

California Department of Fish and Wildlife

Survey Considerations for California Endangered Species Act (CESA) Candidate Bumble Bee Species

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1. Introduction

The California Department of Fish and Wildlife developed this document to provide an overview of survey considerations and methods for Crotch’s bumble bee (*Bombus crotchii*), western bumble bee (*Bombus occidentalis*), Franklin’s bumble bee (*Bombus franklini*), and Suckley’s cuckoo bumble bee (*Bombus suckleyi*). These four bumble bee species are candidates for listing under the California Endangered Species Act (CESA). The scientific information provided herein is intended to assist CDFW staff, project proponents, and consultants in developing, proposing, and evaluating survey protocols and surveys on a project- and site-specific basis. This document should not be interpreted as an order or mandatory protocol for species surveys.

2. Evaluating Potential for Presence

Historical and current occurrence data can provide information on whether one of the candidate species is likely to occur within or near a given project area¹. We recommend that evaluations include a review of occurrence data within and adjacent to the project site. Species' range data in resources such as Williams et al. (2014) or species distribution models in published literature can also be used to help determine potential site occupancy. See Appendix 1 for range maps of the four candidate species.

Historical and current records should be evaluated by consulting a combination of reliable data sources including the [California Natural Diversity Database](#) (CNDDDB) and the [Bumble bees of North America occurrence database](#) (which can be requested from its curator Dr. Leif Richardson). Citizen science data platforms such as [iNaturalist](#) and [Bumble Bee Watch](#) can also provide occurrence data, however the data may or may not be verified by expert taxonomists.

Occurrence data may not always be available for a variety of reasons including the lack of systematic surveys across all potential habitat and recent species declines. Absence of occurrence records should not be interpreted as absence of the species at or near a given site. When records do exist, they often only provide positive data and do not provide negative data from surveys where species went undetected. It is therefore inadvisable to solely rely on occurrence records to assert that a species is absent from a project site. When there is a data deficiency or lack of sightings in a given area that contains suitable habitat for the candidate species, site specific surveys should be conducted.

3. Habitat Assessment

A habitat assessment evaluating the likelihood of bumble bees occurring within and adjacent to the project area should occur and results should be submitted to CDFW prior to initiation of ground disturbing project activities. The assessment should include historical and current species occurrences as well as proximity to the last known sighting. The habitat assessment should include data from site visits to observe and document potential habitat including potential foraging, nesting, and/or overwintering resources. The habitat assessment should quantify which plant species are in bloom and what their percent cover is. General plant diversity should also be assessed and documented. The foraging resources should be quantified across multiple site visits, corresponding with the Colony Active Season (see Table 1) of the

¹ The dispersal distance of new queens as well as the colony's foraging range are difficult to determine and can vary greatly. It is estimated through homing studies and genetic distance analysis that queen dispersal distance may be around 10 km (6.2 miles) (Kraus et al. 2009; Jha and Kremen 2013; Williams et al 2014). However, in Europe, there are reports of bumble bee queens migrating en masse over large distances including over water for several hundred kilometers (Fijen 2021), so these estimates may be much smaller than true distances. Bumble bee foraging range varies among species, the size of the colony, the size of the individual bees, and can also be attributed to the quality of habitat present (Goulson 2010; Kreyer et al. 2004; Walther-Hellwig and Frankl 2000). Though some bumble bee species have been recorded foraging in patchy agricultural landscapes up to 11.5 km from their nest (Rao and Strange 2012; Goulson and Stout 2001), it is likely that the foraging range occurs much closer to the nest, from 1-2 km in a single trip (Walther-Hellwig and Frankl 2000; Dramstad et al. 2003; Williams et al. 2014).

candidate species in the region where the project is located. Foraging resources recorded should not be limited to the preferred plant species known to be favored by a given candidate species but should include all flowering plants including non-natives and invasives. Nesting resources quantified can include bare ground, rodent burrows, and other potential nesting sites that may support bumble bee colonies². Leaf litter and woody forest edge that could provide overwintering habitat should also be described.

It is important to assess habitat both within the proposed project area and in the surrounding landscape, as habitat in the landscape may help predict whether candidate species could be nesting in adjacent areas and foraging within the project site. For additional information on what could be included in habitat assessments see the [Rusty Patched Bumble Bee Habitat Assessment Form & Guide | Xerces Society](#).

