Survey Protocols for Monitoring Status and Trends of Pollinators

This annex presents the bee monitoring protocols to be applied in the context of monitoring status and trends of pollinators in STEP sites.

1. Definitions and conceptual framework

The following conceptual framework underlies the protocol.

2. Protocol objective

Survey Target: Bees (With 90% of the common species having some probability of being detected)

Geographic Coverage: A region covering approximately 10 – 200 Km^2

Goal: Detect changes in native bee populations

Specific Objectives

1. Survey will be designed to detect trends in bee populations over a 5 year time period (note that by setting our detection period to 5 years mathematically we will have a much heightened ability to detect longer term trends in bee populations (i.e., 10, 25, 50 years out)).
2. Over those 5 years we would like to have the ability to detect a 25-50% decline (approximately 6%-13% annual declines) in species richness, overall abundance of bees, and in at least some of the individual species
3. Our statistical parameters would be alpha = 0.20, analytical technique = sign test and route regression, power > 0.90,

3. Overall Protocol Structure

Listed below are the parameters that were used in designing the protocols in this document.

Choice of Study Area

The specific study area will be determined by the researcher or participant. Within that study area it must be decided if the entire area is going to be sampled or only parts. Some examples of partial surveys would be:

A survey of the bees in specific sites (such as STEP sites) taken as a whole landscape, with multiple land uses
A survey of the bees in crops or orchards in a specific site (such as STEP sites) STEP site
A survey of the bees in natural areas in a specific site (such as a STEP site)

All are legitimate targets for investigations; however, statements about trends in bees will be limited to only those targeted areas. If you survey crops or orchards only and find declines in most of the bees there, you cannot say that bees are declining throughout the specific site (such as a STEP site), you can ONLY say that they are declining in crops or orchards in the STEP site.

Placement of surveys

There are three choices with respect to placement of surveys

1. They may be placed according to where sites of interest are located.
2. They can be chosen randomly.
3. They can be located systematically.

The consequences of choice number 1 are that about the survey can then only provide information on trends in bees on those chosen sites, and no extrapolation can be made to locations outside of the those sites. So, if orchards are being sampled orchards and it is found that bees have declined in those orchards it may be concluded that: "Bees have declined in these sampling locations." It is **not** possible to state: "Bees have declined in orchards in this region." Choosing to place surveys according to sites of interest will severely limit the ability to talk about declines in bees and the overall usefulness of the survey.

The consequences of choices number 2 and 3 are the same. Because the location of samples has not been predetermined, it will be possible to extrapolate findings to the region as a whole; therefore it may be possible to make much stronger statements such as: "From this survey it has been shown that bees are declining in this region's orchards."

If needed, refer to text books and web sites that provide information how to choose random or systematic locations for a study area, and if possible show your plan to a statistician for review. It is very common to make statistical mistakes when designing monitoring programs and many of these can be resolved by consulting with a statistician before data is collected rather than after.

Sampling Method

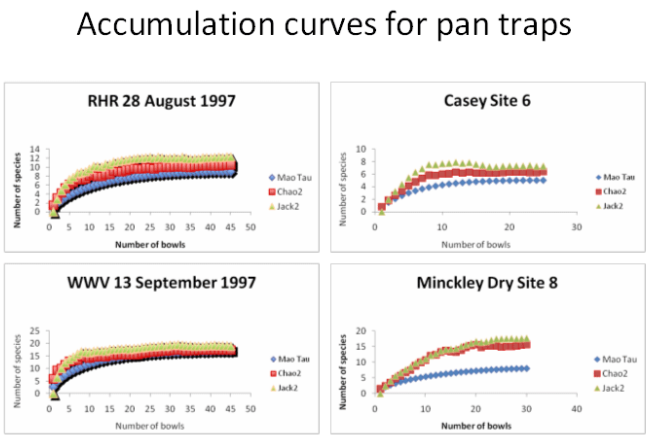
This protocol is based on the use of pan traps. The exact reasons for these types of pan traps are covered in a document available on the project website.

