Protocols for Monitoring Pollinators: Bees, Wasps, & Flies

Objective and Purpose

Pollinators provide immeasurable benefits to both natural and anthropogenic ecosystems and global food security is dependent on their ecosystem services (van der Sluijs and Vaage, 2016). Plant-pollinating invertebrate species include those that belong to the orders Hymenoptera, Diptera, Lepidoptera, and Coleoptera. Although there has been concern over declining worldwide pollinator diversity within the scientific community since the mid-1990s, mainstream concern over this issue is relatively new. Since pollinator diversity contributes to higher overall biodiversity within an ecosystem, monitoring the state of native pollinators is an important aspect of the Urban Biodiversity Inventory Framework (Eardley et al., 2006).

Protocol Consistency

Standardizing sampling protocols for the Urban Biodiversity Inventory Framework is a critical requirement of designing surveys that are replicable and producing results that are spatially and chronologically comparable (Larsen, 2016). This is especially important for long-term monitoring efforts that aim to measure changes over time. While a standardized approach among all cities using the Urban Biodiversity Inventory Framework is preferable, each city may identify a methodology best suited for their species of interest and resources at hand. It is important to record and report the methodology used and remain consistent in protocols unless modifications are essential to its improvement. It is equally important that site conditions and day-of conditions for sampling are kept as similar across sites as possible to reduce the impacts of confounding factors. All methodology will be improved with the use of non-biased approaches to data collection, appropriate sampling efforts and accurate reporting of data. The methodology below follows the assumption that the observers are properly trained, using methods to limit bias, and following designated protocol to ensure consistency among sites and years of sampling efforts.

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Track 2
Presence/Absence

Data to be Entered into UBIF Database

- City
- Data Collector(s)
- Date
- Location name
- Ecosystem/habitat of interest
- Taxonomic group
- Species
- GPS coordinates of transects (Lat/Long in decimal degree format)
- Reference or city site
- Presence or absence of target species

Additional Required Information to Record (see Data Collection Sheet)

- Number and length of transects

Optional Information to Record (see Data Collection Sheet)

- Start and end time of transect walks
- Temperature, wind and weather (sunny, partly cloudy, etc.)
- Dominant vegetation in the area and flowers that are in bloom

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Sampling Protocols:

Adapted from protocols described in Arnold and Parrent (2014), Pacheco (2012), Popic et al. (2013) and Ward et al. (2014).

Condition Requirements:

» Data collection should occur only when temperature is greater than 60□, wind is less than 5.6 mph, and skies are mostly clear (partly cloudy is acceptable as long as you can still see your shadow). Optimal survey time may vary depending on target pollinator, but is typically between 11am and 4pm.
» Data collection must occur during the known flight period of the target species and within the post-rain flowering season, which varies by region.

Establishing Transects:

» Transect locations will be selected systematically within a site and should be restricted to one habitat and land-use type. It is important to consider available resources for the target pollinator when selecting transect locations.
» The entire length of the transect should be exposed to sunlight.
» Transects do not need to be straight and can bend around structures (trees, bushes, etc.).
» We recommended a total of four 100 m transects per site. Other combinations that add up to a total of 400 m per site may also be used, but be sure to keep transect lengths consistent across sites and over time.
» Permanent transects are recommended as long as the required resources for the target pollinator remains available.
  • Permanently mark the beginning and end of each transect using weather and fireproof markers.
  • If using permanent transects is not possible, keep transects in the same general area during each data collection period.

Collecting Presence/Absence Data:

» Starting at one end of the transect, walk the entire length of the transect at a slow and constant pace.
  • Time spent walking along each transect will depend on transect length. Overall effort should be kept consistent across all transects and sites.
» Inspect the designated area around the transect for the target species. This area should include approximately 2.5 m to the right and left of the transect, 5 m in front of the surveyor, and 5 m above the ground (Figure 1). Surveyors will not inspect the area behind them.
» If the target pollinator is seen at any point along the transect, the species is considered present. If target pollinator is not seen along the transect, then it is considered absent.
  • Bees, wasps, and flies can be difficult to positively identify from a distance. The surveyor can use an insect net to capture and verify whether or not the individual belongs to the target species. If positive identification cannot be made in the field, a specimen should be collected for more detailed identification.
» Presence/absence data should be collected from city and reference sites on at least three occasions during the known flight period of the target species.