4. Survey Method

On-site surveys provide the most valuable information for determining potential impacts of proposed projects and activities on the four candidate bumble bee species, and subsequently developing measures to avoid or minimize take of these species. Survey efforts should include multiple on-site surveys and should be developed to detect foraging bumble bees and potential nesting sites (nesting surveys). Survey timing should be determined on a project-by-project basis based on seasonality and when activity or foraging will most likely occur each year³. Timing of the surveys may vary depending on the location, elevation, seasonal rainfall, average ambient air temperatures, and local seasonal weather conditions. To increase probability of detection, bumble bee survey efforts should be conducted during the Colony Active Period (Table 1) and when floral resources are present, ideally during peak bloom.

Survey efforts should occur and results should be submitted to CDFW prior to initiation of ground disturbing project activities. The number and type of surveys conducted during a survey effort may vary on a project- and site-specific basis. For very large project sites, for example, surveyors should use large meandering transects that incorporate patches of floral resources across the landscape. It is recommended that at least 3 on-site surveys take place prior to project implementation. Each survey should ideally be spaced 2-4 weeks apart during the Colony Active Period to ensure that they cover a range of dates and account for variability in resource use by the candidate species and floral resource phenology within the site. Separate

² Although there is little data describing the nesting of candidate bumble bee species, they may utilize similar nesting habitats as other *Bombus* species (Williams et al. 2014). Bumble bee queens from the *Bombus* subgenus do not dig or make their own nests, rather they search for suitable nest sites by flying low to the ground investigating cavities in a variety of different substrates including thatched grasses, abandoned rodent burrows or bird nests, brush piles, rock piles, and fallen logs (Sladen 1912, Free and Colin Gasking Butler 1959, Alford 1975, Fussell and Corbet 1992, Lye et al. 2012, Williams et al. 2014). They have also been found nesting in man-made structures such as walls, rubble or abandoned furniture (Fussell and Corbet 1992, Williams et al. 2014).

³ Peak activity figures for each species can be found in Bumble bees of North America, which show the timing of when queens, workers, and males have been observed (Williams et al. 2014). Peaks in activity can also be viewed on seasonality graphs in iNaturalist.

surveys should not be conducted on sequential days or in the same week as the species may not be using the site during those days. Surveys should occur during the day (at least an hour after sunrise and at least two hours before sunset, though ideally between 9am-1pm) on warm, but not hot, sunny days (65-90 degrees F), with low wind (less than 8 mph).

| Common Name | Species Name | Queen Flight Season | Colony Active Period (highest detection probability) | Gyne Flight Season |
|-----------------------|----------------------------|-----------------------|--|--------------------|
| Franklin’s bumble bee | <i>Bombus franklini</i> | Late April-early June | Late June-August | September-October |
| Western bumble bee | <i>Bombus occidentalis</i> | February-March | April-September | October-November |
| Crotch’s bumble bee | <i>Bombus crotchii</i> | February-March | April-August | September-October |

Table 1: Approximate Queen and Gyne Flight Seasons and Colony Active Periods of three candidate bumble bee species (taken and adapted from seasonality charts in Williams et al. 2014). The highest detection probability for each species is during the Colony Active Period. Suckley’s cuckoo bumble bee is not included because there is high potential the species would not be detected if surveys were conducted outside of the queen’s flight season, which is typically late spring through mid-summer.

While surveys conducted using these flight seasons/active periods as a guide are considered the most effective and protective to the species, surveys may fail to detect the presence of candidate bumble bee species. Therefore, some project proponents may choose to assume presence and rely on habitat as an indicator of presence in lieu of, or in addition to, surveys.

Bumble bees move nests sites each year; therefore, surveys should be conducted each year that project activities will occur. Even if surveys from a particular project site failed to detect bumble bees one year, project proponents should perform a full round of surveys each year that project activities will occur or assume presence.

4.1 Survey Protocol

The following are example protocols that can be used in survey method development:

- CA Bumble Bee Atlas non-lethal protocol (volunteer handbook)- <https://www.cabumblebeeatlas.org/point-surveys.html>
- USFWS Rusty patched bumble bee protocol- https://www.fws.gov/sites/default/files/documents/Survey_Protocols_RPBB_12April2019.pdf

CDFW's preferred survey method includes non-lethal photo vouchers of all captured bumble bees - photos that show multiple angles of a specimen to allow for accurate identification. This is best accomplished by netting then chilling specimens to facilitate manipulation. When done properly, this method has a low risk to the species (USFWS 2018). Photos of bees on vegetation are also acceptable, but identification may be impaired by photo quality or inability to show identifying characteristics in sufficient detail. Survey methods that involve lethal take of species are not acceptable.

If candidate bumble bees will be captured or handled, a 2081(a) Memorandum of Understanding (MOU) with CDFW will likely be required. MOU authorizations do not require submittal of an application fee. A Scientific Collecting Permit (SCP) may be required in conjunction with the issuance of an MOU if the surveys are likely to impact the two additional bumble bee species on CDFW's Terrestrial and Vernal Pool Invertebrates of Conservation Priority List, *B. morrisoni* and *B. caliginosis*.

