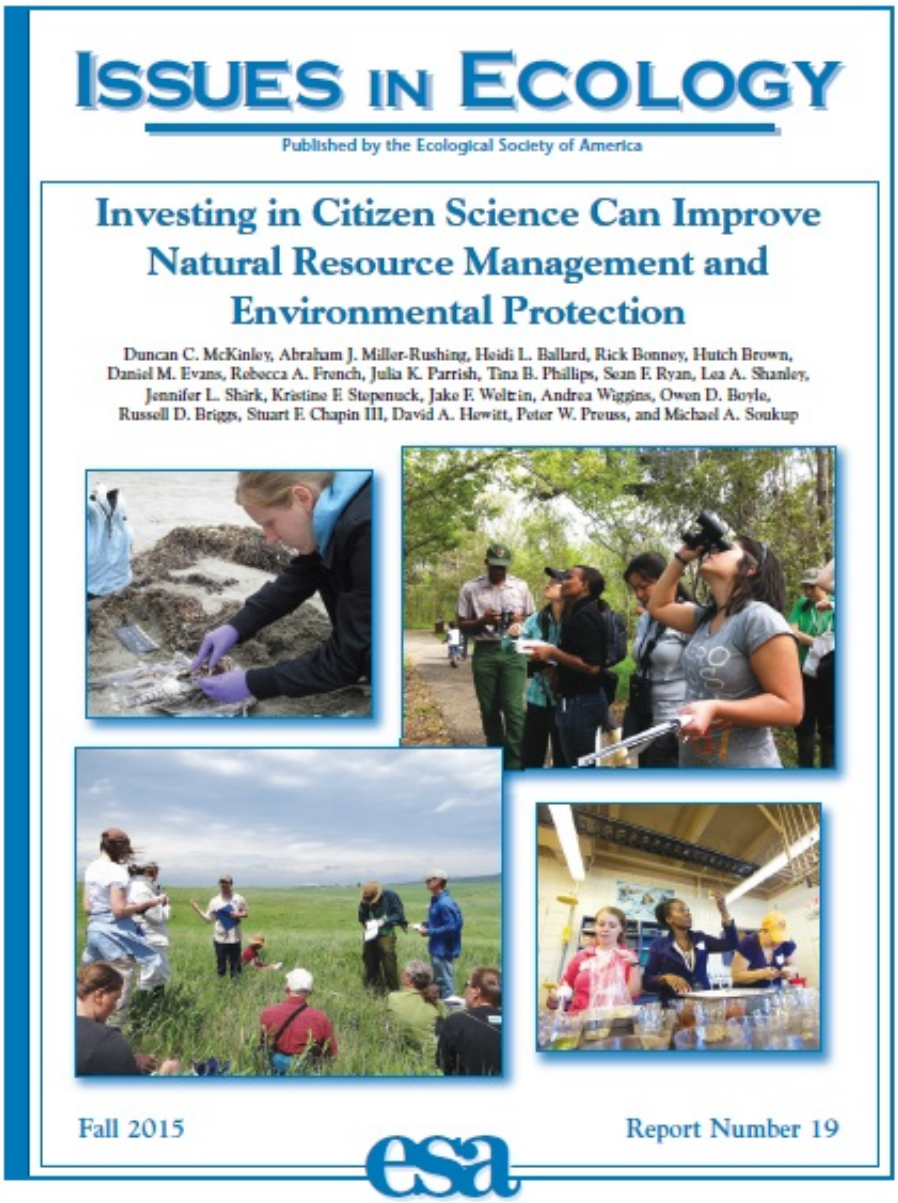
Citizen science in a nutshell: A guide to expanding the reach of environmental research

September 30 2015, by Liza Lester



Cover for McKinley et al "Investing in Citizen Science can improve natural resource management and environmental protection" Issues in Ecology no. 19, Fall 2015. Credit: Ecological Society of America

Public participation in scientific research has surged in popularity and

prominence in recent years through the connections of the world wide web, an explosion of smartphone pocket computing power, and a slow cultural change within professional science toward a more open and welcoming research environment.

