

Reflections on the Strong Growth of Citizen Science:

An Interview with Abe Miller-Rushing

Can you share your thoughts about the strong growth of citizen science?

I think the strong growth of citizen science is driven by a happy set of coincidences—developments in technology, computing, communication, and data analysis; growing interest in STEM (science, technology, engineering, math) education; growing recognition that volunteers can contribute meaningfully to science (after more than 100 years of science trending in the opposite direction, towards professionalization); and an emphasis on making science more relevant to society and translating science to action. I think it's telling that citizen science blossomed in recent years in lots of different areas independently—big nature observation programs, online data processing and games, DIY labs in urban centers, community-based groups solving local public health or environmental problems, and traditional amateur science clubs and organizations, among others. People working in these different areas of citizen science have only recently started communicating regularly, learning from each other, and working as a cohesive community of practice. The explosion of citizen science in all these areas just goes to show that the idea of citizen science was a good idea whose time had come for lots of areas of science and society.

What is happening in Maine with regard to citizen science?

Maine is a hot spot for citizen science in the country. When I go to national meetings on citizen science, Maine is disproportionately represented. It's great to see. Maine has a strong history of community members taking it on themselves to tackle all kinds of issues—a type of self reliance. Maine has a long tradition of citizen science programs in recording basic natural history observations of birds, fish, plants, and other species; monitoring water quality in lakes and at beaches; and solving local problems. In recent years, Maine organizations (Maine Audubon, Gulf of Maine Research Institute, University of

Maine, Maine Sea Grant, MDI Biological Lab, Maine Department of Inland Fisheries and Wildlife, Maine Department of Environmental Protection, and many others) have used their expertise in citizen science to test innovations in how to design programs to improve their value for science, conservation, communities, or education. Several of these programs have grown beyond Maine, and many are nationally known.

What leadership role has the Schoodic Institute played?

Schoodic Institute, which started in 2003, has really grabbed onto its role in testing ways to do citizen science better and to facilitate growth and communication of best practices in the field. They have developed several new approaches to getting citizen science into classrooms and getting students into the field and for making their science meaningful for scientists, teachers, and students. Schoodic Institute has had a crucial role in helping to establish the growing Citizen Science Association. I think innovation hubs like Schoodic Institute will be important to the continued growth of the field.

How national parks have been involved?

National parks are natural places for citizen science. Huge numbers of people visit the parks (Acadia National Park has had over 3 million visits each of the last couple of years), and most of those visitors are eager to learn and contribute and want to continue contributing when they get home. National parks have done a lot with citizen science—especially through wildlife observation and bioblitzes (an intense period of biological surveying in a particular area)—but we've been limited to a large degree by our bureaucracy—things like strong stovepipes limiting communication across disciplines, which limits interdisciplinary interactions crucial for citizen science, and the Paperwork Reduction Act, which limits our ability to ask volunteers to help collect data. But happily the National Park Service attracts employees

and partners who are predisposed to appreciate citizen science and see its potential. We are investing a lot of energy into overcoming the obstacles and strengthening our system of citizen science in national parks and increasing its benefit to visitors and to preserving park resources. We want to make science a valuable part of every visitor's and employee's experience.

What are we learning from the many different citizen science projects?

We're learning a ton! It's like drinking from a fire hose right now. What I love most is that we're at a stage where learning is happening across groups that you wouldn't think would normally interact—technology hackers, environmental justice advocates, online game developers, social scientists, conservation biologists, big data scientists, astronomers, public health experts, policy-makers, and K–12 educators.

What surprises you have found in the citizen science movement and work?

There have been many surprises. I think it's in the nature of a highly interdisciplinary field, where people come from many different backgrounds, that it would be unpredictable and full of surprises. I have been surprised at how enthusiastically and naturally many different people working in citizen science have come together through the Citizen Science Association and other collaborative groups to push the field forward. I have been surprised at the continued skepticism of citizen science data from professional scientists—happily that is waning as evidence of the value of citizen science data grows and citizen science becomes a part of more and more high-profile science projects. That skepticism also helps check some of the overpromising of citizen science that has happened in the past. I have also been surprised at the pace of innovation. People are creative and have tons of great ideas. I am amazed at the variety of ways that people of all ages can engage in meaningful science!

What opportunities or setbacks have people encountered in doing citizen science?

In terms of opportunities, I think we have only scratched the surface of how we can apply citizen science at scale to address some of the wicked problems facing soci-

ety—e.g., public health, environmental justice, climate change, conservation, food security, and disaster response. That would take a lot of coordination among different disciplines and organizations, including public and private sectors. It hasn't happened yet, but I think it will soon. For setbacks, I would say (knock on wood) the field has managed to avoid most big ones. Some that have come up are skepticism about data quality, the sense that citizen science represents free labor (it's not free and is often underfunded, which can lead to poor experiences for volunteers and bad science in some cases), and the sense that citizen science is simply environmental education and not really science at all.

Citizen science has various goals: to collect more data, to provide educational opportunities, to educate communities, to have data influence policy. How are we doing in terms of these various goals?

I think a huge challenge for any project is to have clear goals and desired outcomes that can be achieved with the resources available. That almost always means prioritizing and managing trade-offs among competing goals. If a project is being done primarily to answer a scientific question, that goal should be kept in the fore; similarly, if the focus is education or policy, other project goals can take a back seat when resources are scarce (as they always are). A challenge that citizen science projects have beyond many types of projects is that they require really diverse skill sets—expertise in science, working with volunteers, education, technology, translation of science to policy—that can be tough to bring together. In general, though, I would say the field is making good progress on all the types of goals listed in the question.

For whom is citizen science making a difference: policy-makers, citizens, scientists?

All of the above! I think citizen science is helping change how society (including scientists) think about science and how it can and should be done. It's leading to new knowledge, policies, and management. I think those are great outcomes!

Abe Miller-Rushing is the science coordinator for Acadia National Park and the Schoodic Education and Research Center. He is responsible for setting the science priorities for the park and as a result plays a key role in the Schoodic Institute's science programs, including citizen science.