ice or ice packs chilled below about 27°F. You don't have to test your freezer with a thermometer, but check the temperature adjustments or manual to ensure that your appliance is not set to a lower temperature. If you're buying ice at the grocery store or minimart, you can assume this is not too cold!

One other cooler concern is that chilling bees need to be kept dry. Many types of vials can admit water if they are submerged, and the combination of cold and moisture can kill bees. The water also mats their hair, making identification challenging. To avoid wet bees, you'll want to check your cooler periodically, draining off excess moisture and readjusting the position of vials. One easy solution is to place your vials in a Ziplock-type bag within the cooler—as long as you keep water out of the zipped bag, you should be okay.

If you accidentally end up killing bees in the cooler, that's okay and we understand that this happens! But, you should notify a project staff person if this happens. Per our SCP, we need to report mortality of Species of Greatest Conservation Need (SGCN; in California these are *Bombus caliginosus*, *B. crotchii*, *B. franklini*, *B. morrisoni*, *B. occidentalis*, and *B. suckleyi*) to CDFW; as it can be difficult to identify some of these, please contact us if this happens so we can evaluate. In any case, you will not be in any kind of trouble for reporting accidental mortality!

Point Surveys

Point surveys are our standard surveys and will provide high-quality bumble bee data from any survey area. These surveys are 45 person-minutes and will need to take place in an area around the size of a hectare (2.5 acres). This means that if you are alone you will survey for 45 minutes. If you brought one friend, you will survey for 22.5 minutes, and if you brought two friends, you will survey for 15 minutes, etc. You will also need to plan for time to conduct a habitat assessment on each visit to gather habitat information about the site that you surveyed and the surrounding area at each site.

Phase 1: Plan your survey area

Surveys should cover approximately one hectare or 2.5 acres (100m x 100m or 328' x 328'). This does not have to be a square, but could be 20m x 500m along a roadside or any other similar area configuration. Mark the center of your location on a map (either paper or

smartphone app). This will be very important later for data submission, please document the location of each survey accurately! See the videos on our website to help you get the latitude and longitude information. These will need to be in decimal degrees (i.e., formatted as '34.123, -121.456'; **not** degrees/minutes/seconds or any other coordinate convention).

Phase 2: Fill out the data sheet

This will include date, time, surveyors, location, and basic weather information (approximate temperature, cloud cover, wind, etc.). See the [data sheets](#) for more detail.

Phase 3: Begin your survey

Note the start time of your survey, start the timer and begin searching for bumble bees. While looking for bumble bees you should wander through the entire survey area, focusing on plants that are flowering. Focus on ALL flowering plants, not just those that are most abundant or showy. Because of many reasons different bumble bees are sometimes attracted to different species of flower. When you find a bumble bee, *stop your timer* and capture it into a vial (either directly or using an insect net), note the plant species that it was visiting, and place the vial in a chilled cooler. I like to put a petal of the flower into each vial to remind me which species of flower it was visiting when I record my data later. Alternatively, use a small piece of paper, a grease pencil etc. to document and connect each bee to its flowering plant. Be sure to keep bees from different flowers also separated in the cooler so you remember later. Take a picture of each plant (include flowers and leaves) for later confirmation or identification. There are several wildflower smartphone apps focused on the California flora that can help you in the field, and there are many other resources available (see <https://www.cabumblebeeatlas.org/project-resources.html>). Start your timer before starting to survey again. Continue in this fashion for 45 person-minutes (count only time searching for bumble bees) or until you have run out of vials. If you run out of vials, stop the timer and continue to Phase 4, and then return to Phase 3 for the remaining amount of time. When your time is complete, note the end time of your survey.

Phase 4: Document each bumble bee

After bees are cooled for a period of time (10+ minutes) they will slow enough to allow you to photograph them. You can work with the anaesthetized bees in your hand, or directly on another surface (see Figure 9). Using a camera or smartphone take clear, in-focus pictures of each bee's head, thorax, and top and bottom of the abdomen (maximum of five photos for each bee). You'll have 5-10 minutes to work before the bee warms up enough to sting or fly away. Please use caution to avoid stings as you handle the bees—but be aware that when properly chilled, they can be safely handled for a short period of time. We offer some photography advice on the project website:

<https://www.cabumblebeeatlas.org/photography-tips.html>. Be sure to document how many photos you take of each bee, and note the file names on the [field form](#). Also, make note of the species of flower on which the bumble bee was captured if applicable, or note otherwise (e.g. nest searching, patrolling). After you photograph the bumble bee it may still be a bit sluggish and may take some time to warm up. Place in the shade and it will slowly acclimate and be on its way. Continue in this fashion until you have documented each individual bumble bee. If you have time remaining on your survey, return to Phase 3, otherwise continue to Phase 5.



