

Special Issue on Innovation 2018

Untapped: Accessing Extension to Strengthen Connections Between Citizen Science and Community Decision Making

Abstract

Citizen science is on the rise, and Extension is poised to support this movement by offering technical assistance to citizen science programs, communities, federal partners, and researchers. The expansion of citizen science provides an opportunity for fostering innovative access to Extension resources and increasing engagement with new audiences. To encourage capitalization on this opportunity, we outline Extension's traditional strengths and connect them to the needs of citizen science programs, offer examples of Extension-based citizen science programs that are working with communities to make natural resource management decisions, and make suggestions for ways in which Extension's technical assistance can be shared with the citizen science community to build new partnerships.

Keywords: [citizen science](#), [public participation in scientific research](#)

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Introduction

Citizen science, the involvement of volunteers in scientific research, has existed for thousands of years (Miller-Rushing, Primack, & Bonney, 2012; Shuttleworth, 2015), but the field of citizen science has grown dramatically and continues to expand to include new communities and uses. Extension, with its national cadre of volunteers, is an untapped resource for supporting this expansion. With the county-based national reach of the Extension system, we in Extension are well placed to integrate citizen science in communities across the country to facilitate projects that address community needs. We propose a vision for Extension's role in the field of citizen science: "Capitalizing on our strengths and existing expertise, Extension will

coordinate a national effort to link citizen science programs with our communities and play a key role in supporting those programs in our communities."

A Citizen Science Resurgence

In recent years, the field of citizen science has mushroomed as online tools and mobile technologies increase access to research tools and professionals realize the value of engaging the public in research (Dickinson et al., 2012; Pocock, Tweddle, Savage, Robinson, & Roy, 2017). Researchers value the increase in the scale of research that citizen science offers, allowing them to gain access to observations over larger areas and timescales than would be feasible working with professionals or students alone (McKinley et al., 2017). Involving volunteers in research may bring new perspectives into the scientific process, opening up new lines of inquiry and making scientific research more relevant to local communities' and the broader society's needs (Chari, Matthews, Blumenthal, Edelman, & Jones, 2017). Funding agencies such as the National Science Foundation are putting increasing importance on broader impacts in research proposals, with citizen science promoted as an approach to engaging people in and providing education on the science process (National Science Foundation, 2014).

Furthermore, new organizations and federal resources have begun providing structure for the citizen science field. The Citizen Science Association (CSA) formed in the United States in 2014 in parallel with similar organizations, including the European Citizen Science Association and the Australian Citizen Science Association (Storksdieck et al., 2016). The CSA launched a peer-reviewed journal to promote evidence-based best practices in developing, sustaining, and evaluating citizen science projects. Following a 2015 White House forum on crowdsourcing and citizen science, the U.S. Congress passed the American Innovation and Competitiveness Act (2017), giving federal agencies the authority to use citizen science to advance their missions. The Federal Crowdsourcing and Citizen Science Toolkit website (<https://www.citizenscience.gov/toolkit>) showcases projects from a wide range of federal agencies, such as the U.S. Environmental Protection Agency and U.S. Geological Survey, and disciplines, including projects focused on sensing earthquakes (Did You Feel It), detecting animal diseases (Enhanced Passive Surveillance System), monitoring monarch butterflies (Monarch Larva Monitoring Project), transcribing historical documents (Smithsonian Transcription Center), and tracking seasonal plant changes (Budburst).

Citizen science also offers potential benefits to society beyond the research community, opening up science to more diverse participation (Pandya, 2012; Soleri, Long, Ramirez-Andreotta, Eitemiller, & Pandya, 2016), offering opportunities for authentic science, technology, engineering, and math (STEM) learning by people of all ages (Masters et al., 2016; Zoellick, Nelson, & Schauffler, 2012), and democratizing science by broadening participation in the scientific process (Bäckstrand, 2003; Chari et al., 2017). Furthermore, citizen science research has the potential to connect more directly to community decision making by informing environmental policy, natural resource management, and land stewardship discussions (Ballard et al., 2017; Newman et al., 2017).

Connecting research to community decision making builds on principles in sustainability science that stress the importance of linking knowledge (research) to action (decision making) in order to solve the complex social and biological problems facing our world today, such as loss of biodiversity, poverty, and climate change (van Kerkhoff & Lebel, 2006). We suggest that Extension can lead innovation in the field of citizen science by promoting two-way connections between professional researchers and the communities that may

benefit from research.

