NEWS & VIEWS

American Journal of Botany

ON THE NATURE OF THINGS: ESSAYS
*New Ideas and Directions in Botany*

# Scaling up public engagement in botanical research

Austin R. Mast[1,3] and Elizabeth R. Ellwood[2]

Manuscript received 15 December 2017; revision accepted 27 February 2018.

[1] Department of Biological Science, Florida State University, 319 Stadium Drive, Tallahassee, FL 32306, USA

[2] La Brea Tar Pits & Museum, Natural History Museum of Los Angeles County, 5801 Wilshire Blvd, Los Angeles, CA 90036, USA

[3] Author for correspondence (e-mail: amast@bio.fsu.edu)

**Citation**: Mast, A. R. and E. R. Ellwood. 2018. Scaling up public engagement in botanical research. *American Journal of Botany* 105(4): 628–630.

**doi:10.1002/ajb2.1075**

Public engagement in botanical research has the potential to simultaneously advance research, science literacy, research sustainability, and workforce diversification goals, if strategies are carefully crafted and implemented to do so. Here, we briefly explore the present and future of projects engaging the public in authentic science (e.g., producing data fit for research use) in which the public is motivated by something other than payment. The engagement might be voluntary or not quite so (e.g., when part of a classroom exercise). Some projects engage the public in the data collection step alone ("contributory" projects), whereas others involve the public in the framing of the scientific question, the write-up of the work, and steps in between ("co-created" projects; Shirk et al., 2012). "Citizen science" and "crowdsourcing" are recently coined, commonly applied terms to this public engagement in science, but other terms are also used (Eitzel et al., 2017). Our intention in this article is to provide a catalyst for professional botanists to find new success with public participation in their research with a few of our own observations, rather than provide an expansive review of the topic, no matter what label is applied to it.

The botanical community has a long history of public engagement, especially through volunteer programs at museums and herbaria. However, new resources have transformed the community's abilities to involve public participants, enabling greater scales of engagement and greater effectiveness. Expansions in scale have largely been driven by cyberinfrastructure and media attention. Best-in-class examples of online resources include the public engagement platform Zooniverse.org, the project management platform CitSci.org, the go-to site for the public to learn about science engagement opportunities SciStarter.org, and the mobile app iNaturalist. Boosts in public awareness of opportunities have come with, e.g., *Discover Magazine's* Citizen Science Salon blog and the documentary series *The Crowd & The Cloud*. Greater effectiveness has largely been driven by the formalization of the community involving the public in science, such as the creation of several citizen science organizations around the world (e.g., the Citizen Science Association in the United States, the European Citizen Science Association, and the Australian Citizen Science Association), and the peer-reviewed journal *Citizen Science: Theory and Practice*.

Even greater advances are being fueled by investments at the federal level in the United States (see the National Science Foundation [NSF] Agency Priority Goal for FY 16–17: Invest strategically in public participation in science, technology, engineering, and mathematics research; Kurose et al., 2017). A search of active NSF grants using "PPSR" (Public Participation in Science, Technology, Engineering, and Mathematics Research), "citizen science", and "crowdsourc" produced 70, 301, and 196 results, respectively, on 13 February 2018. Encouragingly, 13 of these fell into a broadly circumscribed domain of botanical research, but there is certainly room for the botanical community to grow beyond this modest percentage of total grants.

Demonstrated opportunities to powerfully advance botanical research exist, especially in the areas of floristic surveys (often, though not always, organized as "bioblitzes"), invasive species surveys, phenological surveys, and the digitization (e.g., databasing) of herbarium specimens. Each of these areas benefits from making data collection massively parallel (i.e., done in a standard way by

many people at the same time) and so has attracted a critical mass of interested parties to produce data standards (e.g., Willis et al., 2017, for phenology), best practices (e.g., Meier et al., 2009, and citations therein for phenology), and cyberinfrastructure (e.g., USA National Phenology Network, usanpn.org). Those public engagement activities reasonably promise data sets of unprecedented geographic, taxonomic, and temporal scales, but successful engagement of the public in scientific research can have simpler goals (e.g., curation of an herbarium). In fact, it is important to recognize that public motivation to participate might be stirred by goodwill toward a local science resource or interest in (or perhaps concern for) the local flora, as has been historically demonstrated by herbarium and museum volunteer programs. These place-based public motivations (where place is small scale, rather than Earth) might actually be quite prevalent (e.g., see Newman et al., 2017) and will need to be addressed in project design as scientists perhaps head in the opposite direction with their ambitions for broadened geographic scope in public-enabled research.

