

Tips on How to Use Bee Bowls to Collect Bees

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The Bowl

Bee Bowls are small colored plastic bowls or cups that are filled with soapy water. Bees are attracted to these colors, fly into the water, and drown. Bee bowling has evolved toward the use of smaller and smaller bowl sizes as it was realized that size of bowl was not necessarily correlated with capture rates (see <http://online.sfsu.edu/~beeplot/> for several reports that document those results).

Currently, we are no longer using bowls at all but items that are listed in plastic manufacturer's catalogs as soufflé cups. We are not aware of other manufacturer's lines, but Solo has a large selection of soufflé cups that we have experimented with. These cups usually come in their native translucent plastic color which is not at all attractive to bees. However the 3.25 oz. cup, which is steep sided and stable on the ground, does come in white (model number: p325w-0001) and appears to provide a better color base than the translucent ones.

The 0.75 oz. and perhaps the 2 oz. cups are nice sizes to carry around, but appear to lose too much water in hot, low humidity areas. The 1 oz. cups are more steep-sided and narrow (and therefore more unstable). This model may be worth investigating for use in desert areas. Small cups have the advantages of using much less water, being hard for the general public to see (but not apparently bees), and very cheap.

These cups usually need to be ordered or picked up from a local distributor and are almost always available only in case lots (usually that means about 2500 cups). Solo distributors can be located by calling 1-800-FOR-CUPS. The solo product line catalog is online and can be viewed at: www.solocups.com. The price for a case is usually in the \$50 to \$80 buck line.

Painting Bowls

Originally, when bowls rather than soufflé cups were being used, colored plastic bowls from party stores or other sources were used to capture bees. The usual colors were yellow, white, light blue, and dark blue. Those worked well, but fluorescent yellow and fluorescent blue were found to be much more effective in the East. However, Laurence Packer has found that cactus bees, especially *Macrotera*, seem to be attracted to dark blue and even red colored bowls. He didn't compare these with fluorescent colors, but both those colors collected more *M. texana* than did either white or yellow.

Unfortunately it was found that commercially available fluorescent spray and brush paints varied in their characteristics and availability by brand and location. In 2003 we experimented with creating a standardized fluorescent yellow and blue paint from scratch and have done so with the help of the Risk Reactor Company (800-803-5281) (**Link to**

specific pages for bee colors will go here) who can be contacted both for price and ordering information as well as a complete spec sheets that list this paint's components . The current formulation has an acrylic base (water-based). In 2004 we are working on adding surfactants to the base to see if we get better adhesion to the plastic bowls and cups.

Most paint does not stick well to plastic. Many commercial can spray paints have added compounds that do help with adhesion, but as with most commercial paints those formulations are proprietary. Additionally, if many bowls are being painted, a can of spray paint becomes both expensive and wasteful. We also found using liquid paint in compressed air spray guns to not be worth the cost and trouble. The paint inevitably clogged the sprayer (even when thinned) and it was difficult to coat all the sides and bottom uniformly. After much experimentation it was found that an oil-based primer needed to be painted on first before anything but the commercial spray can paints would stick to plastic bowls. We found that white primer looks the best as a base for fluorescent yellow and a gray primer (any good paint shop will tint your primer for free) works best for the fluorescent blue. However, even these primers often will bead up to some extent. Sanding the bowls also allows paint to stick, but takes too much time. We hope to have this more under control soon following our experiments with surfactants.

Using a brush to put on primer worked adequately for bowls, but not so well for cups. Two other techniques seemed to be faster and more complete. One technique was to don latex gloves and dip a bit of rag in the paint and rub it all over the cup or bowl. The other technique was to use a very small foam roller of the type often used in edging to apply the paint. This, in particular, worked well for applying the final coat of fluorescent paint. However, neither of these techniques seemed to consistently produce a particularly pretty paint job, usually there would be places remaining where the paint would not stick. So, if anyone comes up with a better means of painting these bowls we would love to hear about it. In 2003 we completed a series of small experiments that indicated that the amount of surface area painted did influence the number of bees captured. When bowls were placed next to each other the bowl with the more paint caught more bees. This may affect may disappear if bowls were spaced apart.

How to Set a Bowl Trap

A bowl trap is set when it is filled with soapy water and left outside. The soap decreases the surface tension so that even small insects are trapped if they land on the surface. Most insects stop moving within 60 seconds of hitting the water. However, we have found that many of these insects will wake back up if not either placed in alcohol for several hours or put in the freezer prior to pinning. We have noted that unpinning insects that do wake back up never regain normal behavior and usually simply stand or move very slowly following being in the trap.