Citizen Science and Extension Traditions

Extension has integrated volunteers in scientific research for decades, though, in most cases, terms other than citizen science have described the programs. For example, the New Hampshire Lakes Lay Monitoring Program, founded in 1978, works with lake association volunteers to collect monthly water samples. University researchers analyze the samples and share the data with local lake associations to inform management and decision making. Similar water quality monitoring programs for lake, river, and coastal ecosystems exist throughout the country, many of them based in or collaborating with Extension programs (Extension Volunteer Monitoring Network, n.d.). In recent years, citizen science has emerged as a program theme in such Extension programs such as Virginia Master Naturalists at Virginia Cooperative Extension, Coastal Research Volunteers (CRV) at University of New Hampshire (UNH) Cooperative Extension, 4-H Citizen Science at University of Illinois Extension, and Driven to Discover at University of Minnesota Extension.

Whereas recent work has suggested that Extension programs in 4-H, natural resources, agriculture, and community development can benefit from easily accessible citizen science programs and tools (Stofer, 2017), we suggest also that the history, experience, and tradition of Extension can contribute unique insights and values to the broader field of citizen science. In particular, we outline Extension's expertise in volunteer management, science communication, needs-based programming, and relationships with both academic researchers and community organizations.

Expertise in Volunteer Management

For more than 100 years, Extension has involved community volunteers in virtually all program areas, and the organization continues to invest in volunteers. For example, UNH Cooperative Extension has added three new volunteer programs in the last 5 years (University of New Hampshire Cooperative Extension, 2016b). Volunteer involvement continues to grow throughout Extension, with programs such as master naturalists seeing annual increases in the number of active volunteers (Blanton, Crall, Prysby, Mellor, & Brown, 2014; Texas Master Naturalist Program, n.d.). Extension has expertise in volunteer management throughout its staff across many disciplines. In contrast, many citizen science programs originate in state agencies, nonprofits, or academic research laboratories, which may have little experience or expertise in working with volunteers and may assume that working with volunteers means garnering "free labor." New models such as those represented by CRV or master naturalist programs suggest that partnerships between Extension and researchers or agencies looking to work with citizen science volunteers offer strong potential for increased citizen science participation and more effective, organized, and sustainable citizen science projects.

Science Communication

One of Extension's core missions is to translate science for practical application (U.S. Department of Agriculture National Institute of Food and Agriculture, n.d.). This skill is essential in citizen science practice, where iterative discussions about science questions, protocols, and methods and skilled training of volunteers are integral to successful, high-quality research with volunteers (Wiggins, Newman, Stevenson, & Crowston, 2011). Within Extension–citizen science partnerships, Extension professionals work to bridge academic language for volunteer audiences and connect research questions to their real-world implications. Extension

professionals have experience publishing science-based communications through the media, potentially making citizen science methods and results more approachable for a broad audience.

Needs-Based Programming

Of the three recognized categories of citizen science—participatory, collaborative, and cocreated (Shirk et al., 2012)—the latter type requires a level of connection between scientists and volunteers that is relatively rare in today's scientific community (Dempsey, 2009; Miller-Rushing et al., 2012). Extension's traditional method of using community needs assessments to inform programming has promise for informing cocreated citizen science, whereby community members cocreate research with scientists to address local problems. In particular, Extension's role as a bridge between academia and the broader community positions Extension as the potential facilitator of such cocreated, needs-based programming. It is this type of collaboration, in which scientists, community members, and decision makers work together to cocreate locally relevant research programs, that is most likely to inspire community action based on science research (Cvitanovic, McDonald, & Hobday, 2016).

Relationships with Academic Researchers and Community Organizations

Citizen science programs are based in a wide variety of institutions, including academic research labs, not-for-profit groups, museums, and public agencies. Extension, based at land-grant universities but simultaneously well connected to community organizations and public agencies, is optimally positioned to build partnerships for citizen science among all these sectors. For example, UNH Cooperative Extension's Nature Groupie initiative serves as a community connector by linking more than 200 New England organizations to volunteers through an online hub. Virginia Cooperative Extension's Virginia Master Naturalist program connects its volunteers to conservation projects, including citizen science projects, organized by seven state agency partners and more than 300 other local partner organizations.