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Track 3
Relative Abundance

Note: Track 3 data can be collected from the same sites and transects that were surveyed in Track 2. If Track 2 is not used, refer to Track 2: "Establishing Transects" for information of transect establishment within city and reference sites. Special permits may be required for collecting and marking pollinators. Verify any permits or wildlife regulations that may apply prior to conducting surveys.

Data to be Entered into UBIF Database

- City
- Data Collector(s)
- Date
- Location name
- Ecosystem/habitat of interest
- Taxonomic group
- Species
- GPS coordinates of transects (Lat/Long in decimal degree format)
- Reference or city site
- Relative abundance (%) of target species

Additional Required Information to Record (see Data Collection Sheet)

- Size and type of trap used (pan vs. bowl vs. cup)
- Number and length of transects
- Amount of liquid used in traps
- Trap placement (on ground vs. elevated)
- Counts of target and non-target individuals
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Optional Information to Record (see Data Collection Sheet)

- Time pan traps were set out and retrieved
- Temperature, wind and weather (sunny, partly cloudy, etc.)
- Dominant vegetation in the area and flowers that are in bloom
- Non-target species information

Sampling Protocol:

Sampling protocols were adapted from those described in Arnold and Parrent (2014), Campbell and Hanula (2007), Droege et al. (2016), Lebuhn et al. 2016, Sutherland (2006) and Van Swaay et al. (2012).

Collecting Relative Abundance Data

- Pan traps should be white, fluorescent blue, and fluorescent yellow. Bowl or cup traps may be used instead, but trap type needs to be kept consistent across transects, sampling sites, and collection years. Standard trap size is 3.25 oz.
  - Trap type must be determined prior to the first data collection occurance so that all subsequent data are collected using the same trap type.
- 24 (8 of each color) traps will be evenly spaced along each transect alternating the three colors.
  - Traps can be placed either on the ground or elevated, but should be visible to pollinators (not covered by vegetation).
  - For elevated traps, it is recommended that they be placed 0.5 m above the ground.
- Fill the traps with water and a small amount of non-citrus scented detergent. Leave bowls out for 24 hours.
- After 24 hours, use an aquarium net to remove any bees, flies, or wasps from the liquid and discard any other individuals that may have been caught. Place all collected bees, flies, and wasps from one transect into a container with 70% (140 proof) alcohol and transport for later identification.
  - All collected bees, flies, and wasps will be counted as either belonging to the target species or belonging to a non-target pollinating species.
- Pan traps should be deployed on at least 7, evenly-spaced (weather-permitting) occasions over the course of the target-species' flight period.

Calculating Relative Abundance

- After each trap deployment period, counts will be summed for target species and non-target species for each transect.
- Relative abundance (%) for each transect will be calculated as the proportion of the individuals counted that belong to the target species.

$$\text{Relative Abundance (\%)} = \frac{\text{Number of target species}}{\text{Number of target species + Number of non-target}} \times 100$$

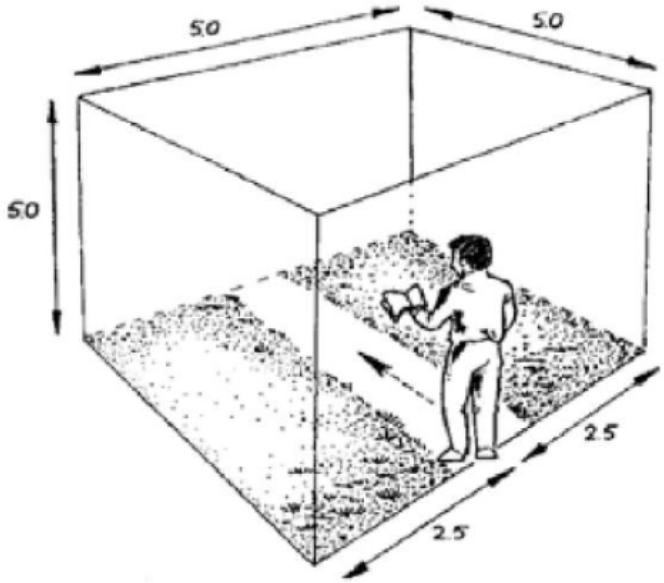

Figure 1. Starting from one end, walk the entire length of the transect at a slow and constant pace. Inspect the area around the transect for the target pollinator. This area includes 2.5 m to the left and right of you, 5 m in front of you and 5 m above the ground. Do not inspect the area behind you. Image from Van Swaay et al. (2012).

Citations and Additional Resources

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