Figure 9: Different options for photo documenting bumble bees. The bee on the left has been in a chilled cooler, while the one on the right may have been collected directly from a flower.

Phase 5: Collect Habitat Information

Spend some time walking around your site collecting the data for the field form. Take photos of each plant visited by bumble bees you caught, as well as an overview of the overall habitat.

Phase 6: Complete Documentation

Ensure that the [data sheet/field form](#) is complete and that you have collected all necessary habitat information. You'll note on the website that we have a second field form you can use to record plants and bees if you need more space. (You can also use a blank sheet of paper for this.) While it might be tempting to leave some of this information for later, or when you get home, taking the time to do it while on site will reduce errors and increase the quality of the data you collect.

Phase 7: Submit your data

See **Step 6** above for assistance. You can find more advice on data submission on our website: <https://www.cabumblebeeatlas.org/submit-data.html>.

Roadside Surveys

Roadside surveys are a common way to document bumble bee abundance and species richness, and have been used in a standardized way in other regions on the country (MN, VT, ME). They are also a great way for most anyone to participate, as they often do not require walking long distances or over uneven terrain. However, roadside surveys are also not perfect (no method is) as each individual survey is significantly shorter, and our roadsides tend to get crowded with non-native plants. As one of the goals of this project is to better understand the needs of our SGCN bumble bees, finding which native plants they are using is a priority. Roadside surveys may not be a perfect format to learn that specific information, but will still contribute to our understanding of bumble bee distribution and habitat needs. Roadside surveys can be conducted en route (or in return) from a formal survey site, or on their own, but should take place within a grid cell that has been adopted by someone in your party.

Again, be sure to follow posted signs and regulations; please respect private property and if necessary obtain permission from the landowner.

Phase 1: Plan your route

Select a stretch of road that is at least 10 miles long. Ideally, the stretch of road would have several obvious open patches when looking at aerial photos/maps.

Phase 2: Begin survey

Once you arrive on your selected route stop at the first patch of available flowers that you observe (park carefully and follow local regulations and general safety precautions). Before you begin the survey, fill out the top of the datasheet (site and weather information). Be sure to include the start and stop times. A roadside survey is 15 person-minutes long. Start your timer and capture bumble bees into vials. While looking for bumble bees you should wander from flower patch to flower patch in the roadside area. Focus on ALL flowering plants, not just those that are most abundant or showy. Different bumble bees are sometimes attracted to different species of flower. Be sure to document the species of flower that each bumble bee was visiting (you can use a small label, a grease pencil, or a sample of the flower placed in the vial). Place each bee into a chilled cooler.

Phase 3: Record bumble bee data

Once the 15-minute period is over, record each individual bee on the field data sheet and photo-document each individual following the tips here:

<https://www.cabumblebeeatlas.org/photography-tips.html>. Be sure to write the corresponding photo file names for each individual.

Phase 4: Collect habitat data

Fill out the habitat and site information at the top of the data sheet for each roadside stop. Take a picture of each species of blooming plant, as well as the overall habitat surveyed.

Phase 5: Repeat

Drive at least 1 mile down the road and then find another patch of flowering plants at which to conduct a survey and go back to Phase 2. Each Roadside survey should consist of five fifteen-minute surveys within a ~10 mile stretch of road.

Phase 6: Submit your data

See Step 6 above for assistance. Please note, you'll be uploading each of your roadside stops as separate survey events. Name your stops in some coherent way so that we know they are connected—for example, “Main Street Stop #1,” “Main Street Stop #2,” etc. You can find more advice on data submission on our website: <https://www.cabumblebeeatlas.org/submit-data.html>.

Rapid Habitat Surveys

At each location that you conduct a bumble bee survey (point or roadside) you will need to conduct a habitat survey. This information will help us to understand what kinds of landscape features are important for bumble bees. The habitat survey should take between 10 and 30 minutes to complete. Habitat surveys will be longer for point surveys where each individual survey area is larger. Each roadside habitat survey will be a bit shorter. You'll record your habitat information on the first page of the field form, which may be downloaded from our website: <https://www.cabumblebeeatlas.org/project-resources.html>

Phase 1: Fill out the site and weather information

Use a GPS device and/or smartphone to gather weather information and locality. If you don't have access to weather in the field, you can gather weather from a nearby weather station later. See <https://www.cabumblebeeatlas.org/project-resources.html> for guidance.