Today, the White House affirmed the potential for citizen science to engage the public directly in scientific discovery and the monitoring and management of our natural resources. In a memorandum to the heads of executive departments and agencies, Director of the Office of Science and Technology Policy John Holdren mandated that all federal agencies build capacity for citizen science and crowdsourcing while facilitating cooperation across agencies and with outside organizations.

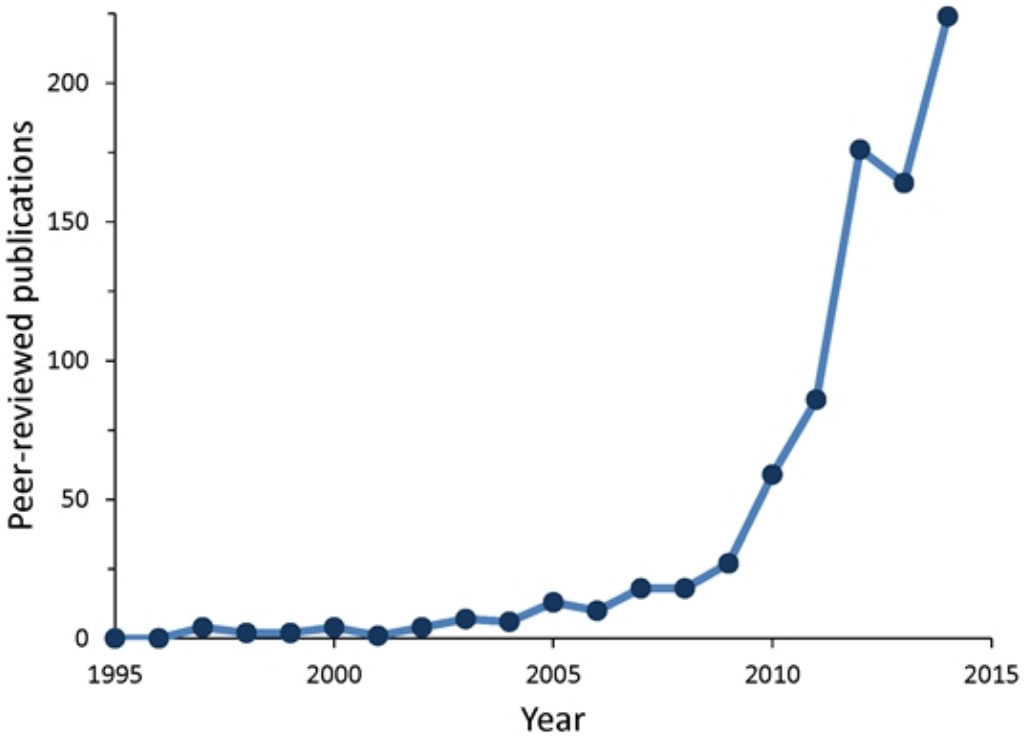
To help guide program managers in deciding if citizen science is right for their organizations and how best to design citizen science projects to meet their organization's goals, the Ecological Society of America (ESA) has released a report today summarizing how "Investing in Citizen Science can improve natural resource management and environmental protection." The report is number 19 in ESA's series *Issues in Ecology* and is included as a resource in the Federal Citizen Science and Crowdsourcing Toolkit, released this morning in conjunction with Holdren's policy memo and a Citizen Science Forum webcast live from the White House.

"If you ask a dozen practitioners about citizen science, you'll get a dozen different definitions, and a dozen reasons for why they are doing it—all of which are valid! But it can be confusing," said Duncan McKinley, a research ecologist with the USDA Forest Service and a lead coordinator of the scientific team behind the report. "We wanted to zoom out to the big picture, the 30,000-ft view of citizen science, and capture the shared values of the field, within the specific context of ecology and the environment."