At this point, you might be ready to develop a new public engagement component to your research but are wondering how to start. We offer four suggestions. First, the Cornell Laboratory of Ornithology hosts a thorough, though perhaps slightly dated, *Citizen Science Toolkit* (http://www.birds.cornell.edu/citscitoolkit/toolkit) for designing new projects. The kit's initial step involves assessing existing projects (e.g., at SciStarter.org) so as not to reinvent wheels. Several public participation projects have matured to the point where they offer robust cyberinfrastructure tools (e.g., Biospex.org and NotesfromNature.org) and popular events (e.g., the annual Worldwide Engagement for Digitizing Biocollections event; Ellwood et al., 2018) to make opting into public engagement relatively easy (in these examples, for digitizing herbaria; Ellwood et al., 2015). You will benefit from identifying those resources early. Second, a build-it-and-they-will-come approach is unlikely to be successful. Identify one or more existing organizations with missions that align to your science goals, and start a conversation early on with the organization's leadership and education/outreach professional with the goal of reaching organizational buy-in for later joint appeals to the organization's membership for participation. For the botanical community, these organizations could include garden clubs, agricultural and horticultural extension programs, soil and water conservation districts, environmental education nonprofits, and state and federal parks and forest services. Identify how the core science activity could be used to advance the organization's mission and create the missing resources to do so. We took this approach with the WeDigFLPlants project (https://biospex.org/project/wedigflplants), which aims to complete the historical baseline for Florida's flora by digitizing all Florida-collected plant specimens, irrespective of where in the world they are curated. WeDigFLPlants started as a partnership between Florida herbaria still digitizing their collections and the Florida Native Plant Society, but we have since worked to engage Florida's Master Naturalist and Master Gardeners Programs and other partners (e.g., iDigBio and Florida's high school science teachers) in creating useful resources (e.g., lesson plans and videos) to layer on top of the core digitization activity at Notes from Nature. Third, familiarize yourself with program evaluation and take it seriously. An excellent place to start is the *User's Guide for Evaluating Learning Outcomes from Citizen Science* (Phillips et al., 2014), but you might wish to round out your understanding of evaluation with resources at the Center for Advancement of Informal Science Education (informalscience.org), especially if you are preparing a grant proposal on this topic. Fourth, plan to do strategic planning for your project once you are a year or two into it. Among other things, such planning involves identifying the project's stakeholders, writing or revising the mission and vision statements, formalizing goals and strategy, planning for sustainability, and reassessing evaluation strategies. Unfortunately, there are few strategic planning resources specifically tailored to public participation in scientific research projects, but we are hopeful that these might grow as citizen science organizations build momentum.

We end by advocating for greater formal cross-fertilization of ideas between the botanical research community and the professional community forming around a shared focus on involving the public in science. The several new citizen science organizations regularly host conferences (e.g., future Citizen Science Association conferences can be found listed on its website) and support working groups (e.g., the Citizen Science Association's Data and Metadata Working Group) of potentially broad interest in the botanical research community. Should this be a new front in your research, we encourage you to participate individually in those activities. However, we also encourage professional organizations to make interactions between the two communities easier. For example, an active exhibit exchange program between the Botany and Citizen Science Association conferences, where staffed booths highlight relevant activities of the constituent organizations could be a valuable catalyst for new projects. The time is right to empower the botanical community to effectively scale up public engagement in research.

## ACKNOWLEDGEMENTS

We thank two anonymous reviewers for their suggestions. This material is based upon work supported by the National Science Foundation under Cooperative Agreement Numbers DBI-1115210 and DBI-1547229 and Grant Numbers DBI-1458550 and DBI-1410288. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

## LITERATURE CITED

Eitzel, M., J. L. Cappadonna, C. Santos-Lang, R. E. Duerr, A. Virapongse, S. E. West, C. C. M. Kyba, et al. 2017. Citizen science terminology matters: Exploring key terms. *Citizen Science: Theory and Practice* 2: 1.

Ellwood, E. R., B. A. Dunckel, P. Flemons, R. Guralnick, G. Nelson, G. Newman, S. Newman, et al. 2015. Accelerating the digitization of biodiversity research specimens through online public participation. *BioScience* 65: 383–396.

Ellwood, E. R., P. Kimberly, R. Guralnick, P. Flemons, K. Love, S. Ellis, J. M. Allen, et al. 2018. Worldwide engagement for digitizing biocollections (WeDigBio)—the biocollections community's citizen science space on the calendar. *BioScience* 68: 112–124.

Kurose, J., J. Lewis, B. Johnson, R. Wakimoto, J. Ulvestad, F. Cook, and R. Keiser. 2017. Dear colleague letter: public participation in science, technology, engineering, and mathematics research: capacity-building, community-building, and direction-setting [online]. Website: https://www.nsf.gov/pubs/2017/nsf17047/nsf17047.jsp [access 15 Dec 2017].

Meier, U., H. Bleiholder, L. Buhr, C. Feller, H. Hack, M. Heß, P. D. Lancashire, et al. 2009. The BBCH system to coding the phenological growth stages of plants—history and publications. *Journal für Kulturpflanzen* 61: 41–52.

Newman, G., M. Chandler, M. Clyde, B. McGreavy, M. Haklay, H. Ballard, S. Gray, et al. 2017. Leveraging the power of place in citizen science for effective conservation decision making. *Biological Conservation* 208: 55–64.

Phillips, T., M. Ferguson, M. Minarchek, N. Porticella, and R. Bonney. 2014. User's guide for evaluating learning outcomes in citizen science. Cornell Lab of Ornithology, Ithaca, NY, USA.

Shirk, J. L., H. L. Ballard, C. C. Wilderman, T. Phillips, A. Wiggins, R. Jordan, E. McCallie, et al. 2012. Public participation in scientific research: A framework for deliberate design. *Ecology and Society* 17: 29.

Willis, C. G., E. R. Ellwood, R. B. Primack, C. C. Davis, K. D. Pearson, A. S. Gallinat, J. M. Yost, et al. 2017. Old plants, new tricks: Phenological research using herbarium specimens. *Trends in Ecology & Evolution* 32: 531–546.