TECHNICAL NOTE

BENEFICIAL INSECT SCOUTING GUIDE

FIGURE 1: *Floral monitoring outside a high-tunnel greenhouse (left), sweep-netting meadow habitat (center), and a parasitized colony of aphids (right).*

Overview

Pollinators and other beneficial insects, such as natural enemies that attack crop pests, can contribute significantly to pest management and crop pollination. Robust populations of native bees complement honey bees in providing pollination services, and provide a safety net for farmers when honey bees are scarce. The presence of natural enemies of crop pests can reduce overall pest pressure and decrease the need for insecticides. Insect-friendly habitat is a critical component of supporting beneficial insects; the pollen and nectar produced by flowering plants makes up 100% of a bee's diet, while many natural enemies rely on floral resources at key stages of their development or to supplement their diets. Habitat also creates cover and nesting sites for both pollinators and natural enemies (collectively referred to as 'beneficial insects').

This protocol is designed to assess populations of beneficial insects on a farm, both in habitat areas (e.g., hedgerows, cover crops, natural areas), as well as in cropped areas. It can also be useful in assessing the quality of habitat for beneficial insects in a natural area. The insect groups monitored in this protocol were selected because they are widespread, easy to recognize, and have the potential to contribute significant ecosystem services. When using this protocol, it is important to keep in mind that the movement of different beneficial insect groups in and out of areas can be complex, depending upon many factors such season, movement of pest insects, and proximity and quality of adjacent habitats. While it is not possible to quantify to what extent beneficial insects are contributing directly to crop pollination or pest reduction on a farm from this protocol alone, it is useful in providing a general assessment of beneficial insect populations in a given area.

The Protocol

This beneficial insect monitoring protocol consists of three distinct monitoring methods: floral observations, foliar monitoring, and aphid mummy monitoring. Running these monitoring methods in both cropped areas and surrounding habitat may provide the most useful assessment of beneficial insects on the farm as a whole. Using all three methods will yield the most robust data, but each can also be used independently.

Supply List:

- Datasheets, clipboard, and pencil
- Pin flags
- Measuring tape or wheel
- Timer
- Sweep net / beat sheet (white paper & clipboard) or beat cloth
- Hand-lens
- Weather meter or weather app
- ***Optional:*** Clicker or counter app (helpful where there are large numbers of insects such as honey bees)

1. Floral Observations

This method consists of timed observations of floral visitors along a transect. Observations should focus on open flowers, counting the number of visitors from each insect group (listed in this monitoring method below) that is visiting those flowers. Try to pace yourself such that you walk the entire transect in exactly the allotted amount of time.

(continued on next page)

Floral Monitoring Continued

Basic Instructions:

- Total transect length: 200 linear feet. This could consist of a single 200' transect or several shorter transects adding up to a total of 200'.
- Total time = 15 minutes. Should be divided up proportionally if sampling multiple, shorter transects.
- Time of day: Between 10:00 am and 4:00 pm.
- Time of year: During the active growing season.
- Weather conditions: temperature should be between 65–95°F; wind speed should be below 10 mph; and it should be sunny, partly sunny, or bright over-cast.
- Conduct floral observations at least two times per year, separated by a minimum of three weeks.
- Count and record the following insects (adult / mature forms) visiting flowers within 3' of your transect line: honey bees, native bees, syrphid flies, predatory wasps, lady beetles, and green lacewings.
- If there are a lot of insects, it may be necessary to walk the transect twice, counting sub-categories of insects (e.g., once for honey bees and once for the other insect groups).
- Record insects by making a hash-mark in the appropriate box on the accompanying datasheet. Tally the total count at the end of the timed transect(s).

Helpful Tips:

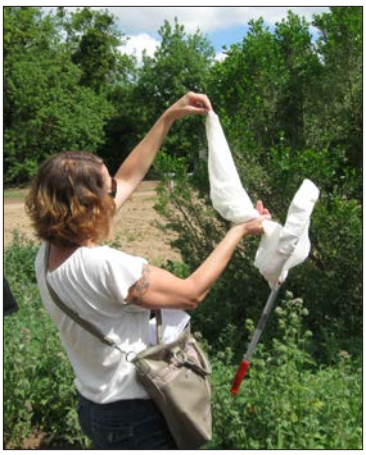
- 'Visiting' can be defined as landing on a flower for longer than 0.5 seconds.
- Be sure to keep your shadow behind you when walking your transect.
- Try to pace yourself so you reach the end of the 200' transect when the 15 minutes are up. If the timer goes off before you have reached the end of the transect, quickly finish the transect.
- Try not to count the same insect twice, even if it visits multiple flowers. The goal is to count the total number of insects in an area, not the total number of floral visits.
- A clicker-counter may be helpful for counting if there is a particularly numerous insect species.

