New Horizons for Citizen Science Participation: Multiproject Volunteers

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Most research on citizen science volunteers is based on an assumption that volunteers experience a single project. We surveyed 3,894 volunteers, and collected online metadata from 3,649 volunteers to test this assumption. We found that 77% of volunteers participated in more than one project. A minority of volunteers participated in up to 50 projects. Multi-project volunteers were split evenly between discipline specialists and discipline spanners (participants in projects from multiple disciplinary topics) while 33% of multiproject volunteers participated in both online and offline projects. Public engagement was narrow: multiproject participants were eight times more likely to be white and five times more likely to hold advanced degrees than the general population. We propose a volunteer-centric framework that explores how the accumulation of experiences in a project ecosystem can support learning objectives and inclusive citizen science. Additionally, we suggest new avenues for broadening participation in citizen science such as through corporate volunteer programs.

The typical citizen scientist is white, works in STEM, is highly educated and does multiple projects.

HOW CAN WE SUPPORT MORE INCLUSIVE CITIZEN SCIENCE?

Background

Citizen science is growing quickly (Theobald et al. 2015). Beyond its benefits to science, it also provides an opportunity for volunteers to learn and gain skills from their experience (NASEM 2018). Most researchers who study citizen science focus on it within the context of a single, standalone project (Allf 2022). However, given the burgeoning landscape

of projects and ways to participate, it's possible that volunteers are participating in multiple projects. Better understanding the participation landscape would reveal new insights into how some projects might serve as gateways to deeper learning, or how citizen science experiences can be scaffolded across projects to bolster learning. The primary aim of this study is to better understand the dynamics of multiproject participation.

Methods

Between 2017 and 2019, we surveyed nearly 4,000 volunteers from the Christmas Bird Count (a national field-based ornithological project), Candid Critters (a mammal camera-trapping project based in North Carolina) and SciStarter (an online database of citizen science projects) to ask them about their multiproject participation. We also collected data from approximately 3,500 SciStarter members regarding which projects they joined on SciStarter.

We then coded each of the projects joined by volunteers according to its disciplinary topic (ecology, astronomy, etc.) and mode of participation (online or offline). Next, we coded each volunteer in our sample according to whether they participated in one project ("singleton"),

multiple projects within one discipline ("discipline specialist"), or multiple projects in multiple disciplines ("discipline spanner"). Likewise, we also coded each volunteer according to whether they were a "mode specialist" (participated in only offline projects or only offline projects) or a "mode spanner" (participated in both online and offline projects).

Next, we compared the characteristics of volunteers in our sample to the general US population. Finally, we used regression models to understand what volunteer characteristics were predictive of multiproject participation.