What is a Bowl Trap?

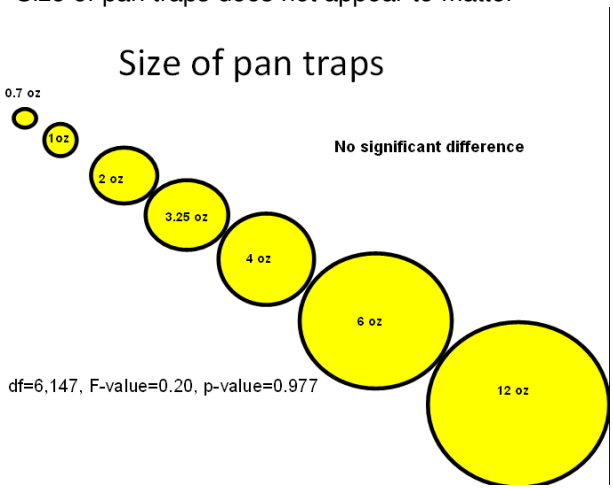
Bowl traps are small plastic bowls or cups, colored white, fluorescent blue, or fluorescent yellow. The bowls are filled with water mixed with a small amount of detergent. Bees are attracted to the colors (because bees are attracted to the colors of flowers), land in the water and drown. Normally a bee landing on water would float on the surface tension, but, in this case the soap diminishes the surface tension enough that they sink.

The essential recommendations that this framework is based upon are:

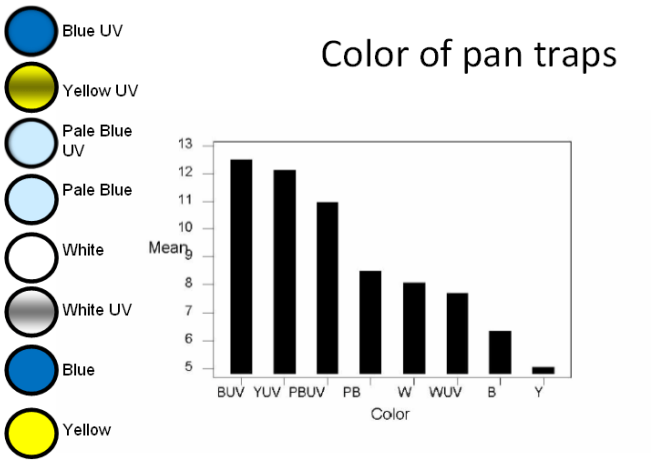
1. The accumulation curve for pan trapping saturates at 15-20 pan traps; thus it is recommended to use 25 pan traps per site, to allow for some losses.



2. Size of pan traps does not appear to matter

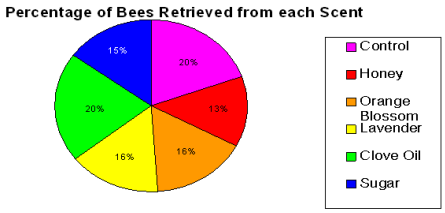


3. Color is important; multiple colors catch more species and fluorescence dramatically increases catch. It is recommended to use 3 colors UV-blue, UV-yellow and white.



4. While it is important to add dishwashing liquid to pan traps, the scent of the liquid is not important.

Is there a best Scents or Sweet to use in the water in the bowl?



5. Trapping web and paired studies suggests bowls should be 3-5 m apart
6. Pan traps should be sampled every two weeks for 24 hours.

While there are many more ways to catch and sample bees – such as netting, trap nests, malaise traps, it is recommended that if these are used in STEP sites to collect ancillary data, they should only be uses away from the standardized pan traps so they don't take away specimens from the main survey.

Sampling Procedure

At each sampling locations, bowl traps are placed in a line or transect. Twenty four bowls are used, 8 of each color, and the colors are alternated throughout the transect. Bowls are placed on the ground 5m apart and are located such that each individual bowl is not hidden by vegetation but left out in the open where a bee can spot it.