MOU website: [Wildlife Branch Research Permitting](#)

Application Procedure: Contact the Wildlife Branch, wildlifemgt@wildlife.ca.gov

SCP website: [Scientific Collecting Permits](#)

Application Procedure: Apply through the [CDFW Scientific Collecting Permit Portal](#)

4.1.1 Foraging Bumble Bee Surveys

Focused surveys should be conducted for a minimum of one person-hour of searching per three acres of suitable habitat (see example for Rusty patched bumble bee protocol provided above). This one-hour time period does not include the time for capture, photography, identification, or release. Alternately, surveys can continue until at least 150 bumble bees have been captured, photographed and/or identified, and released⁴. The surveyor should walk through the habitat focusing on areas with floral resources. The surveyor can target bees matching the candidate species description or capture all bees if they are unsure of proper identification.

Bumble bees should be captured with a net from blooms, avoiding destruction of the flower when possible⁵. Each bee should be carefully transferred into a sterile vial and moved to a cooler with only one bee per vial to avoid disease spread. The bee should be kept in the vial for no more than 10 minutes in ambient temperature before being placed in a cooler as they have a tendency to over-heat (the amount of time should be decreased on hotter days). The vial should be placed in a cooler at a temperature above 25 degrees F, as lower temperatures could

⁴ See Appendix E of the [USFWS Rusty patched bumble bee protocol](#).

⁵ CDFW recommends becoming familiar with any existing [state-listed plants](#) in an area before conducting foraging bumble bee surveys. If state-listed plants occur in the survey area, surveyors should ensure that pollination disruption is minimal during peak flowering and that disturbance of vegetative tissue and soil is minimized. If any state-listed plant occurrences are visited during bumble bee surveys, GPS location and any pollinator association data should be included with survey reports to CDFW and to Nativeplants@wildlife.ca.gov for data collection purposes.

freeze and kill the bee. A thermometer should be placed in the cooler to avoid potential freezing. Crushed ice should be used rather than ice packs to avoid freezing the bee. Time in the cooler should be limited to no more than 120 minutes.

[Photographs for Identification](#)

To identify the bumble bee species captured in vials, carefully remove the cooled bee from the vial and take several photographs against a solid or grided background in light shade so that the bee does not wake up right away or overheat. The bee should never be left or positioned in direct sun. Photographs should be clear and in focus, they should be taken from multiple angles including:

- Face including cheek length
- Top of the head
- Banding on the abdomen
- Color pattern on the thorax
- Hind leg for Psithyrus/sex diagnosis

After photographs have been taken, release the bee in the shade near where the bee was collected (it will slowly start moving and fly away on its own). Keep an eye on bees to ensure they rouse, if any bees die, collect them and report the mortality as specified in the MOU. In the event of a mortality event cease all new activities until you receive direction from CDFW. More information on how to preserve deceased bees can be found in Section 6 below. If there are unsafe conditions such as pesticide application, do not return the bee to the location collected, instead return it to a suitable location as close as possible to where it was found while remaining out of harm's way.

[Sterilization Methods](#)

Surveyors should have a sterilized, dry vial and lid for each bee collected to prevent the spread of disease. The nets should be sterilized between survey locations. Sterilizing should include soaking in 10 percent liquid bleach solution (do not use crystalized bleach). Vials and nets need to be rinsed and dried before subsequent use. Surveyors should not attempt sterilization in the field because the sterilizing solution could poison the bees; surveyors should have enough clean vials and nets for each day of surveys.

[4.1.2 Nesting Surveys](#)

Potential nesting sites in project areas should be surveyed for active colonies. Surveyors can consult maps or habitat assessment(s) to determine potential area(s) to survey. Recall nests may not be co-located with foraging resources and could occur in forest edges, unmowed areas, or areas with rodent burrows or other habitat used as nest sites. Surveys for nests can begin in early spring when new queens search for a nest location. This can be challenging, however, as queens may spend weeks searching for a suitable site. If a site is suspected to be occupied by a queen, it can be flagged and then surveyed in 1-2 weeks once a nest has been established or you may wait until later in the Colony Active Period (see Table 1). Another

possible, though potentially challenging, method is to try to follow the bees from blooms to their nests and look for concentrated bumble bee activity in suitable nesting habitat to focus on where active nest sites may be located. More typically, areas with potential nesting resources are systematically walked and nest activity is observed (high levels of bee movements from a given location). Dogs have been trained to sniff for bumble bee nests, but success rates have been found to be on par with human searchers (Hatfield et al. 2012).