Results

We found that volunteers participated in between one and 50 different citizen science projects. 77% of volunteers joined more than one project while just 23% were singletons. Christmas Bird Count volunteers participated in the most projects (mean = 3.5) while Candid Critters volunteers participated in the fewest projects (mean = 1.6).
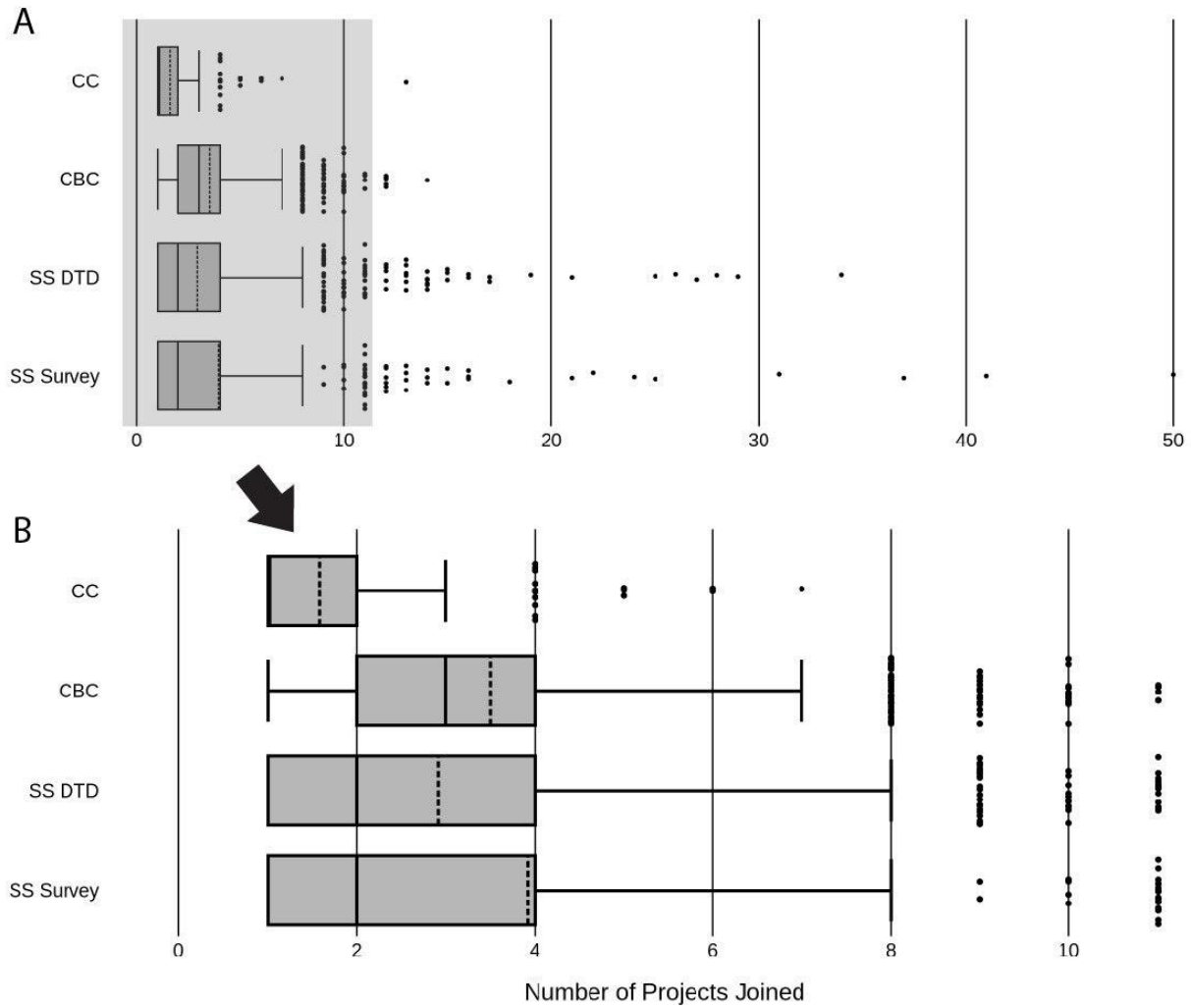
Figure 1. CC, Candid Critters; CBC, Christmas Bird Count; SS DTD, SciStarter Digital Trace Data; SS Survey, SciStarter Survey. Gray area in A expanded in B.

Multiproject volunteers in our sample were split evenly between discipline specialists and discipline spanners. More than 80% of projects

joined were in four disciplines: Ecology & Environment, Pollution, Geology & Earth Science, and Astronomy & Space.

Figure 2. Diversity of projects joined by volunteers from four data sources, grouped by discipline. CC, Candid Critters; CBC, Christmas

Bird Count; SS DTD, SciStarter Digital Trace Data; SS Survey, SciStarter Survey.

Multiproject participation was divergent among the different data sources. Approximately 75% of Candid Critters volunteers were singletons while 77% of Christmas Bird Count volunteers were discipline specialists. About half of volunteers from SciStarter (both data sources) were discipline spanners.

