NRCS Honey Bee Habitat Effort: Monitoring Protocol

Monitoring goals:

- Demonstrate to landowners when honey bees are present in fields so that steps can be taken by the landowner to protect foraging bees from insecticide and fungicide applications on adjacent land (for example, coordinate with aerial or ground applicators to adjust spray times in the field to not coincide with foraging honey bees).
- Provide data to the land manager on the relative abundance of honey bees visiting different plant species used in bee forage plantings to facilitate timely adaptive management decisions, such as the end of the bloom period that triggers the decision to terminate the cover crop.
- Inform NRCS conservation planners of bloom time(s) and how this relates to planting time and location for the plant species used in bee forage plantings.
- Inform NRCS conservation planners about the relative abundance of honey bees visiting different plant species used in bee forage plantings to help document value of plantings for honey bees.
- If a mix of species is planted, inform NRCS conservation planners on how plants compete with each other over time to help in adjusting seed mix ratios for future plantings, while also helping land managers understand the best plant species for their operation.

Overview of data to be collected during each monitoring event:

- Number of honey bees foraging on flowers in the planted area.
- Plant species in bloom in bee habitats, and planting date of each species.
- End of bloom period by planted species.
- A representative digital photo (.jpeg format) of each sampling area.

Protocol[1]

Sampling times:

In Montana, sampling honey bee habitat sites occurs every two weeks beginning mid-June and ending in October or when bee forage plantings stop blooming. Conduct your sampling when weather conditions are favorable for bees to forage. It must be at least 61°F, with clear skies (partly cloudy or overcast is OK if you can still see your shadow) and wind speeds less than 8 mph. To help determine if wind speeds are appropriate, if leaves and branches on trees are in constant motion, then it is likely too windy. If you feel wind on your face and leaves are simply rustling, then the wind speed is likely fine for sampling. If weather conditions are appropriate (i.e. warm enough temperature and sunny), sample anytime between 9:00 am and 7:00 pm.

[1] This honey bee monitoring protocol is based on a similar protocol developed by Kimiora Ward and Neal Williams (University of California, Davis), Emily May and Rufus Isaacs (Michigan State University), and Dan Cariveau and Rachel Winfree (Rutgers University) designed to monitor native bee abundance and diversity at restoration sites. Development of the streamlined native bee monitoring protocol was funded through a USDA NRCS Conservation Innovation Grant awarded to University of California, Davis.

Beaufort Wind Scale (to help determine wind speed)

Wind (mph)	Classification	Appearance of Wind Effects
0	Calm	Smoke rises vertically
1-3	Light air	Smoke drift indicates wind direction, still wind vanes
4-7	Light breeze	Feel the wind on your face, leaves rustle, and wind vanes begin to move
8-10	Gentle breeze	Leaves and small twigs will be in constant motion, light flags extended

Sampling locations:

You need to sample one site for every 20 acres contracted in honey bee habitat. If you have less than 20 acres contracted, then you sample one location. If you have 20 to 40 acres contracted, you must sample at least two locations, and so on. In choosing sites to monitor, try to sample from as many different types of cover as you have planted. For example, if you planted a field of buckwheat and a field of phacelia, please collect data from each crop type if you have more than 20 acres total. In plantings less than 20 acres in size per crop, you may sample from the fields that are in bloom and switch from one crop type to the other over the course of the growing season.

You will monitor honey bees along two 100-foot transects for each sampling location. These transects should be parallel to the edge of the planting, in the same location each visit, and in areas where cover crops or other plantings for bees are well-established. One transect should be 10 to 25 feet from the planting edge. The other should be 250 feet from the planting edge or in the center of the planting, whichever is shorter (e.g. if a planting is only 125 wide, then the second transect will be at approximately 63 feet from the planting edge). It is important that transects are in full sun because bee activity declines in the shade. Each transect should be 100 feet long, marked with a flag at the beginning and end, and be sampled for 10 minutes.