2. Foliar Monitoring

This method entails using a sweep-net to collect and record specific insects found on the vegetative parts of plants along a transect. Beat sheets or beat cloths can be substituted for sweeping if plants are fragile or thorny, or if a sweep net is not available. For beat sheets or cloths, quickly and carefully bend the plant material over sheet and smartly tap the plant material against the sheet several times to shake insects out of the vegetation. Collected insects should be released after being counted and recorded.

Figure 2: Floral monitoring.

Figure 3: Foliar monitoring using a sweep net (left) or a beat sheet (right).



Foliar Monitoring Continued

Basic Instructions:

- Total transect length: 200 linear feet. This could consist of a single 200' transect or multiple shorter transects adding up to a total of 200'.
- Total of number of sweeps or beats: 15.
- Time of day: Between 10:00 am and 4:00 pm.
- Time of year: During the active growing season.
- Weather conditions: temperature should be between 65–95°F; wind speed should be below 10 mph; and it should be sunny, partly sunny, or bright over-cast.
- Conduct foliar monitoring at least two times per year, separated by a minimum of three weeks.
- Count and record the following insects: lady beetles (adults and larvae), green lacewings (adults and larvae), spiders, and minute pirate bugs.
- Record insects by making a hash-mark in the appropriate box on the accompanying datasheet. Tally the total count at the end of the timed transect(s).
- Insects are captured via sweep-netting. After each sweep, insects captured in the net can be emptied onto a sheet of paper or into a jar for easier viewing and identification. It is also possible to view and identify insects in the net.

Helpful Tips:

- Sweep-netting will generally result in larger numbers of captured insects as compared to beat sheets / cloths.
- If sweeping is not possible, use small beat sheets (e.g., 8.5"× 11" white paper and clipboard) for most habitat areas. Beat sheets can also be used in cropped areas in vineyards, berries, and vegetable crops.
- If monitoring tree crops, use large (e.g., one square meter) beat cloths.
- Viewing and identifying collected insects must happen quickly before insects hop, crawl, or fly away.
- A hand-lens can help with identifying the smaller insects, particularly the minute pirate bug.

3. Aphid Mummy Monitoring

Look for evidence of parasitoid wasps by recording parasitized aphids.

Aphid Mummy Monitoring—Basic Instructions:

- Use in cropped areas where aphid outbreak exists.
- For vegetable or berry crops, observe four plants. For tree crops, inspect 3' sections of a single branch on four different trees.
- Record the presence / absence of parasitized aphids ('mummies') on each plant or branch.

Helpful Tips:

- This monitoring method is primarily intended to be used in cropped areas, but is also relevant in adjacent habitat areas.
- Although many insects can be parasitized, the evidence is not always easy to see. Thus, this monitoring method is limited to monitoring aphids.

Baseline Monitoring / Control Sites

Data collected using these monitoring methods is most meaningful if used to track changes in insect populations over time. It is generally most informative if measuring changes resulting from habitat implementation and / or changes in management or pesticide use in a given area. For this reason, it is ideal to utilize this protocol to collect baseline data at a site before implementing any changes. However, if this is not possible, setting up control sites is another option.

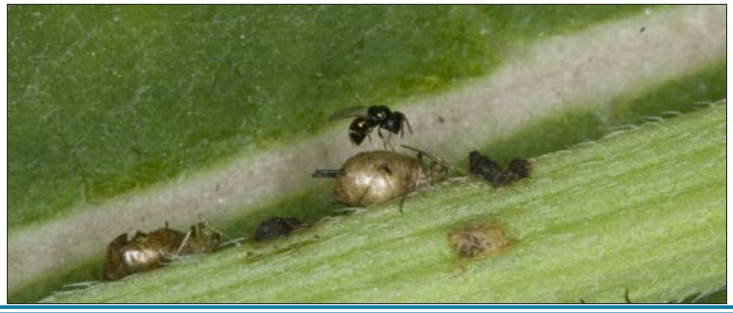
Basic Instructions for Baseline Monitoring:

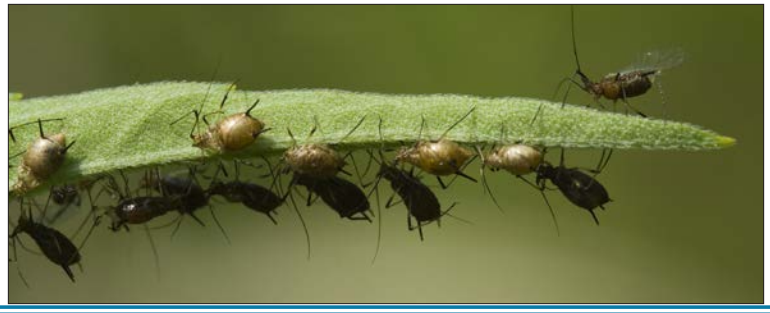
1. Use the same methods for baseline monitoring as for post-project monitoring.
2. Use approximately the same transect(s) for baseline monitoring as for post-project monitoring.
3. Collect baseline data during the same season / time of year (within two weeks) and same general weather conditions as collecting post-project monitoring.

Basic Instruction for Control Site Monitoring:

1. Control sites should be a minimum of 200' from habitat areas, preferably >500'.
2. Control sites should be the same distance from the same type of surrounding habitat as the habitat areas (for example, if the cover crop being sampled is 100' from a natural riparian area, then the control area sampled should be 100' from the same riparian area).
3. Control sites should match project area sites as closely as possible. For example, if monitoring an understory insectary cover crop in a perennial cropping system, the control site should involve monitoring resident understory vegetation in the same cropping system. If monitoring a roadside hedgerow, the control should be resident vegetation along the road edge.

FIGURE 4: Aphid parasitoid wasp emerging from aphid mummy (left), and live aphids next to mummified aphids parasitized by the wasp *Aphidius colemani* (right), a widely used biological control agent.





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Natural Enemies Table

Below is a reference table of the natural enemies referred to in this protocol, and the crop pests they prey upon. This is not a complete table of natural enemies or their prey, but serves to provide information to support the use of this guide.

Natural Enemy*			Crop Pest(s) Preyed Upon†
Green lacewings			**Aphids, leafhoppers, lygus bugs, mealybugs, mites, psyllids, small caterpillars, soft scale, thrips, whiteflies, eggs of pest insects** Figure 6: Green lacewings (*Chrysoperla* spp.) adult [left] and larva attacking a cabbage looper (*Trichoplusia ni*) caterpillar [right].
Lady beetle			**Aphids, mealybugs, mites, soft scale, whiteflies, eggs of pest insects** Figure 7: Convergent lady beetle (*Hippodamia convergens*) adult [left] and larva [right] hunting aphids.
Minute pirate bug			**Leafhoppers, mites, small caterpillars, thrips, eggs of pest insects** Figure 8: Minute pirate bug (*Orius* spp.) adult feeding on whitefly [left] and nymph feeding on aphids [right].
Parasitoid wasp			**Many pest insects (host-specific), including aphids, caterpillars, eggs of pest insects** Figure 9: Parasitoid wasp (*Colpoclypeus florus*) stinging a leafroller caterpillar [left]; adult parasitoid wasp (*Trissolcus* sp.) emerging from a stink bug egg [right].
Predatory wasp			**Caterpillars, soft-bodied insects** Figure 10: Western yellowjacket (*Vespula pensylvanica*) preying on a cabbage white (*Pieris rapae*) caterpillar [left]; sand wasp (*Bicyrtes* sp.) nectaring on goldenrod flowers [right].
Spider			**Aphids, cucumber beetles, flea beetles, leafhoppers, lygus bugs, eggs of pest insects** Figure 11: Jumping spider with armyworm caterpillar prey [left]; black-footed yellow sac spider (*Cheiracanthium inclusum*) eating bollworm eggs [right].
Syrphid fly‡			**Aphids, soft-bodied insects** Figure 12: Syrphid fly adult nectaring on coyotebrush (*Baccharis pilularis*) [left] and larva feeding on aphids [right]

NATURAL ENEMIES TABLE NOTES:

* For more information on recognizing native bees, please refer to the Xerces Society's Simplified Monitoring Protocol (xerces.org/publications/id-monitoring/streamlined-bee-monitoring-protocol)

† Natural enemy prey information found in NCAT ATTRA IPM Insect Field Guide and UC–IPM (http://ipm.ucanr.edu/)

‡ It is the larval syrphid fly that feeds on the pests listed in the table above, but this protocol focuses on monitoring for the adult syrphid, as they are easier to find and recognize. Adult syrphid flies can also be effective pollinators.