52% of all volunteers sampled were mode specialists, 25% were mode spanners, and, as mentioned above, 23% were singletons. Again, these data were divergent depending on the data source. Nearly all the Christmas Bird Count and Candid Critters volunteers participated in only offline projects while approximately half of the SciStarter volunteers were mode spanners.
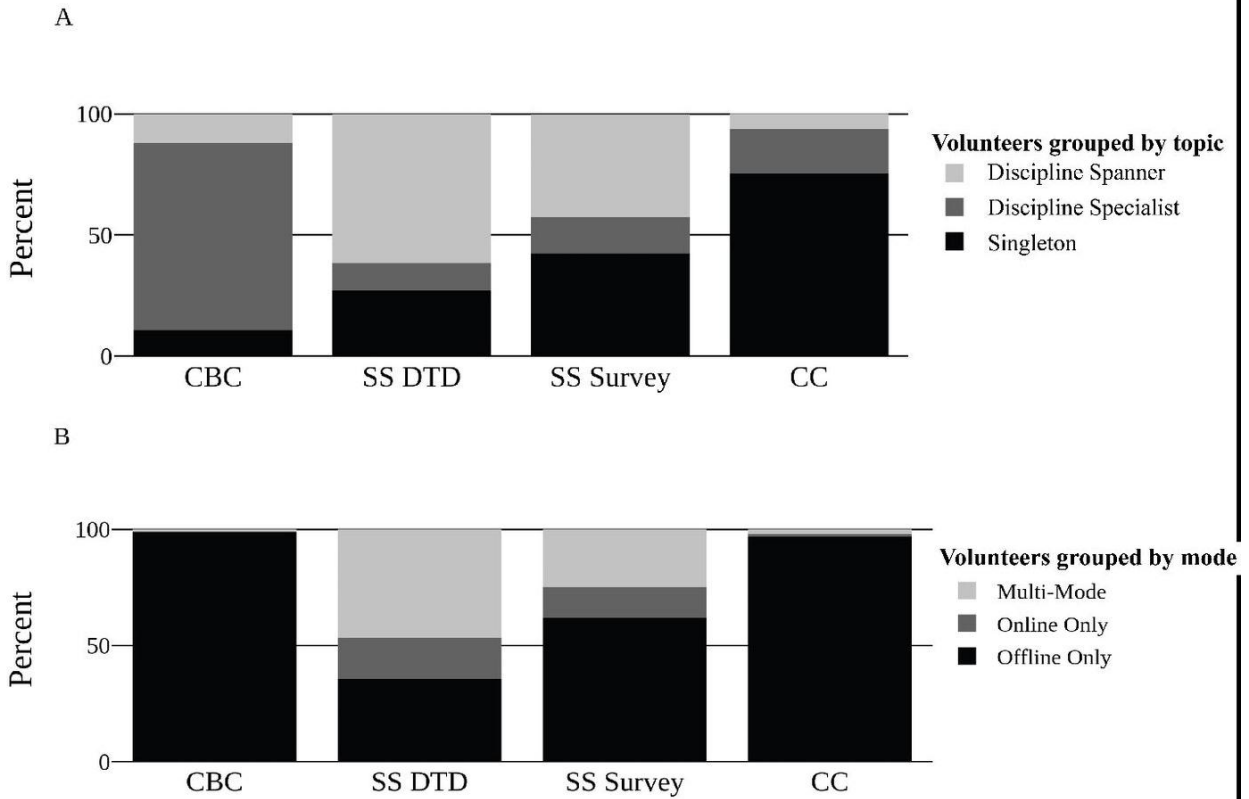
Figure 3. CC, Candid Critters; CBC, Christmas Bird Count; SS DTD, SciStarter Digital Trace Data; SS Survey, SciStarter Survey.

Thus, taken together, mode spanning and discipline spanning were most common among SciStarter volunteers.

Survey respondents from each data source were overwhelmingly more likely to be white, highly educated and to work in science-related fields than the general US population. When controlling for other volunteer

characteristics, multiproject participants were more likely to work in STEM-related fields, have more experience doing citizen science, be younger, more liberal and not have children, compared to singletons.