Sampling process:

When you arrive at a new sample site, fill out a new data sheet. Write in the appropriate information at the top of the data sheet: site name, zip code, EQIP contract number (if available), the date and your name. Note the weather conditions to demonstrate that the monitoring was conducted during optimal conditions for bees. Also note the type of planting (e.g. cover crop, pasture/hayland, rangeland interseeded with bee forage, etc.). If your type of planting is not on the data sheet, choose 'other' and describe it. Then take a digital photo of the transect with and without the data sheet in the foreground. Make sure that the information at the top of the data sheet is clearly visible in the photo.

If sampling a cover crop planting designed for bee forage, in the data sheet table note the species and variety planted and the state of species in bloom. The state of bloom is the percentage of buds that are in flower and whether buds are still maturing or starting to die back. For example, you might have 20% of buds in flower with 80% still to open. This would be 20% bloom/before peak. If all of the buds are open with few or no dead flowers, then you are at 100% bloom/peak. If 50% of the buds are in

flower and the rest have already died back, then your planting is at 50% bloom/after peak. This does not have to be exact. Please round to the nearest 10%.

Depending upon your honey bee monitoring needs, at the end of this guidebook we provide three different data sheets with space for 3, 7, or 15 plant species. For example, these can be used if monitoring a single species cover crop or pasture planting, a diverse mix of cover crop mix or wildflower species, or a very diverse mix of wildflowers, respectively.

When sampling each transect, first record the time you start. Then start the timer and begin walking along the transect. Plan your transect walk so that your shadow does not move in front of you or across where you are counting bees. As you walk slowly, focus on about three feet to one side of the line you are walking, trying to observe all the open flowers. Record each honey bee you see visiting a flower (visiting = landing on a flower for > 0.5 secs). Pause the timer if you need extra time to record an insect, and then start the timer again when you are ready to resume observations. Tally honey bees visiting each plant species in the habitat. For cover crops or cover crop mixes, it should be relatively easy to identify the plant species in bloom and count the honey bees visiting each plant. If sampling a wildflower meadow with a diversity of plants in bloom, do your best to associate honey bees with individual plant species, but more importantly note the total number of honey bee flower visits for all plants combined. Then add notes about what is in bloom and which species seem to be preferred in the notes section of the data sheet.

Pace yourself so you reach the end of the 100 foot transect in ten minutes. It is suggested that you walk a trial transect prior to your first monitoring event to calibrate your pace. If you do reach the end of the transect before the timer goes off, continue walking and counting honey bees until the timer is finished. Do your best to walk 10 feet for each minute of sampling. If the timer goes off before you have reached the end of the transect, quickly walk to the end of the transect and take a rough count of the honey bees visiting flowers. Try not to count the same bee twice even if it visits several flowers – the goal is to count the number of bees using the site, not the rate of flower visitation. If possible, also count the other flower visitors you see along each transect. These will include native bees, flies, wasps, butterflies, and more.

When finished, look over the area around the planting and note if apiaries are obviously present or not and approximately how far they are located from the planting. The presence or absence of an apiary within a mile of the planting (whether you can see it or not) is going to have a significant effect on the number of honey bees present and is useful to know when the NRCS reviews the results of monitoring conducted by you and other landowners.

Supplies:

During your site visit you will need:

- A stopwatch, wristwatch, or timer on your phone
- 1 data sheet per sampling location (**NOTE**: At the end of this guide, we provide three different data sheets that can be used depending upon how many plants you are monitoring in your

planting. We also provide an example data sheet that has been completed.)

- Monitoring protocol
- Clipboard
- Pencils or pens
- Measuring tape or other tool to lay out 100 foot transect
- Stakes and flagging tape, or other method of marking transects in the field
- Digital camera or phone with high quality camera

You may also want to have the following supplies on hand to help (not required):

- Handheld counter

Submitting your monitoring data:

Submit all datasheets and digital photos to your local NRCS field office contact. Digital photos can be brought to the field office on a flash drive or emailed to your NRCS contact.

Recognizing honey bees

In order to assess the abundance of honey bees using a habitat planting you will need to know how to distinguish honey bees from native bees, flies, and wasps that also look like bees and are visiting the flowers in the habitat areas. Here we provide an overview of honey bee identification, and guidance in differentiating them from other similar flower-visiting insects.

Is it a bee?