Extension agents can serve as brokers (Kumar Chaudhary & Warner, 2015; Peters, 1992) between academic research and community organizations in at least two ways. First, for existing projects where lead researchers need local expertise and/or volunteers to help with project activities such as data collection, Extension agents can serve as connectors to the right groups of people for meeting those needs. Alternatively, if a local organization has a problem or a research question, Extension agents can locate professional experts to consult and/or help the community members design their own data collection and analysis. As Extension is truly an example of university and community engagement due to the "mutually beneficial nature of [their] exchange" (Atiles, 2017, para. 7), existing relationships would allow Extension to build new programs into existing partnerships and set Extension up to create relationships and programs for new communities (Kumar Chaudhary & Warner, 2015).

An Innovative Role for Extension: Technical Assistance in Citizen Science

Across topic areas, Extension offers technical assistance to landowners, communities, farmers, businesses, public agencies, individuals, and volunteers. This tradition of bringing resources and research to varied audiences offers Extension professionals in the field of citizen science a new avenue that has the potential to

strengthen and support the larger citizen science community. In particular, Extension can provide technical assistance with citizen science practices such as (a) recruiting, training, and managing volunteers; (b) sharing citizen science best practices through communication, research codesign, and consultation; (c) sharing educational resources on project-related topics; (d) disseminating data and research findings; (e) facilitating partnerships at all stages; and (f) moving science to action.

Volunteer Recruitment

With widespread and prolific volunteer programs across many topic areas (e.g., gardening, STEM, natural resources, community development, water resources), Extension can bolster the citizen science movement by promoting and partnering with citizen science efforts, particularly those aimed at researching and monitoring locally relevant topics. For example, the Great Sunflower Project, a national native bee monitoring and pollinator habitat management project based at the University of San Francisco, promoted its citizen science volunteer opportunities to master gardeners in multiple states. Access to a relevant Extension volunteer network resulted in exponential growth in data contributions and a corresponding increase in the number of habitat improvement projects measured through the project's database system (G. LeBlanc, personal communication, May 18, 2017).

Volunteer Training and Management

With its large number of volunteer programs, Extension could contribute expertise and materials related to how to train and manage volunteers to the citizen science community, either in partnership with citizen science programs or as speakers or educators at volunteer training sessions. Extension is already providing these types of materials in the field of water quality monitoring through the USA Volunteer Water Monitoring Network, including guides for starting new programs, training volunteers, and growing existing local water quality monitoring programs.

Best Practices for Citizen Science

Despite new leadership and organization around citizen science in the United States, new advances in the field are still slow to reach the local organizations, agencies, and researchers who could benefit from them. Extension educators can play a role in sharing best practices for citizen science similar to the way they share best practices in the fields of agriculture, nutrition, or forest management. Outreach publications, trainings, or conference sessions could provide research-based information on effective citizen science techniques, such as how to design protocols, support volunteer learning, share results, and evaluate programs; one such example is the "Tips for Working with Citizen Science Volunteers" fact sheet created by UNH Cooperative Extension (Clyde, 2015).

Citizen Science Protocol Design

The science expertise of Extension staff is a valuable asset for communities looking to cocreate citizen science projects. Extension can provide expertise to community-based projects by vetting project methods, including quality-assurance and quality-control procedures, to increase confidence in volunteer-collected data. Furthermore, by combining technical expertise with an understanding of volunteer needs, Extension can

work with research partners to develop citizen science–friendly protocols. For example, UNH Cooperative Extension's CRV program partnered with the New Hampshire Fish and Game Department (NHFG) to increase the number of sites that conduct federally required eel surveys. CRV staff worked closely with NHFG prior to the project's start to modify the agency's protocol to both satisfy the research agenda and be workable by volunteers. Modifications included developing an alternative fish anesthetic agent to decrease risk to volunteers, revising the methods language, developing additional support materials, and removing noncritical components of the protocol.

Selection and Provision of Educational Resources

For many citizen science programs, volunteers' interest in learning about the subject matter of the project is a significant motivator for participation (Kragh, 2016). Extension has access to a wide variety of educational materials and learning opportunities, such as workshops, fact sheets, videos, and web-based resources, to augment hands-on citizen science efforts. Providing accurate, research-based educational materials when training volunteers may contribute to stronger commitments or greater levels of confidence in the project subject matter among volunteers.