If a nest is suspected, the surveyor can block the entrance of the possible nest with a sterile vial or jar until nest activity is confirmed. If the nest is active, it will typically only take a few minutes before the bees start congregating inside or outside the vial. Vials should not be left on suspected nests for longer than 30 minutes, though less than 5 minutes should be sufficient to confirm use.

If active nests of the candidate bumble bee species are present, an appropriate no disturbance buffer zone should be established around the nest to reduce the risk of disturbance or accidental take.

Overwintering habitat for the majority of North American bumble bees is poorly understood and therefore surveys for it are not recommended. Sloping areas or areas under trees insulated with moss or leaf litter have been found to support overwintering gynes.

4.2 Interpreting Survey Results

If no CESA-protected bumble bees are found during the multiple rounds of focused surveys, but the habitat assessment identified suitable nesting, foraging, or overwintering habitat within the project site, it is recommended that a biological monitor be onsite during vegetation or ground disturbing activities that take place during any of the Queen and Gyne Flight Period and Colony Active Period.

If CESA-protected bumble bees are observed, project proponents may propose site-specific measures to avoid take, or consult with CDFW to obtain an Incidental Take Permit (ITP) if take of CESA-protected bumble bees may occur during project activities.

4.3 Surveyor Qualifications

Surveyors must be qualified to conduct surveys for the candidate bumble bee species. There are a range of potential qualifications including coursework, bumble bee-specific workshops, and focused surveys. It is important to consider the type of training or field work when evaluating whether it provided relevant experience. Project proponents applying for a permit should submit a resume of the proposed surveyor (designated biologist) with their research MOU or ITP application for review by CDFW (see DFW820 [resume form](#)). Given the level of expertise needed for taxonomic identification, it may be acceptable for a less experienced surveyor to confirm the identifications of the bumble bees encountered during surveys by sending photo vouchers to an experienced taxonomist. If this is the case, please also provide the resume of the taxonomist in addition to the qualified biologist.

5. Monitoring and Reporting

For projects that will be receiving an ITP or surveyors receiving a research MOU, survey reporting may be required. Generally, survey reports should include the following information:

1. Qualifications/resumes of surveyor(s) and, if applicable, approved biologists for identification of photo vouchers.
2. Location (latitude and longitude) and extent of surveyed area (maps recommended).
3. Description of conditions during each survey: date, time, temperature, wind speed.
4. Detailed habitat assessment including percent cover of floral resources and potential nesting and overwintering habitat.
5. Number of surveyors per acre, number of acres surveyed, amount of time of focused surveys.
6. List of bee species observed.
7. Foraging habitat surveys: name (at least down to genus) of host plants observed and whether bees were captured on them.
8. Nesting habitat surveys: type of nest/structure surveyed and if bees were found in them, number of nests found in project site, photo log of suitable habitat and plants.
9. Photo vouchers of bumble bees for identification.
10. Confirmation that photo vouchers were submitted and candidate bumble bees were identified, if applicable.

6. When to Contact CDFW

If any of the candidate bumble bee species are detected during surveys, the designated biologist should notify CDFW as further coordination may be required to avoid or mitigate certain impacts. As very little is known about nesting or overwintering sites of the candidate species, if nest or overwintering sites are discovered or can be documented, contact (preferably within three days) CDFW (wildlifemgt@wildlife.ca.gov), USFWS (for *B. franklini*, *B. occidentalis*, and/or *B. suckleyi*), as well as regional CDFW staff ([CDFW region](#)) in which the sighting occurred to assist us in learning more about their habitat and behavior.

If a bumble bee is killed during the source of survey efforts, stop all work and immediately contact CDFW for guidance. Collect the bumble bee into a vial and freeze it as you may be asked to send the specimen to CDFW for further assessment. Record the date, location, GPS coordinators, project name, collector, and any other relevant information related to how it came to die (e.g., freezer may have been too cold; hot day and extreme shifts in temperature from ambient air to cooler may have contributed).

Survey data should also be submitted to the California Natural Diversity Database (CNDDDB). Information that should be included in this nest observation report are; the nest type, type of vegetation cover, slope, aspect, GPS location, distance to foraging location (if known) and other relevant conditions noted about the nest. Negative survey data should also be reported.

NOTE: Due to the sensitivity of the species, suspected or confirmed presence of candidate bumble bee species should not be documented on publicly available databases.

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Appendix 1: Range Maps



Franklin's Bumble Bee (*Bombus franklini*) Historic Species Range



Western Bumble Bee (*Bombus occidentalis*) Current and Historic Species Ranges