In addition to the European honey bee, there are 4,000 species of bees native to North America, and along with that biodiversity comes great variation in appearance. One feature all bees share is their dependence on pollen for rearing young. Their adaptations for carrying pollen can make them easy to distinguish from other insects. Bees tend to be quite hairy, allowing pollen grains to stick to them, and females have special pollen carrying structures on their legs or bellies. The location of these pollen-carrying structures and the appearance of the pollen load (dry powder vs. moist packets) can be helpful in identifying various groups of bees. Bees' eyes are positioned at the sides of their heads, giving their heads a heart-shaped appearance, and their bodies tend to have a rounder shape than many wasps or flies. Although it can be hard to observe unless they are at rest, bees differ from flies in having four wings.

Do not count native bees when monitoring.

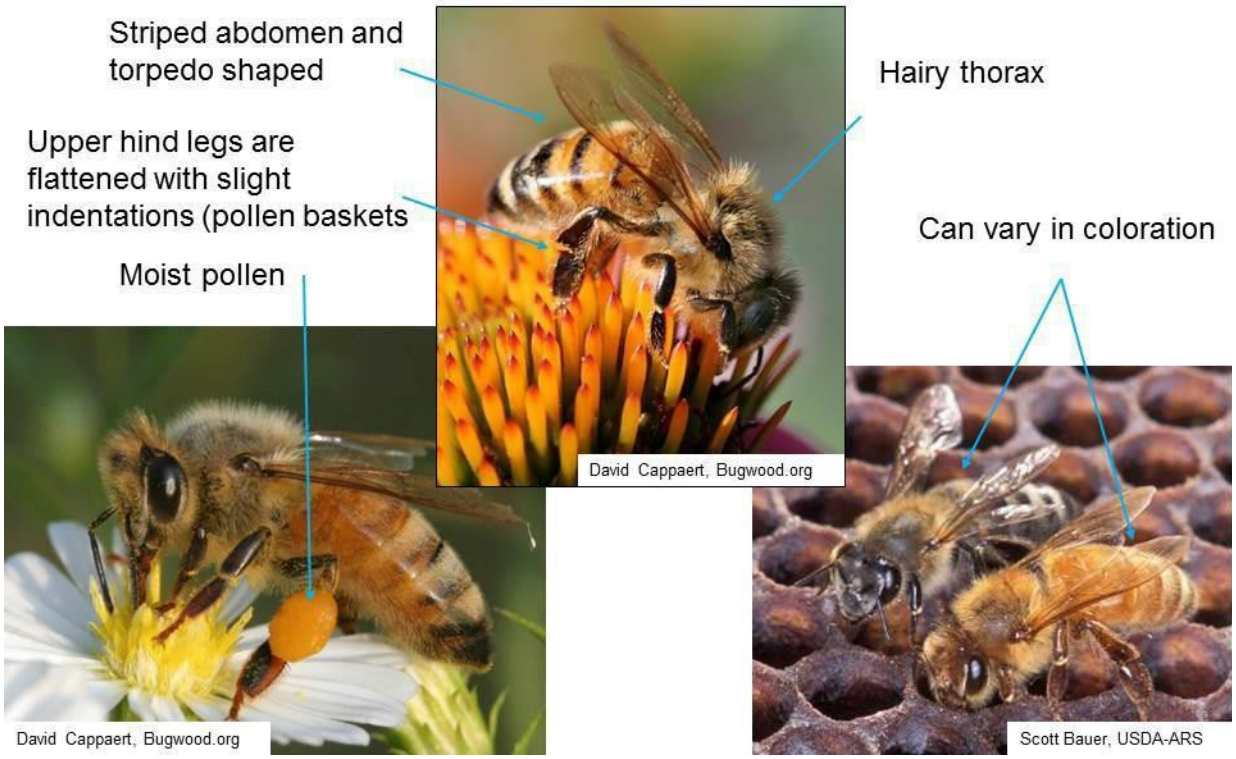

Mace Vaughan, Xerces


Mace Vaughan, Xerces


David Cappaert, MSU, Bugwood.org

Honey bees

For this protocol, it is important to distinguish European honey bees from wild native bees. While support of honey bees is the primary goal of this honey bee habitat effort, keep in mind that honey bees are an unreliable indicator of the planting's ability to attract pollinators because their numbers can vary with the changing location of bee hives or