Phase 2: Gather habitat information

1. Choose a primary habitat type of the survey area from the list provided, as well as the habitat types of the surrounding area.
2. Walk the entire survey area and estimate how much of the survey area has blooming plants.
3. Count the number of blooming species of plants (include trees and shrubs) you observe.
4. Look for habitat features noted on the datasheet - these are often associated with bumble bee nesting locations.
5. Do your best to assess the management activities in the area.

Phase 3: Document the species of plant in bloom.

Document each species of blooming plant. Remember that if possible, we'd like you to submit a photo of the host plant with each separate bumble bee observation you upload to Bumble Bee Watch.

Phase 4: Submit your data.

See steps 5- 7 of the Point Survey section above (p. 18) for assistance.

Alternative Survey Options

Incidental Observations

In addition to the formal surveys described above, incidental surveys or bumble bee observations can also help to our understanding of bumble bee distributions in California. They are more casual, and could occur anywhere, and at any time. These surveys are also appropriate for land jurisdictions or times of the year where you are not permitted to handle bumble bees. You might be in your adopted grid cell, or 100 miles away from it. Nevertheless, and especially now that you have caught the bumble bee watching bug, you may observe bumble bees visiting flowers and decide to stop and take a picture. These observations will not take the place of formal surveys, but they will help fill information gaps in California.

Incidental observations/photos can either be *in situ* (directly on a flower) or in a vial/photo chamber. Submit only photos that are in-focus with enough detail to determine the species in the photo (see <https://www.cabumblebeeatlas.org/photography-tips.html>). Please remember that all observations for the project need to be photo documented to count. Including information (and a photo if possible) about the plant on which you observed the bee is also very helpful.

Considerations:

- With incidental observations, you do not need to submit an observation of every bee you take at each location. Include only the best photos of each species (but see bullet point below). If you are not sure if photos are different species or not, err on the side of including too many observations.
 - Include observations of the same species of bee visiting different species of flowers -that is great information to have.
 - Do your best to identify the species of flower that the bumble bee was visiting. See <https://www.cabumblebeeatlas.org/project-resources.html> for resources.
-

Resources

Books and Literature:

Droege, S. October 2015. The Very Handy Manual: How to Catch and Identify Bees and Manage a Collection. Available from:

<https://ecos.fws.gov/ServCat/DownloadFile/152039?Reference=101509>.

Goulson, D. 2009. Bumblebees: Behaviour, Ecology, and Conservation. Oxford University Press. 336 pp.

Hatfield R, Jepsen S, Mader E, Black SH, Shepherd M. 2012. Conserving Bumble Bees. Guidelines for Creating and Managing Habitat for America's Declining Pollinators. Available from <https://www.xerces.org/publications/guidelines/conserving-bumble-bees> (accessed March 14, 2022).

Koch JB, Strange JP, Williams PH. 2012. Bumble Bees of the Western United States. USDA Forest Service and the Pollinator Partnership.

Stephen WP. 1957. Bumble bees of western America (Hymenoptera: Apoidea). Corvallis: Agricultural Experiment Station, Oregon State College.

Thorp RW, Horning DS, Dunning LL. 1983. Bumble bees and cuckoo bumble bees of California (Hymenoptera, Apidae). University of California Press.

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

Project Websites:

California Bumble Bee Atlas: CABumbleBeeAtlas.org

Pacific Northwest Bumble Bee Atlas: PNWbumblebeeatlas.org

The Xerces Society for Invertebrate Conservation: xerces.org

Other websites:

- [Google Maps with Overlaid Grid](#) (you will be able to find the grid number of your adopted cell to help you plan a trip)

Social Media:

Join our Facebook Group: <https://www.facebook.com/groups/cali.bumblebees>

Follow us on Twitter: <https://twitter.com/cabumblebees>

Follow us on Instagram: <https://instagram.com/cabumblebees/>

Data Sheets

https://www.cabumblebeeatlas.org/uploads/1/1/6/9/116937560/cabba_combined_datash eet_2025.pdf

https://www.cabumblebeeatlas.org/uploads/1/1/6/9/116937560/cabba_extra_datasheet_2024.pdf

BUMBLE BEE ATLAS DATA SHEET



Complete this form at every visit to a site on which you conduct a point or roadside bumble bee survey

Site Information

Site Name:		Date:		Accuracy (for pt. survey use 50 m to cover the hectare plot):
Latitude (DD): N		Longitude (DD): — W		
# Observers:	Observer Names:			

Bumble Bee Survey Information:

Survey Method:			I captured all bees, different bees, or a combination of methods:
Survey Type: Point Roadside	Survey Area (Approx., in HA):		All Different Combination
Survey Start Time:	Survey End Time:	Active search minutes (45 for pt. survey, 15 road):	

