Mortality During Bee Sampling , Consequences for Bee Populations with Particular Reference to proposed Threatened Species.

Mortality Associated with Traditional Bee Survey Techniques. The Pros and Cons

A good treatise and place to start on the Morality of Invertebrate Mortality can be found here:

http://animalstudiesrepository.org/cgi/viewcontent.cgi?article=1138&context=animsent

Cons (The General Case for Non-Lethal Techniques)

1. Lethal techniques result in the deaths of bees. Killing anything, from weeds to musk oxen, must consider moral, ethical, as well as scientific evidence that together weighs the impacts of using such techniques as well as the consequences of not using them.
2. The premature loss of any individual bee during collecting may have an impact on the resulting fecundity of that species the following year (note, this has never been demonstrated for any bee species, and as pointed out while possible is unlikely to occur).
3. Non-lethal identification techniques such as photography can provide vouchers for the occurrence of species in an area.
4. When working with known populations of endangered species, non-lethal techniques become more useful for the study of bees in the area but, if care is taken to minimize collection of the endangered species then lethal techinques can also be considered.
5. Field observations of highly visible bees such as some bumble bee species by experts and advanced amateurs using binoculars or net and release techniques can be a highly effective way to target survey the small subset of species identifiable with those techniques.

Pros (The General Case for Traditional Techniques)

1. You can sample both places and specimens more efficiently.
2. You are much more likely to detect rare/uncommon species.
3. These techniques are generally more easily replicated and repeated in the future by different observers, increasing the likelihood of statistically valid comparisons among sites and over time....i.e., it provides inventory and monitoring information.
4. Results from photographic and observation techniques are greatly impacted by the skill (and equipment) of the observer.
5. Traps can be put out any time, and can run concurrently, but field observations can only be collected during good weather and in only one place and one time period at a time (note: bees vary in their activity throughout daylight hours and populations shift throughout the season).

6. Most species of bees (75%?) cannot be identified in the field with binoculars or photographs because identification characters are microscopic and thus need to be seen under a microscope.
7. Identification of bees on the wing is difficult, few people have that skill set, and all people who have that skill vary in the level of their abilities, making comparisons, again, difficult.
8. The identifications of specimens collected and pinned can be double checked and corrected by experts at any future point.
9. Taxonomy of bees is still evolving and many new bee species are being discovered, even in Eastern North America, and collected specimens provide the opportunity to upgrade identifications in the future.
10. Collected specimens allow for additional studies of morphology, taxonomy, and DNA.
11. There are circumstances where non-lethal sampling can work well, but those are very few compared to other techniques.
12. Actual population sizes of native bees are vast compared to the numbers of specimens collected using trapping/netting techniques. For example, alfalfa growers typically buy around 30,000 leaf cutting bees per acre to pollinate just that one crop.
13. Under all but extraordinary circumstances it is impossible for trapping and netting techniques to impact the population size/viability of bees the following year (i.e., mortality from trapping/netting is compensatory and no studies have shown a negative effect the following year)
14. For broad based surveys of bee communities traditional techniques provide more specimens and higher quality surveys per unit time that are much more likely to detect species that could be of conservation concern than observational/non-lethal techniques.
15. The average bee has a flight period of 5 weeks, thus trapping/netting in one time period captures only a fraction of all the bees that emerge throughout the year.
16. Most field bees in summer and fall are eusocial bees in the Family Halictidae and, in a similar way to worker Bumble Bees, many of these bees captured are not reproductive.
17. Most solitary bees make a series of cells, each cell is independent of the other and not tended by the female following nest completion, and if the female dies (from being collected or natural sources) the cells created are "good to go." Thus, on average, only half a captured reproductive female's potential progeny output are affected by being captured.
18. Males do not provide parental care of any kind and thus their captures have little impact on the next generation.
19. Bees are abundant: As an example of what density of bees an environment can sustain in a year, a single hive of honeybees, produces, on average, in excess of 200,000 bees in a season. By contrast: A large scale survey captures bees in the hundreds (or fewer) at any individual location within a year and only 1% of those captures are, on average, honey bees.
20. Not collecting bees using netting/traps means that most species in a region go unrecorded and consequently, conservation planning or the identification of species of conservation concern, is not possible.