apiaries. Honey bees, like wild bumble bees, carry pollen in flattened structures ringed with long hooked hairs on their upper hind legs called pollen baskets. If the pollen baskets are empty, you can see the flattened wide shape of the upper hind legs. If the pollen baskets are full, you can see that the pollen is carried in moistened clumps, unlike the powdery dry pollen loads of many wild native bees. Honey bees can vary in coloration, but many are a shade of amber with a striped, "torpedo" shaped abdomen, and a thorax covered in brown or pale brown hairs.



Wasps

Wasps are close relatives of bees and share many features, including 4 wings, striping, and heart-shaped heads with the eyes on the sides. However, wasps are carnivores and do not have adaptations to collect and carry pollen. They are not very hairy and have little or no pollen on their bodies. Wasps' coloration results from patterns in their exoskeleton, giving them a shiny appearance compared to bees, which usually get their stripes from colored hairs (NOTE: honey bees provide a notable exception to this, getting their abdominal orange and black stripes from colored exoskeletons). Wasps have been described as having a "tough" or "mean" look with their more slender pointed bodies compared to the more rounded shape of bees. One very common family of wasps folds their forewings lengthwise when at rest.

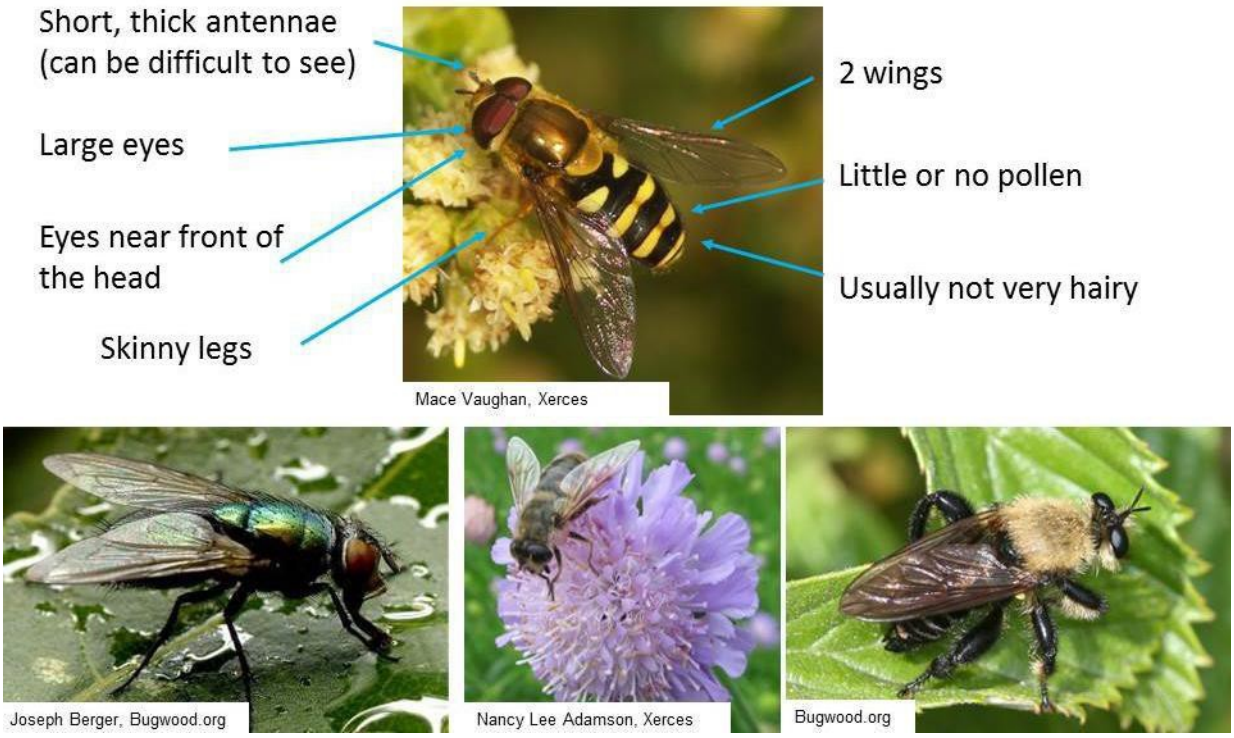
Do not count wasps when monitoring.