Experiments have found that as long as there is water in the bowl or cup it will catch bees at about the same rate as one that is full to the top. However, in hot and arid climates bowls can dry out if not filled to the top or if they are too shallow. Currently we advocate

that people use either Blue Dawn Dishwashing soap or laboratory detergent. Lemon-scented detergents and ammonia appear to have decreased catch compared to these soaps. Laundry soaps have been tried and do work, but contain so many other fragrance chemicals that we fear that changes in formulation could easily change the catch. We have found it easiest to add a big squirt of soap directly to a gallon jug of water rather than adding soap to each bowl.

When using bowls to collect rather than monitor, it is often useful to leave them out for longer periods of time. Laurence Packer has found that propyl glycol will remain in the larger bowls for about 3 weeks even in early summer in the southern Atacama Desert. Under those long and windy conditions, digging the bowl into the substrate is necessary. Tenebrionids, scorpions and the occasional lizard may also be collected under these circumstances.

Several people have tried using urine instead of water in the bowls (bees in tropical areas are often attracted to urine soaked soils) but no great increase in catch was noted.

Sunny days are best for setting out bee bowls. The effects of temperature are unclear but catch appears to be reduced in the spring if temperatures are in the 50's F or below. However, in the fall temperature seems to have less impact. Cloudy days catch almost no bees, and rainy ones never catch bees.

Where to Set a Bowl Trap

The best places to put bee bowls are exposed open settings...places where bees are likely to see them. This includes almost all habitats. In North America the exceptions are woodlands once the spring blooming period for forbs and woody vegetation is over, and under any dense vegetation (e.g., thick cool season grasses, leafy shrubs). Open warm season grasslands often have good capture rates of bees if the grass overstory is not too thick. The general rule of thumb is that if you can easily see the bowl then bees can too. Flowers need not be apparent in an area in order for catches to be quite high. However, the presence of a superabundant nectar and pollen source (e.g., creosote bush or mesquite) often appears to lead to low bowl capture rates.

In tropical Central and South America Dave Roubik (Panama), Steve Javorek (Belize), and Gordon Frankie (Costa Rica) have all noticed that soapy water bowls capture almost no bees in closed canopy or canopy top situations (however, more extensive tests are warranted here), but are successful in open habitats. Roubik also has had good success with capturing stingless bees using a honey solution (or sucrose when honey is not available) either in bowls or sprayed on vegetation.

Laurence Packer writes about strategies for collecting bees in bowls: "When attempting to collect Xeromelissinae, some of which are oligolectic, I have often put pans out by suitable looking flowers en route to a different collecting spot. The success rate has been remarkably high and I have found males of species only collected by net as females, and females of species only collected by net as males using this method.

By placing pans adjacent to the flowers visited by oligolectic species. I have managed to collect samples directly into buffered formalin and absolute alcohol for histology and DNA respectively - though capture rates were not high, in a couple of hours a couple of pans of each collected enough for my needs.”

In general small bees are sampled well in bowls, but larger bees often need to be netted.

Most researchers put bowls out in strings rather than as single bowls. Capture rate per unit of field time is much higher this way. Once a location has been chosen in which to place bowls it takes relatively little additional time to place many bowls as compared to just one, particularly when compared to the cost of traveling to a new place. An internal study available from Sam Droege (301 497 5840, sam_droege@usgs.gov) indicated that the variances for characterizing the species richness of a single site may level out after 15- 30 bowls at one site. Bowls placed right next to each other have been shown to have reduced per/bowl capture rates. The specific distances at which capture rates among bowls equalizes or becomes insignificant for bees is unclear, it would appear, however, that per bowl capture rate may stop declining after even distances as short as 5m. In Brazil additional species were captured when bowls were elevated off the ground, but in the Eastern United States no additional species were captured and capture rates were much lower than bowls placed on the ground. In the East, when large black circles were added to the bottom of cups catch was decreased, while adding small *Andrena*-sized markings to a bowl did not change capture rates.

A procedure has been developed for monitoring bees on plots that is available at Gretchen LeBuhn’s bee monitoring web site (<http://online.sfsu.edu/~beeplot/>). A scheme for replicable monitoring or inventory of bees over larger landscapes is being developed by Sam Droege (sam_droege@usgs.gov). That design will likely include the superimposing of a grid over the landscape with numerous individual transects of 12-20 bowls taken within each grid in appropriate habitats and used as replicates. Because a completely random or systematic sampling scheme is impossible in most public/private landscapes, an effort will be made to GPS all points and collect habitat co-variates to permit counts to be adjusted over time.