Some Context To Consider When Assessing Whether you Want to Use Lethal Techniques

When we focus on the loss of some bees during collecting we may lose sight of the bigger picture. Here are some things to keep in mind that should help put collecting in perspective.

1. Human-caused mortality factors for bees such as burning, plowing, mowing, the keeping of honey bees, the numbers and speeds of automobiles on roads are certainly higher than any collecting activities
2. Ag/chemical activities within a property put bees at huge risks for mortality via herbicides, fungicides, and pesticides via direct spraying or indirectly through the use of surfactants, large machinery compacting nesting locations, plowing up of nests in crop fields, dust and residue from plantings treated seeds and any spray blown onto surrounding non-crop habitat.
3. All vegetation management on a property ultimately both augments and depletes the different bee species present. Maintaining lawn rather than meadows, planting non-native plants, uncontrolled non-native weeds, overgrazing by deer, forest regeneration in open lands, and all manipulations that shift the vegetation species composition increases or favors "weedy" bee species and decreases uncommon bees of possible conservation concern that are often dependent on one species or genus of native plant for pollen.
4. The 3 classes of mortality factors listed above are responsible for many orders of magnitude greater impact to bees than that of the ephemeral collecting of bees for scientific or monitoring purposes. These impacts are long-term, causing permanent changes in bee populations in subsequent years. All current evidence indicates that collecting bee specimens is inconsequential in comparison to other sources or mortality and lack of collecting and the sponsorship of collecting deflects from the learning, conservation, and study of bees. The study of bees is still in the most rudimentary of stages compared to that of vertebrates and other insect groups such as butterflies. Without extensive collecting we will continue to practice bee conservation with little to no information about the bees that are actually present. Good conservation and management of native bees species requires that fundamental information.
5. Within NJ, PA, MD, DE, VA, WV we have estimated that 2.2 Trillion Bees are alive in any given year. A single healthy honey bee colony produces 250,000 bees in a year. The numbers of bees collected for study is quite small in comparison.

Specific issues surrounding the impacts to B. affinis from trapping and netting specimens:

This species is under investigation for Threatened/Endangered status. It was formerly very common and occurred through much of the East. It has not been collected now for many years in most parts of the country. Halting all bee collecting at any locality that was once part of the original range would increase the likelihood that any residual or new populations of B. affinis would go undetected. Detection of these populations is of high conservation priority and for the reasons expanded upon below, the collecting of one or two individuals is un-likely to have any impact on the overall population...but not collecting any bees in B. affinis range would be deleterious both for this species and the many other native bees that would go undocumented.

Within B. affinis' former range in the Mid-Atlantic Sam Droege has collected over 250,000 bees since 2000 (this sounds like a lot...but this is about the production of a single honey bee colony in one year), during that time he collected only one B. affinis in 2002 when the population was crashing, none since. If he had stopped using lethal techniques since that time his group would not have saved a single B. affinis from being killed because not a single additional specimen was collected. However, what was accomplished amounts to dozens

of papers, guides, surveys, lists for refuges, understanding of biology, monitoring manuals, several new species, and countless trainings of biologists all of which would not have occurred if collected were halted, significantly impacting conservation activities for all bees.

General Technique Suggestions for Collecting/Surveying Bees using Traditional Techniques both in and out of Areas with Active Populations of B. affinis.

1. Bowl traps (the primary survey technique for many groups) capture relatively few bumble bees and could be used in all locations, with consideration given to not using them at locations of known populations of B. affinis.
2. Net collecting could be used in any location, but at sites with active B. affinis, training and care need to be taken that B. affinis individuals are not collected.
3. Malaise traps can capture significant numbers of Bumble Bees and should not be used where active colonies of B. affinis are established, but are safe and useful to deploy elsewhere.
4. Blue vane traps (particularly when queens come out in the spring) can capture a great many Bumble Bees and should be used with caution. Likely they should be avoided during the times when queens fly in the spring, but could be deployed in small numbers at other times of year as they do provide information that other techniques do not. That said, there are reports of circumstances where large numbers of non-Bumble Bees have been collected with this technique and so further caution using this trap is warranted and certainly small numbers should be deployed at an individual site and the captures monitored.