Table 1. Proportional demographic characteristics of citizen scientists in samples collected from 2016 to 2019 compared with the general US population

	Christmas Bird Count (n = 3,191)	Candid Critters (n = 280)	SciStarter Survey (n = 423)	US Population
Female	.46*	.51	.69*	.51
White and not Latinx	.96*	.96*	.88*	.60
65 years old and over	.48*	.30*	.18	.16
Hold graduate or professional degree	.49*	.43*	.53*	.12
Have Liberal political views	.68*			.24
Median household income	$65-80k*			$63k
Work in STEM occupations	.46*	.33*	.48*	.06

Note: Percentages do not include non-respondents (1-12% for all questions except household income, which was 18% non-response). CBC and CC surveys' occupation questions asked about work in "life sciences, natural resources and conservation fields," rather than STEM fields. Data for US population from US Census Bureau and US Department of Labor Statistics.
*p<.05

Discussion

Our results suggest that multiproject participation is widespread among citizen scientists. Remarkably, some volunteers have participated in literally dozens of different projects. This suggests that, at least in some cases, initial experiences in citizen science might amplify interest in science, leading to sustained and heightened engagement over time. Future research should examine what factors regarding initial experiences lead someone to become such a dedicated volunteer.

We found important differences between the citizen scientists in our sample. Candid Critters volunteers tended to stick to Candid Critters while Christmas Bird Count volunteers participated in many different bird projects, and SciStarter volunteers participated most broadly across the landscape of project disciplines and modes. Future work should explore whether the SciStarter platform, owing to its history as a multidisciplinary project database, actually facilitates this breadth of engagement.

All types of multiproject participants tended to have more experience with science. A core goal of citizen science is to engage the public more inclusively than does the professional scientific enterprise. If citizen science were succeeding in this regard, we would expect to see high proportions of participants from underrepresented groups and those employed in non-STEM fields engaging with citizen science. Unfortunately, we found the opposite. Out of the nearly 3,600 volunteers

whose demographics we collected, fewer than 200 (5%) identified as Black, Asian-American, Pacific Islander, Native American, Latinx, or any other minority racial or ethnic group in the US. By comparison, 40 percent of the US population identifies with one or more of these minority racial or ethnic groups. Nearly half of the volunteers we sampled worked in science-related fields and half held PhDs, MDs, or other advanced degrees. In short, citizen science participants are nearly exclusively individuals who, relatively speaking, already have access to science. Thus, citizen science may not be effectively broadening public participation in science. These trends held across all three of our survey data sets. While acknowledging the caveat that our surveys might have oversampled highly engaged volunteers, the possibility that the most committed citizen science participants are up to ten times more likely to be white, and seven times more likely to hold advanced degrees, than the general population suggests that citizen science has a strikingly narrow reach in terms of public engagement. A better understanding of multi-project participation and the ways that participants navigate a landscape of citizen science options could help meet the immediate need to address diversity, inclusion, and equity in citizen science (Cooper et al. 2021).

Recommendations for Volunteer-Centric Management

Our results demonstrate that a key dynamic of contemporary citizen science is participation in multiple projects. We therefore propose a *volunteer-centric* agenda for researchers interested in the phenomenon of citizen science that foregrounds multi-project participation when exploring fundamental questions about the scientific, environmental and societal value of citizen science. Below, we outline five themes of particular importance (in bold) for such an agenda.

Volunteer Learning. Researchers interested in studying volunteer learning through citizen science should form their hypotheses on the assumption that volunteers' citizen science experience extends across multiple projects. Additionally, researchers should study potential synergistic or additive effects on learning as a result of participation across a breadth of topics.

Guided Learning Trajectories. We found that volunteers on a multiproject platform (SciStarter) were more likely to participate in

projects from different disciplines and modes than volunteers from standalone projects. This finding leads to a fascinating possibility: that platforms like SciStarter might design scaffolds and trajectories that foster learning across projects. For example, some projects could be designed as gateways with entry-level protocols and other projects could plan for data quality standards that require volunteers with prior experiences and skills gained in gateway projects. Other scaffolding strategies might encourage movement from online to offline projects as a means of encouraging connection to nature, or a movement from offline to online projects to encourage technological literacy.

Participation Skew. We know that a minority of dedicated citizen scientists contribute the majority of data to most projects (Woods et al. 2011). New research should investigate whether participation skew manifests across multiple projects as well.

Demographic Diversity. Despite the promise of citizen science to "democratize" science (Irwin 2002), our study demonstrated that citizen science volunteers are more likely to be white, highly educated, and STEM professionals than the general population. Indeed, according to our study, working in a STEM field is highly predictive of engaging more broadly across the citizen science landscape. Exploring how multi-project participation and/or learning trajectories might differ across

race, economics and education should be an important goal of a *volunteer-centric* framework. Additionally, researchers should look across the project landscape to find projects that may be more successful in reaching underserved populations to understand what factors lead to that diversity.

