Citizen Science and the Democratization of the Climate Crisis

Courtesy of the National Parks Service / Renata Harrison.

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Introduction

The question of how to contend with the rapidly warming Earth is immense in scope. The implications of the climate emergency affect each and every individual on the planet—whether in the form of increased food scarcity, extreme weather events, or negative health impacts. Scientists warn that since 1982, our planet has been warming three times faster than it was in the 1800s and that the past decade has been the warmest on record (Dahlman & Lindsey, 2024). An immense amount of scientific data is required to understand this uniquely global crisis, allowing us to combat climate change by mitigating its fundamental causes, including greenhouse gas emissions and deforestation, and by adapting communities, ecosystems, and socioeconomic structures to its impacts.

Though traditional perceptions of scientific research and data collection may involve white-coated academics gathered around a bubbling flask or typing out lines of code, citizen science—the collection and analysis of natural data by the general public—may aid in the large-scale data collection required to improve understanding of the climate crisis. Public involvement in the production of scientific knowledge is not only a way of accelerating data collection far beyond what might be accomplished by a handful of researchers but also gives participants agency in developing solutions for this increasingly dire crisis.

A Brief History of Citizen Science

Members of the general public have been recording their observations of the world around them for centuries. Science was not professionalized until the 19th century with the proliferation of scientific societies and journals; instead, early climate science was largely done by amateur experts and

non-scientific professionals tracking the world around them for cultural or agricultural means (Le Treut et al., 2007). For instance, court diarists in Japan have logged the dates of cherry blossom blooms for over a thousand years, while the oldest organized datasets on American climate were compiled not by scientific or government officials but by farmers documenting sowing and harvesting seasons (Miller-Rushing et al., 2012).

Even after science was professionalized, citizens have been continuously collecting data on the natural world, often in amateur science groups. A study at Portland State University compared recent observations of plant leafing and flowering to data collected between 1826 and 1872. This data was collected by a network of over 500 observers organized by the New York State Regents and the Smithsonian Institution's national network of meteorological observers, which would later become the National Weather Service. The investigators concluded that, as a result of changing temperatures and exponentially growing industrialization, plants now leaf and flower earlier than they did two hundred years ago (Battle et al., 2022).

Citizen science was not formally named until the 1990s, when it was conceptualized independently by Alan Irwin, a British sociologist who defined citizen science as "developing concepts of scientific citizenship which foregrounds the necessity of opening up science and science policy processes to the public," and American ornithologist Rick Bonney, who defined citizen science as projects where amateur scientists contributed to scientific data (Riesch & Potter, 2013). The current ideal of citizen science as defined by the National Parks Service is top-down, with scientific researchers introducing a project that they recruit citizens to participate in. There are also bottom-up projects, which are created by citizens to address problems in their own communities, with scientific researchers stepping in to aid in the more technical aspects of the work—an approach referred to as "community science" (National Parks Service, 2024).

Since the 1990s, citizen science efforts have helped describe the changing climate and inform responses to natural disasters. A 2019–2022 European Union-sponsored study, TeRRIFICA, surveyed citizens across six European countries to create maps describing climate change impacts on specific regions, demographics, and environments with the ultimate goal of informing policy suggestions (TeRRIFICA, 2022). "One important aspect of citizen science is that it includes knowledge and expertise to which researchers do not usually have easy access," said Norbert Steinhaus, TeRRIFICA's project coordinator in a promotional video. He continued, "It's cultural knowledge. It's individual knowledge" (Global University Network, 2022). Another successful implementation of citizen science involved the rapid characterization of earthquakes in Haiti using data from individual seismometers. Following the devastating earthquake that struck Haiti in 2010, researchers spent days determining the ruptured fault that had caused the earthquake and worked for months after to characterize the event. In 2019, French researchers distributed inexpensive, handheld seismometers to citizens to complement national seismometer networks. When another earthquake struck Haiti two years later, researchers were able to calculate the quake's strength, epicenter, and geometry within hours using data collected from these citizen seismometers (Corbet et al., 2022).

