



## Letter to the editor



## Successful bee monitoring programs require sustained support of taxonomists and taxonomic research

In resuscitating a proposal for a national bee monitoring program (see [LeBuhn et al., 2013](#)), [Woodard et al. \(2020\)](#) have cited the taxonomic bottleneck, and “long wait times to get specimens identified”, as a problem to be addressed. However, we believe their description understates the seriousness of the issue and that their proposed solutions fall short. Here, we clarify the causes of the bottleneck and its negative effects on bee monitoring and propose solutions.

The taxonomic bottleneck exists because there simply are not enough trained bee taxonomists employed professionally as taxonomists. And those that are so employed are being overwhelmed by the number of specimens *current* monitoring efforts are collecting. Monitoring is presently being done haphazardly at an ever-expanding number of sites by the widespread and proliferating use of passive traps which collect huge numbers of bees, some of which lie unexamined and unrecorded in insect drawers or are even discarded. This current program, without the expansion advocated by [Woodard et al. \(2020\)](#), yields many more specimens than professional taxonomists can possibly identify promptly ([Portman et al., 2020](#)).

The glut of unidentified specimens has resulted in an increasing number of bee identifications performed by amateurs with little or no supervision or confirmation by experts. The result is significant numbers of misidentifications. For example, a recent monograph on Michigan bees by [Gibbs et al. \(2017\)](#), includes discussions of multiple misidentified species and additional records that are likely erroneous. The misidentification problem is compounded by the widespread use of outdated taxonomic keys which do not incorporate recent taxonomic advances or unpublished species' additions known only to professional taxonomists. In the United States, there are hundreds of undescribed and poorly known bee species as well as numerous cryptic species, even in taxa that are common and purportedly well-known ([Gonzalez et al., 2013](#)). This problem is particularly acute in such unrevised genera as *Sphecodes* and *Nomada*, where even identifications by taxonomists must be viewed as “speculative” ([Gibbs et al., 2017](#)). Misidentification by tyros using out-of-date resources hampers or even invalidates the results of monitoring efforts because, for many species, especially uncommon ones, the *resultant population estimates and trends* are meaningless.

Several policies must be followed if monitoring efforts are to be successful. The lack of jobs and funding for bee taxonomists, indeed taxonomists in general, is widespread and decades old (e.g., [Futuyma, 1998](#)) and must finally be addressed now. First, those trained bee taxonomists in the U.S. who either lack permanent positions or are working in non- taxonomic positions should be hired to practice their profession by federal and state institutions. Second, researchers requesting funding for monitoring projects should be required to budget for full-time professional taxonomic expertise. Third, looking ahead, it is critical that more professional bee taxonomists be trained for the future, but only if

there are jobs for them to fill. We must recognize that professional expertise is necessary for successful monitoring efforts and that it is acquired only through years of study and research.

Others (e.g. [Packer et al., 2018](#)) have proposed policies to help taxonomists succeed in their dual roles of identifying specimens and pursuing taxonomic research. These include: 1. Paying taxonomists for their identifications; 2. Requiring grants to budget funds for essential identifications; 3. Authorship for taxonomists and others who have performed identifications; 4. Make funding taxonomic research a priority of government agencies. [Woodard et al. \(2020\)](#), suggested increasing digitization of collections and expanding the American Museum of Natural History Bee Course. However, while helping to support practicing taxonomists and their institutions, none of these suggestions will bring additional professionals to the bench. Other proposed solutions, such as new molecular identification tools, still require expert taxonomic confirmation to be useful.

We appreciate that [Woodard et al. \(2020\)](#) highlighted the diversity of non-domesticated bees and their importance as pollinators, not only of wildland plants but of crops as well. Wild bees are an irreplaceable resource, and if their populations are to be monitored in the interests of conservation then it behooves researchers to gather data that is robust and meaningful. That can only be done if trained taxonomists are involved in identifications as well as funded to update our woefully incomplete and out-of-date taxonomic resources.

### Declaration of competing interest

The authors declare no conflict of interest.

### References

- Futuyma, D.J., 1998. Wherefore and whither the naturalist? *Am. Nat.* 151, 1–6. <https://doi.org/10.2307/2463288>.
- Gibbs, J., Ascher, J.S., Rightmyer, M.G., Isaacs, R., 2017. The bees of Michigan (Hymenoptera: Apoidea: Anthophila), with notes on distribution, taxonomy, pollination, and natural history. *Zootaxa* 4352, 1–160. <https://doi.org/10.11646/zootaxa.4352.1.1>.
- Gonzalez, V.H., Griswold, T., Engel, M.S., 2013. Obtaining a better taxonomic understanding of native bees: where do we start? *Syst. Entomol.* 38, 645–653. <https://doi.org/10.1111/syen.12029>.
- LeBuhn, G., Droege, S., Connor, E.F., Gemmill-Herren, B., Potts, S.G., Minckley, R.L., Griswold, T., Jean, R., Kula, E., Roubik, D.W., Cane, J., Wright, K.W., Frankie, G., Parker, F., 2013. Detecting insect pollinator declines on regional and global scales. *Conserv. Biol.* 27, 113–120. <https://doi.org/10.1111/j.1523-1739.2012.01962.x>.
- Packer, L., Monckton, S.K., Onuferko, T.M., Ferrari, R.R., 2018. Validating taxonomic identifications in entomological research. *Insect Conserv. Divers.* 11, 1–12. <https://doi.org/10.1111/icad.12284>.
- Portman, Z.M., Bruninga-Socolar, B., Cariveau, D.P., 2020. The state of bee monitoring in the United States: a call to refocus away from bowl traps and towards more effective methods. *Ann. Entomol. Soc. Am.* 113, 337–342. <https://doi.org/10.1093/aesa/saaa010>.

<https://doi.org/10.1016/j.biocon.2021.109080>

Received 7 December 2020; Accepted 11 March 2021

Available online 23 March 2021

0006-3207/© 2021 Elsevier Ltd. All rights reserved.

Woodard, S.H., Federman, S., James, R.R., Danforth, B.N., Griswold, T.L., Inouye, D.W., McFrederick, Q.S., Morandin, L., Paul, D., Sellers, E., Strange, J.P., Vaughan, M., Williams, N.M., Branstetter, M., Burns, C., Cane, J., Cariveau, A., Cariveau, D., Childers, A.K., Childers, C.P., Cox-Foster, D.L., Evans, E., Graham, K.K., Hackett, K. J., Huntzinger, K., Irwin, R.E., Jha, S., Lawson, S.P., Liang, C., Lopez-Urbe, M.M., Melathopolous, A., Moylett, H., Otto, C.R., Ponisio, L., Richardson, L.L., Rose, R.L., Singh, R., Wehling, W., 2020. Toward a U.S. national program for monitoring native bees. *Biol. Conserv.* 252, 1–6. <https://doi.org/10.1016/j.biocon.2020.108821>.

Zachary M. Portman<sup>a,\*</sup>, Vincent J. Tepedino<sup>b</sup>

<sup>a</sup> *Department of Entomology, University of Minnesota, 1980 Folwell Avenue, 219 Hodson Hall, St. Paul, MN 55108, United States of America*

<sup>b</sup> *Department of Biology, Utah State University, UMC-5305, Logan, UT 84322-5305, United States of America*

\* Corresponding author.

E-mail address: [zportman@umn.edu](mailto:zportman@umn.edu) (Z.M. Portman).