Facilitation of Partnerships

Community partners, public agencies, and university faculty identify Extension as an important convener (University of New Hampshire Cooperative Extension, 2016a). Building strong partnerships is central to Extension's programs and mission (Franz, 2003). Partnerships with academic faculty, community organizations, or public agencies form the basis of many of Extension's existing citizen science programs. UNH Cooperative Extension's citizen science programs offer examples of diverse partnerships: CRV partners with academic researchers to implement coastal citizen science projects, the Lakes Lay Monitoring Program works with lake associations to better understand lake health, and NH Rabbit Reports works with the NHFG to determine the distribution of rabbit species in New Hampshire. Extension staff in a wide variety of fields could consider citizen science partnerships as a new avenue for strengthening community and academic relationships at county and state—and even national—levels. Recent events highlight the prospect of bringing potential new partners together around the subject of citizen science. In December 2017, University of Minnesota Extension held a Citizen Science Symposium to convene current and potential citizen science practitioners. Also in December 2017, UNH Cooperative Extension hosted "Stories from the Field: Celebrating Citizen Science in NH," where volunteers trained as storytellers shared their passion for and experiences with citizen science.

Links Between Citizen Science and Community Decision Making

Extension is well placed to facilitate connections between citizen science data and the community decisions that may be informed by those results. Whereas citizen science has often been about data collection for scientific purposes (Dempsey, 2009; Miller-Rushing et al., 2012), Extension can build on its strengths in science communication and community needs assessments to help forge a link between citizen science data and local stewardship, management, or policy needs. Further, citizen science projects often fall short at motivating action, either by volunteers who could make changes to their own behaviors after participating and seeing data or by government agencies that make relevant decisions (Converse, Shaw, Eichhorst, &

Leinhart, 2016; Research Triangle Environmental Health Collaborative, 2016). Extension can serve as a facilitator by codesigning citizen science projects, or designing educational materials to accompany citizen science projects, that encourage behavior changes based on project results.

A Vision for Citizen Science and Cooperative Extension

We have said that Extension is untapped. Below we outline some steps for moving toward our vision for innovation, tapping into Extension's citizen science expertise to engage with a broader community.

Extension faculty interested in getting their audiences involved in existing projects can take the following actions:

- Access existing citizen science resources and collaborations within and beyond Extension (Stofer, 2016).
- Join the eXtension citizen science electronic mailing list (Stofer, 2016).
- Reinforce with existing Extension volunteers involved in science research projects that they are citizen scientists, connecting their work and identity to the broader international movement.
- Integrate citizen science into existing volunteer programs, such as master gardener, master naturalist, 4-H, and other community efforts. Access these projects through local connections or national resources (Stofer, 2016).

Extension faculty who want to champion the broader movement of citizen science in Extension can take the following actions:

- Become active in CSA by becoming a member, participating in its active electronic mailing list, and/or attending the CSA conference. Another option is to sponsor workshops or meet-ups at future conferences; an informal census at the 2017 conference showed attendance by over 25 Extension staff.
- Consider implementing citizen science approaches in program areas beyond natural resources (e.g., working with volunteers in family and community health; see Washburn, 2017).
- Explore partnerships with social science researchers to investigate the use of citizen science to influence behavior or community change.

The next eXtension citizen science fellow can take the following actions:

- Develop a citizen science track at national Extension conferences (e.g., National Extension Conference on Volunteerism, meeting of the Association of Natural Resource Extension Professionals).
- Create a contact list of Extension professionals involved in citizen science and promote it within the larger citizen science community to facilitate partnerships and provide technical assistance.
- Explore the potential for developing a master citizen scientist program to train community volunteers to facilitate new collaborative citizen science efforts (Stofer, 2016).

- Develop coordinated opportunities for shared learning and advancement among Extension professionals, potentially through use of an eXtension learning network, support for conferences, or support for virtual conferences.

To create national synergy for citizen science in Extension, administrators and partners can provide funding and institutional support for the efforts outlined above.

Sometimes innovation is not about building something from scratch but rather using existing objects or expertise in new ways. Extension has supported citizen science for many years, but the time is right for true innovation that will not only broaden Extension's reach and impact but also contribute to larger global efforts for sustainability.

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