Personal Impact of Involvement in Citizen Science Work

The act of participating in citizen science can also help create a more informed populace. By decentralizing and democratizing the practices of scientific knowledge generation and data collection, participation in citizen science projects can raise awareness of climate issues and incentivize the general population to advocate for governmental change. For instance, a Brazilian study calling on individual citizens and local schools to help map natural disaster risks found that the experiment helped those communities build technical data analysis skills and improved their understanding of risk-management strategies (Albagli & Iwama, 2022). Similarly, participation in citizen science projects raises awareness of the issue being investigated. In the case of climate change, this newfound awareness correlates with increased environmental stewardship and likelihood that a community will be prepared for natural hazards (Walker et al., 2020). A third study noted that 95% of those surveyed who participated in at least one citizen science project per month reported a better understanding of the importance of environmental monitoring and the role humans can play in that process. 73% of those in the same

study noted that they felt more motivated to protect the environment (Jones et al., 2013).

Citizen science may also help alleviate climate anxiety, a recent phenomenon defined as distress related to climate change. According to a study conducted at the University of Kent, participants in citizen science conservation projects are likely to do so because they are concerned about wildlife welfare—in other words, participation in these projects empowers them with the opportunity to make an impact in larger issues (Maund et al., 2020). Aldona Czajewska, who coordinated the University of British Columbia's team for Climate Action Engagement & Outreach, noted that participation in citizen science projects such as species identification using apps "allows people to appreciate the life around them and the importance of the species we share the world with" instead of only worrying about the climate crisis that shapes our world (Wahking, 2024). Citizen science participation also benefits participant well-being, with participants reporting positive outcomes related to their mental or physical well-being in focus group discussions (Eichholtzer et al., 2023).

Pitfalls of Citizen Science & Attempts to Rectify Them

However, participants in citizen science may not always accurately reflect demographic realities. According to a 2022 study conducted at North Carolina State University, 96% of participants in the Audubon Christmas Bird Count, which invites layman volunteers across the country to tally all birds seen or heard over a 24-hour period to determine the health of that population, were white (Allf et al., 2022). These findings, said Dr. Caren Cooper, a professor who worked on the study, demonstrated that only a narrow demographic was engaging with citizen science efforts (Moore, 2023). Similarly, a Pew Research Center poll noted that younger and more educated individuals are more likely to participate in citizen science activities (Thigpen & Funk, 2020).

Mismatches between reporting populations and the populations that stand to benefit from citizen science have marked effects. For instance, popular apps like iNaturalist and eBird—which encourage users to share animal and plant sightings with researchers to better understand the biodiversity of local environments and species distribution—are more likely to have observations concentrated in predominantly white areas. This lopsided user distribution means that the maps produced by these apps are more likely to emphasize certain areas when reporting wildlife sightings. To help reduce bias, researchers at Washington University in St. Louis called on their peers to conduct outreach with diverse populations, for instance by translating project materials into different languages (Ogliore, 2024). A group at the University of Haifa also encouraged researchers to account for demographic bias in their statistical models and make specific engagement goals for target populations (Arazy & Malkinson, 2021).

Citizen science is also uniquely susceptible to politicization and subjugation to commercial interests. For instance, in 2019, Airbnb announced that it would send five citizen scientists on an Antarctic cruise to collect snow samples to be tested for microplastics. However, these projects are often avenues for companies to demonstrate social responsibility and direct attention away from the environmentally-harmful impacts of their ventures; Antarctic cruises have recently been noted as major sources of environmental pollution impacting climate patterns and habitats (Blacker et al., 2022).

Conclusions

As questions about adapting to and remedying a rapidly-changing climate grow increasingly pressing, it is critical to leverage all possible methods of large-scale knowledge generation to understand the world around us. Ongoing citizen science projects aim to do just that, leveraging new and accessible technologies to monitor water quality, document species distributions, and inform disaster relief responses.

These projects not only aim to round out our knowledge of the climate crisis but also to give participants a sense of agency in a global crisis. By leveraging inexpensive, easy-to-use technologies, a bicycle ride could become a method of tracking air quality, or a garden could be a microenvironment-monitoring station. As we enter an era where the study of climate science is simultaneously more accessible and more pressing than ever before, it is vital to recall the impact collective action has had on our centuries-long effort to understand the natural world and to consider how we can leverage the power this collaboration between researchers and the public holds to mitigate the effects of the climate crisis.

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