Flies

Some flies are clever bee mimics, but several features make them easy to distinguish. First, fly eyes are large and round, often making up the bulk of the head and giving the head a helmet-like appearance. Their antennae are short and thick, coming out like a V or from the middle of their face, often with a flattened lobe hanging down. Flies also have only one pair of wings.

Although they may be visiting flowers for nectar, they are not carrying pollen back to their young, so in general they are not as hairy as bees and they never have hairy pollen-carrying structures on their legs. Some flies, however, are very clever bee mimics, including mimicking fuzzy bumble bees. Look for the big eyes, stubby antennae, and lack of pollen baskets.

Do not count flies when monitoring.



NRCS Honey Bee Habitat Monitoring Data Sheet (3 or fewer plant species)

Participant: _____ **EQIP Contract #:** _____

Site name: _____ **Zip code:** _____

Observer: _____ **Sampling date:** _____

Type of cover (circle): Cover crop Pasture/Hayland Range Other (describe): _____ **Date Planted:** _____

Skies (circle): Clear Partly cloudy Bright overcast **Temp:_____°F** **Wind speed (circle):** Calm (0-3mph) Light breeze (4-7mph)

Conduct observations midday (10am to 4pm), when temperatures are over 61° F, skies are clear (partly cloudy or bright overcast is OK as long as you can see your shadow), and wind speed is less than 8 mph (light breeze or less). Conduct observations along two 100 foot transects in open, well-established areas of the planting. Observe plants in each transect for ten minutes. Record the number of honey bees visiting flowers (landing on flowers) within three feet of one side of your transect line. You can note native bees, flies, wasps or other floral visitors in the notes. **Take two digital photos of each transect: one with this completed datasheet in foreground and one without.**

Sample #_	Time start	Time end	Plant species/variety	Percent bloom & Before or After Peak	# Honey bees per plant species/var.	Optional notes (e.g. # other flower visitors)
Transect 1 (10-25 feet from edge of planting)						
Transect 2 (250 feet from edge or center of planting)						

Proximity of honey bee hives or apiaries (check one)? <¼ mile____¼-½ mile_____½-1 mile_____1-2 miles_____None visible_____

Photo taken of transects? YES_____ **Site notes** (e.g. for plant mixes note dominant plants in bloom and percent cover)**:** _____

NRCS Honey Bee Habitat Monitoring Data Sheet (7 or fewer plant species)

Participant: _____ **EQIP Contract #:** _____

Site name: _____ **Zip code:** _____

Observer: _____ **Sampling date:** _____

Type of cover (circle): Cover crop Pasture/Hayland Range Other (describe):_____ **Date Planted:** _____

Skies (circle): Clear Partly cloudy Bright overcast **Temp:_____°F** **Wind speed (circle):** Calm (0-3mph) Light breeze (4-7mph)

Conduct observations midday (10am to 4pm), when temperatures are over 61° F, skies are clear (partly cloudy or bright overcast is OK as long as you can see your shadow), and wind speed is less than 8 mph (light breeze or less). Conduct observations along two 100 foot transects in open, well-established areas of the planting. Observe plants in each transect for ten minutes. Record the number of honey bees visiting flowers (landing on flowers) within three feet of one side of your transect line. You can note native bees, flies, wasps or other floral visitors in the notes. **Take two digital photos of each transect: one with this completed datasheet in foreground and one without.**

Sample #_	Time start	Time end	Plant species/variety	Percent bloom & Before or After Peak	# Honey bees per plant species/var.	Optional notes (e.g. # other flower visitors)
Transect 1 (10-25 feet from edge of planting)						
Transect 2 (250 feet from edge or center of planting)						

Proximity of honey bee hives or apiaries (check one)? <¼ mile____¼-½ mile_____½-1 mile_____1-2 miles_____None visible_____