Weather Information

Temp: F	Cloud Cover: %	Wind Speed: mph
Notes:		

Habitat Information

Survey Area Circle the most appropriate habitat type (CHOOSE 1).	Habitat Types	Examples	Surrounding Area (Visible)
	Agricultural Lands	<i>Crops, pasture, orchard, etc.</i>	From the Habitat Types , list (up to) the top three habitat types visible from most to least abundant.
	Developed / Roadside	<i>Sub/urban areas; parks/gardens; roadsides</i>	
	Grassland / Meadow	<i>Meadow, open, grasses dominant</i>	
	Riparian	<i>Along lake or stream</i>	1
	Shrub / Scrub	<i>Arid, shrubs present, and abundant</i>	2
	Woodland/Forest	<i>Trees dominant, and in the over-story</i>	3
	Wetland	<i>Bogs; marsh; saturated earth</i>	

Flowering Resources: In how much of the plot can you actively search for bumble bees on flowers? (Circle one - closest match): 0 10% 20% 30% 40% 50% 60% 70% 80% >=90%

Nesting Habitat	Choose which of the following features you see in or near the survey area:	
	<input type="checkbox"/> Brush piles <input type="checkbox"/> Bunch grasses <input type="checkbox"/> Leaf litter <input type="checkbox"/> Loose Bare soil	<input type="checkbox"/> Mulch <input type="checkbox"/> Pine needle duff <input type="checkbox"/> Rock piles <input type="checkbox"/> Rodent holes/tunnels

Management	I see evidence of, or know that the following have occurred in or near the survey site:			
	Mowing	Yes	No	Suspect
	Livestock grazing (animals, cow pies, hoof prints)	Yes	No	Suspect
	Native grazing (animals, deer/elk scat, hoof prints)	Yes	No	Suspect
	Agriculture	Yes	No	Suspect
	Insecticide use	Yes	No	Suspect
	Herbicide use	Yes	No	Suspect
	Fire (either controlled burning or wildfire - circle)	Yes	No	Suspect
	Honey bee hives (inc. number of boxes _____)	Yes	No	Suspect
Notes:				

Plants	How many different species of flower (incl. trees and shrubs) are in bloom in the survey area?
---------------	--

BUMBLE BEE ATLAS DATA SHEET

Complete this form at every visit to a site on which you conduct a point or roadside bumble bee survey



Flower Species in Bloom

Document (up to 15) the most common species of currently blooming plants that you see in the survey area – including trees and shrubs. Use plant identification field guides (including iNaturalist/Seek), and take pictures of the flowers and leaves of each species. If you are uncertain, give the plant a generic name, and be sure to photo document for later ID.

List the scientific name of each plant to the best of your ability – if you only know the common name, list that.

1.	6.	11.
2.	7.	12.
3.	8.	13.
4.	9.	14.
5.	10.	15.

Bumble Bee Observations

BBW	Sex Q/W/M/F	Bumble Bee Species	Host Plant	Photo Numbers
<input type="checkbox"/>				
<input type="checkbox"/>				
<input type="checkbox"/>				
<input type="checkbox"/>				
<input type="checkbox"/>				
<input type="checkbox"/>				
<input type="checkbox"/>				
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<input type="checkbox"/>				
<input type="checkbox"/>				
<input type="checkbox"/>				

Volunteer Data

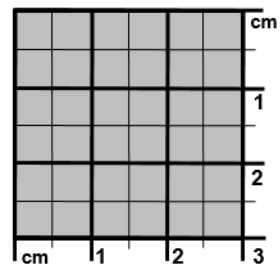
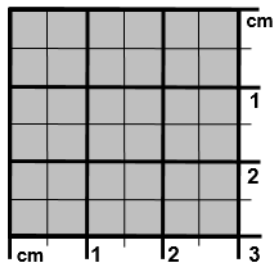
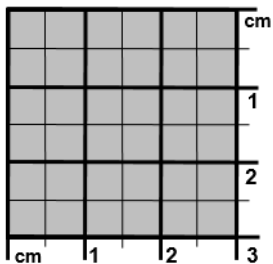
What time did you start and stop volunteering on the day of this survey? Include planning, taking photos, recording data, driving, etc.	Start time:	Stop time:
How many miles, roundtrip, did you drive to conduct your survey?	miles	
How many hours did you spend organizing your data? Photo organization, entering data in Bumble Bee Watch, etc.	hours	



Bumble Bee Observations *continued*

Entered in BBW	Bumble Bee Species	Host Plant	Photo Numbers	Notes
<input type="checkbox"/>				
<input type="checkbox"/>				
<input type="checkbox"/>				
<input type="checkbox"/>				
<input type="checkbox"/>				
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<input type="checkbox"/>				
<input type="checkbox"/>				
<input type="checkbox"/>				

Photograph bees on a grid.