Project Leaders and Platforms. Currently, many project owners view volunteers as finite resources over which projects compete (Sharova 2020). Our project suggests that, since volunteers are already participating in multiple projects, project owners might consider a more collaborative approach by cooperating and coordinating their recruitment efforts in order to jointly foster individual and collective volunteer capacity.

Future Directions – Corporate Volunteers

One of the primary findings of our study was the remarkable homogeneity among volunteers in our sample. One remedy for this lack of diversity is to deliberately seek out new sources of volunteer energy.

One source of such volunteers is corporate volunteer programs. These programs encourage corporate employees to pursue volunteer opportunities. Recently, SciStarter started offering a suite of citizen science projects as one means for corporate volunteers with the company Verizon to get volunteer experience. Over the past two years, this program has blossomed and more than 8,000 volunteers have made 157,000 contributions to citizen science. Survey results indicate that these volunteers better approximate the general US population in terms of, for instance, their race/ethnicity and education. Thus, corporate volunteer programs may be one promising source of new citizen science volunteers who may have more to gain from science engagement than traditional citizen scientists.
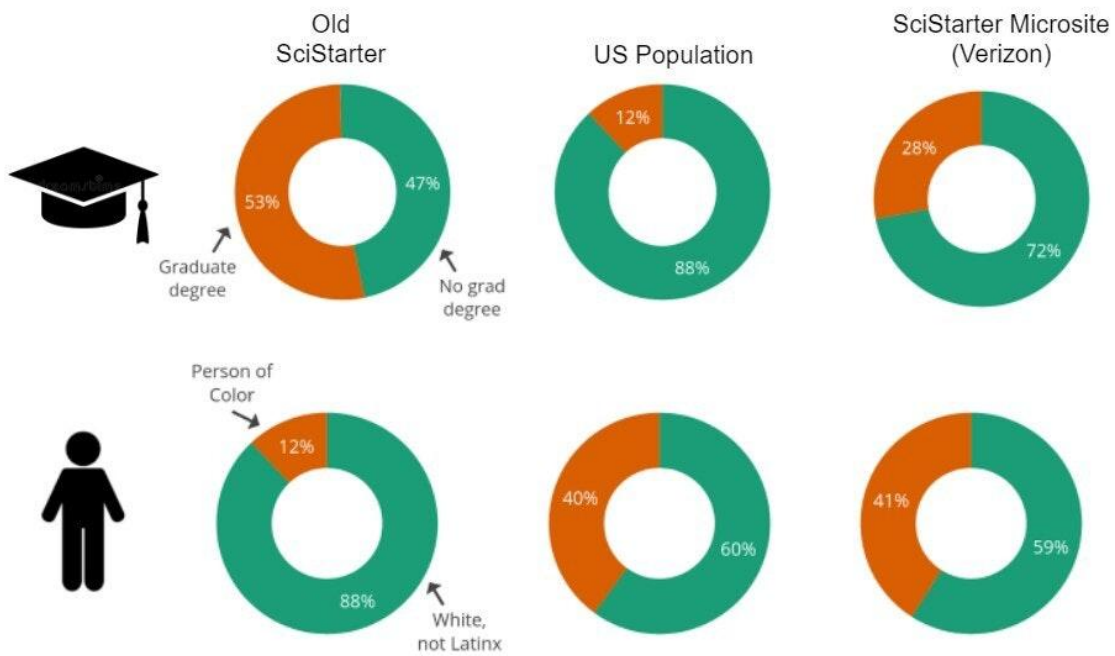

Old SciStarter — Graduate degree 53%, No grad degree 47%
US Population — 12%, 88%
SciStarter Microsite (Verizon) — 28%, 72%

Old SciStarter — Person of Color 12%, White, not Latinx 88%
US Population — 40%, 60%
SciStarter Microsite (Verizon) — 41%, 59%

Figure 4. Old SciStarter refers to SciStarter demographics prior to the incorporation of microsites such as the Verizon microsite.

Acknowledgements

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