Photo taken of transects. YES_____ **Site notes** (e.g. for plant mixes note dominant plants in bloom and percent cover)**:** _____

_____

_____

NRCS Honey Bee Habitat Monitoring Data Sheet (15 or fewer plant species)

Participant:_____ **EQIP Contract #:**_____

Site name:_____ **Zip code:** _____

Observer:_____ **Sampling date:** _____

Type of cover (circle): Cover crop Pasture/Hayland Range Other (describe):_____ **Date Planted:** _____

Skies (circle): Clear Partly cloudy Bright overcast **Temp:**_____**°F** **Wind speed (circle):** Calm (0-3mph) Light breeze (4-7mph)

Conduct observations midday (10am to 4pm), when temperatures are over 61° F, skies are clear (partly cloudy or bright overcast is OK as long as you can see your shadow), and wind speed is less than 8 mph (light breeze or less). Conduct observations along two 100 foot transects in open, well-established areas of the planting. Observe plants in each transect for ten minutes. Record the number of honey bees visiting flowers (landing on flowers) within three feet of one side of your transect line. You can note native bees, flies, wasps or other floral visitors in the notes. **Take two digital photos of each transect: one with this completed datasheet in foreground and one without.**

Sample #_	Time start	Time end	Plant species/variety	Percent bloom & Before or After Peak	# Honey bees per plant species/var.	Optional notes (e.g. # other flower visitors)
Transect 1 (10-25 feet from edge of planting)						

Sample #_	Time start	Time end	Plant species/variety	Percent bloom & Before or After Peak	# Honey bees per plant species/var.	Optional notes (e.g. # other flower visitors)
Transect 2 (250 feet from edge or center of planting)						

Proximity of honey bee hives or apiaries (check one)? <1/4 mile _____ 1/4 -1/2 mile_____1-2 miles_____None Visible_____

Photo taken of transects? YES _____

Site notes (e.g. for plant mixes note dominant plants in bloom and percent cover)**:**

_____

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_____

_____

NRCS Pollinator Habitat Monitoring Data Sheet (EXAMPLE)

Participant: *John Doe* **EQIP Contract#:** *74632214xxx*

Site name: *Paradise Farm - Bee Habitat / Transect 1* **Zip code:** *63132*

Observer: *Mace Vaughan* **Sampling date:** *July 15, 2014*

Type of planting (circle): (Cover crop) Pasture/Hayland Range Other (describe):_____ **Date Planted:** *June 3, 2014*

Skies (circle): Clear (Partly cloudy) Bright overcast **Temp:** *75°F* **Wind speed (circle):** Calm (0-3mph) (Light breeze (4-7mph))

Conduct observations midday (10am to 4pm), when temperatures are over 61° F, skies are clear (partly cloudy or bright overcast is OK as long as you can see your shadow), and wind speed is low (a gentle breeze). Conduct observations along two 100 foot transects in open, well-established areas of the planting. Observe plants in each transect for ten minutes. Record the number of honey bees visiting flowers (landing on reproductive structures of flowers) within three feet of one side of your transect line. You can note native bees, flies, wasps or other floral visitors in the notes. Take two digital photos of each transect: one with this completed datasheet in foreground and one without.

Transect	Time start	Time end	Plant species/variety	Percent bloom & Before or After Peak	# Honey bees per plant species/var.	Optional notes (e.g. # other flower visitors)
Transect 1 (10-25 feet from edge of planting)	*11:35*	*11:45*	*Buckwheat*	*60% (before)*	*85*	
Transect 2 (250 feet from edge or center of planting)	*11:55*	*12:05*	*Buckwheat*	*60% (before)*	*43*	

Proximity of honey bee hives or apiaries (check one)? <¼ mile *X* ¼-½ mile____ ½-1 mile_____ 1-2 miles_____ None visible_____

Photo taken of transects? YES *X* **Site notes** (e.g. for plant mixes note dominant plants in bloom and percent cover)**:** *The buckwheat established well and is approaching peak bloom. Honey bees abundant! Apiaries close by. Also noticed many bumble bees in the planting, and several bees I couldn't identify. Clover in adjacent field is just starting to bloom.*