How to Collect the Bees Once Trapped

At each bowl it usually best to pick out all moths, butterflies, and skippers as well as slugs, and very large bodied non-hymenoptera (e.g. grasshoppers and crickets). These groups tend to contaminate the other specimens when placed in alcohol. The next step is to dump the bees either into an aquarium net, sieve, or tea strainer. The key matter when choosing a particular type of bee strainer is that their mesh must be fine enough to catch the smallest of bees some of which may only be 2-4mm. If using an aquarium net, look specifically for brine shrimp rather than regular nets. In general most kitchen sieves are too coarse while most tea strainers have nice fine mesh.

Usually researchers pool all the bowls from one transect or plot rather than keeping individual trap data, as handling time increases greatly when collecting from individual bowls. Many researchers also wash the soap from their catch in the field using a squirt bottle, however, we have found that not to be necessary. Most researchers then store their catch in 70% alcohol in whirlpaks. We usually pick out the mass of insects in the net or strainer with our fingers and dump it into an individual whirlpak. However, Frank Parker uses a larger sized whirlpak along with a small tea strainer and then gives the strainer a sharp rap when in the bag to dislodge all the insects at once.

Isopropyl, ethyl, or denatured alcohols are all appropriate for storing insects, but isopropyl should never be mixed with the other alcohols. These alcohols can be found in drug or hardware stores. You can go to the pharmacy and almost always find small pint bottles of ethyl alcohol, ethanol, or denatured alcohol (they aren't very consistent in what they call them), if not, they will readily order it for you. At the hardware store they have gallon and pint jars of denatured alcohol (these are 100% alcohol and almost always contain a mix of 50% ethanol and 50% methanol). The drug store alcohol seems to be easier to work with as it is often made with a smaller amount of methanol and smells better.

Often the alcohol needs to be diluted to achieve the right percentage (70%). All hardware store alcohol should be considered to be 100% alcohol. Drug store alcohol can be close to 100% but also can be something less so you will have to read the bottle's label to check. To add confusion to the matter drugstores often label the percent alcohol in terms of "proof." Proof is a simple doubling of the percentage. Therefore 100 proof is 50% alcohol and 190 proof is 95% alcohol. To dilute from 100% alcohol to 70%, choose a convenient sized container, such as a pint bottle, then fill it ~70% full with alcohol and the rest with tap water. This measurement doesn't need to be exact.

The process for washing bees after they have been in alcohol is available at:
<http://online.sfsu.edu/~beeplot/>.

Bob Minckley has found that when he does collections from individual bowls it is useful to use clear plastic fishing lure boxes. The compartments can be numbered and individual bees picked out of bowls by hand and placed in the appropriate compartment. Afterwards, he freezes the entire container for at least 10 minutes to keep anything from re-awakening and then pins them straight from the box. Sometimes these specimens are more matted than ones that have been properly washed, but most of the time they are readily identifiable to species.

Another alternative to whirlpaks is to dump the catch into small numbered squares of cloth which are then rolled up and rubber banded together. Once back from the field these are collected, put into Ziploc bags and frozen until ready for pinning.

In all cases each bag, fishing box, or cloth should have a tag listing the sample location and date written on paper with pencil. Do not trust any kind of writing to stay on the outsides of a whirlpak bag as they inevitably get wet with alcohol or water and run.

A Few Little Efficiency Tips

When setting up for a day of putting out bowls we have found that it is helpful to make up your batches of bowls the day before and have them in a tray or box on the passenger seat. Wire flags (very useful for refinding your transects when driving at 60 mph) can be set in the passenger foot well. If working in a 4-door car we have found it fastest to keep the jug of soapy water on the back seat or on the floor of the back seat behind the driver. When the driver gets out they can grab a set of bowls and a flag in their right hand, open the door with their left hand, leap out of the car, pivot and grab the jug through the back window and then sprint off to put out bowls.

We have learned the hard way that getting into and out of the car many times a day to put out bee bowls can be hard on the human body. In particular it is hard on the left leg as it levers you into and out of the car and may lead to some slow healing muscle strains. The best way to get in is to sit down on the seat first and then swing both legs over. Getting out is the reverse operation swinging both legs out and then standing up.