The report touches on how citizen science can help organizations:

- Meet core information needs for research and monitoring
- Promote environmental stewardship
- Foster public involvement in environmental decision-making
- Spread knowledge and scientific literacy
- Encourage collaboration
- Address questions of local concern
- Expand awareness of an organization's mission
- Ignite synergies between science, education, and public engagement

Twenty-one experienced practitioners hailing from non-profit, government, and academic institutions set out to tame the exuberant diversity of the citizen science frontier into shared core principles. The report delves into the strengths and limitations of citizen science, illustrating the breadth of existing applications through **case studies**. The authors identify hallmarks of research questions ripe for volunteer involvement as well as those that might not be appropriate for a citizen science approach.



Growth in the number of scientific publications that have used or studied citizen science since 1995. Data are based on a search of the Web of Science for the keyword "citizen science" and likely represent a fraction of all scientific publications using or studying citizen science because many publications fail to acknowledge when they include contributions from citizen science. Fig 1 of McKinley et al (2015) Issues in Ecology 19. Credit: Ecological Society of America

"Citizen science is not fluff science," said report co-organizer Abe Miller-Rushing, science coordinator for Acadia National Park and the Schoodic Education and Research Center. "Citizen science has a strong reputation for education and outreach, but its ability to deliver actionable

information is underrated."

Citizen science has earned a reputation for excellence in advancing science literacy at all ages and educational levels. With this report, Miller-Rushing, McKinley, and co-authors hope to demonstrate that citizen science also has the tools to produce high quality data. Citizen science projects have produced rigorous science on par with conventional research produced entirely by professional scientists. Data gathered by observers for the North American Breeding Bird Survey, for example, have contributed to more than 500 peer reviewed papers.

Participation in research makes abstract concepts concrete—and fun. Participants say they are motivated by opportunities to contribute information that will be used in the conservation of organisms, ecosystems, or natural areas that they care about.

"Hands-on involvement in a real research question makes science tangible and lends participants a sense of personal connection to our natural resources," said author Heidi Ballard, an associate professor in the School of Education at the University of California, Davis.

But citizen science is not just an individual or personal activity; it is often undertaken in groups. Local communities and environmental organizations have been involved in monitoring local natural resources for many years. In some cases, local communities have actually driven the development of a research initiative through acute concerns about water or air quality in their region. Participation in citizen science generates greater participation in public decision-making, with some projects providing direct means for public input on government policy and environmental management.

Through citizen scientist volunteers, scientists, land managers, and policy makers have gained access to data collection at scales that would not be

possible through conventional science. Even before the scaling power of the internet and smartphone technology, programs like the Christmas Bird Count and the Cloned Lilac Project mustered observer reports through the U.S. Mail from across North America. Audubon's Christmas Bird Count, celebrated annually since 1900, is not only one of the largest, longest-running citizen science programs, it is one of the largest ecological datasets available. Part of its success lies in its simplicity and backing by a large, experienced environmental organization.

Robust results hinge on appropriate design and implementation of citizen science programs. Project managers must think carefully and honestly about their organization's goals and set clear expectations for program outcomes. "Investing in Citizen Science" provides an overview of the benefits and pitfalls of different approaches to citizen science. It describes some of the technology and data management tools currently available and the infrastructure investments required to build successful citizen science programs, taking into account the special policy considerations that come into play when federal agencies are involved.

"Good citizen science gets us fine grain, broad extent data we can't collect, or afford to collect, any other way," said author Julia Parrish, a professor of aquatic and fisheries sciences at the University of Washington and director of the Coastal Observation and Seabird Survey Team (COASST). "Along the way, we can move thousands—maybe millions!—of citizens from a state of vague worry about the environment to a place of understanding the science and lobbying for responsible resource management based on good science. Win-win in my book!"

More information: Investing in Citizen Science can improve natural resource management and environmental protection. *Issues in Ecology* No. 19, Fall 2015.