Visual Key to California Bumble Bees

California Bumble Bee (*Bombus*) Females



XERCES SOCIETY
for Invertebrate Conservation

1	2	3	4	5
<i>centralis</i> 	<i>bifarius</i> 	<i>fervidus</i> 	<i>appositus</i> 	<i>flavidus</i>
<i>crotchii</i> 	<i>bifarius</i> 	<i>franklini</i> 	<i>occidentalis</i> 	<i>insularis</i>
<i>flavifrons</i> 	<i>flavifrons</i> 	<i>vosnenskii</i> 	<i>occidentalis</i> 	<i>suckleyi</i>
<i>huntii</i> 	<i>impatiens</i> 	<i>caliginosus</i> 	<i>occidentalis</i> 	
<i>mixtus</i> 	<i>rufocinctus</i> 		<i>silkensis</i> 	
<i>sylvicola</i> 	<i>pensylvanicus</i> 			
<i>kirbiellus</i> 	<i>nevadensis</i> 			
<i>rufocinctus</i> 	<i>morrisoni</i> 			
<i>sylvicola</i> 				

Color pattern groups

1. Red hair present
2. Stripes + T1 yellow
3. Stripes + T1 black
4. White hair present
5. Cuckoo bumble bees

Symbols used in key:

- Montane
- Pacific Coast
- Northern CA
- Southern CA
- Declining



CALIFORNIA
BUMBLE BEE ATLAS
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Identifying the Bumble Bees of California

1. Determine whether you are looking at a male or female bumble bee (see **Figure 1**).
2. Next, determine whether your bee is a “true” or a “cuckoo” bumble bee. Most bumble bee females have a concave, hairless pollen-carrying area (corbicula) on the hind leg (**Figure 2**, left panel), while in cuckoo species this area is convex and hairy (right panel). Legs of males are more difficult to tell apart, but generally, cuckoo male legs are hairier than true male bumble bee legs.
3. Hair color patterns: Page 1 of this guide shows typical color patterns for female bumble bees found in California. Examine the hair color on the front and top of the face, the thorax, and the six abdominal segments (‘Terga,’ abbreviated as ‘T’ on the first page). Caution, many species have variable color patterns, and males are not depicted here! Make sure to consult a field guide too!
4. Beyond color patterns, useful identification marks are: cheek length (relative to width; **Figure 3**), wing color, placement of simple eyes on the head, and presence of sternal hairs (**Figure 4**).
5. Symbols indicate recent distribution of species and/or individual color morphs with strong affinities for particular habitats/regions, as well as known patterns of decline. Expect to also find bees outside of the areas indicated!



Figure 2: Hind legs tibial segment of true (left) vs. cuckoo (right) bumble bees. Photos Sam Droege., USGS Bee Inventory and Monitoring Lab.

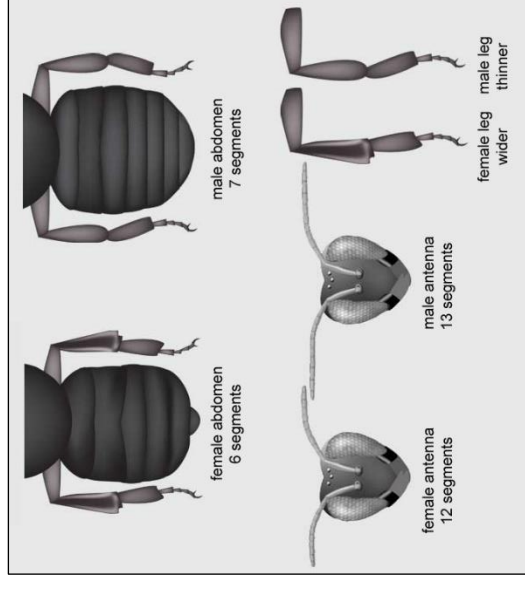


Figure 1: Characteristics of male vs. female bumble bees. Illustrations by Elaine Evans, the Xerces Society



Figure 4: Note the yellow hairs on the sternal (underside of the abdomen) segments. Similar species have black hairs in that location. Photo by Rich Hatfield, the Xerces Society.



Figure 3: Cheek Length. The bee on the left has a long cheek and the bee on the right has a short cheek. Photos: Rich Hatfield, the Xerces Society.





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Questions? Contact us: cabumblebeeatlas@xerces.org



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