Efficient field methods

Advice on streamlining field methods and increasing efficiency in processing samples can be found in a document available from AGP, FAO, "Methods to increase the efficiency of monitoring bee populations"

Length of sampling

Bowls can either be left out for any 24 hour period of good weather or placed out prior to 9 in the morning and picked up after 3 in the afternoon. Bees are most active during the middle of the day and so as long as that active period is sampled it doesn't matter whether over the sampling is done over 1 or 2 days.

Weather Considerations

If the weather is rainy or very cloudy then catch will be minimal. Consequently, bowl surveys should not be run on those days. Conditions are good for doing surveys if rain does not threaten and if it is sunny or only partially cloudy. Rain can be tolerated during the night or, if brief. However, if rain comes down too heavily it will splash the bee specimens out of the bowl so beware of thunderstorms. One option might be to put an overflow hole in the top of the pan trap to let water out.

Loss or Destruction of Bowls During the Survey

This is not a problem. Each time a survey is carried out it will be important to record the number of bowls that remained full of water throughout the survey period. So, if one started with 24 bowls and during the course of doing the survey 1 bowl was destroyed by a tractor, 1 bowl was stepped on, 1 bowl couldn't be found, and 1 bowl was found to not have water in the morning then the presence of 20 active bowls should be recorded in the survey data and notes - not 24. During the analysis of your data you the numbers of bees captured will be divided by the number of bowls available.

Processing of Samples

At the end of the sample period, the liquid in all pan traps should be run through a net (such as that depicted, available in aquarium stores) or strainer to extract the insects within, and these should be transferred to a sealable plastic bag, labeled with the transect number, location, number of bowls, and date.

On a data sheet the number of bowls missed or destroyed should be recorded and the time they were laid out and picked up

.

Preparing Specimens

Bees captured in water and stored in alcohol are difficult to identify if they are pinned directly from the alcohol without any processing. Washing and drying specimens is not difficult or time consuming if you prepare for that before hand and is addressed in the document, "Methods to increase the efficiency of monitoring bee populations"

Drying out Specimens

Once specimens are surface dried and fluffy they can be placed in the box that has the tag that was pulled initially from the sealable plastic bag. At this point the specimens can either be looked at immediately by and expert or left to dry further and after a couple of weeks they can be stored in a covered petri dish or another container until ready for identification.

Identifying Specimens

Bee identification in many circumstances will require sending specimens off to an identification center or a series of experts. However, in most situations there are a few species of bees that are easy to ID and are very abundant. Consequently, there is no real need to actually pin these specimens and a great deal of savings can occur if they are processed immediately without first pinning them. Ways of efficiently accomplishing this are addressed in the document, "Methods to increase the efficiency of monitoring bee

populations". Those bees that cannot be readily identified should then be pinned and labeled. Time-saving methods to process large numbers of specimens are covered in the methods document.

Data Entry Database and Maintenance

Once the bee specimens have been identified, the following information on each specimen should be entered into a spreadsheet or database

Core Fields

Country
Region
Locality
Site Number
Date and time when the trap or collecting event started
Date and time when the trap or collecting even was picked up or stopped
Latitude
Longitude
Indication of how precisely the Latitude and Longitude were determined
Collector
Genus
Species
Who identified the specimen
Date the identification took place
Who entered the record
When the data were entered
Notes field for weather, conditions, problems encountered, flowers blooming etc.
Unique number for the collecting event
Unique number for the individual specimen

Some Possible Optional Fields

Type of trap
Habitat
Physiographic Province
Flower information if you are collecting off of flowers

Maintaining Specimens

Specimens will degrade if exposed to UV light, pests, and excess humidity. Humidity can be controlled by using air conditioners in humid environments. Light can be controlled by keeping specimens in closed cabinets and boxes (note that UV light can come though most glass and is also generated by florescent lighting). Pests can be controlled by periodically freezing the collection (3 days at -10C) and by keeping the specimens in tightly fitting museum drawers and cabinets or by keeping them in smaller cardboard specimen boxes but enclosed in large resealable plastic bags (such as Ziploc bags).