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PRACTICE INSIGHTS

Challenges in the establishment of a rare plant species monitoring program using community science volunteers

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Abstract

1. Community science programs enable the collection of large amounts of important data and enhance the appreciation of science among members of the public. However, there are challenges in the establishment of successful community science programs.
2. We report the challenges associated with the recent establishment of a community science program to monitor rare plants in the geographically diverse southern Illinois, USA region.
3. Over the first 3 years, our program has been successful in the collection of over 250 monitoring records for rare species through the recruitment of a group of passionate volunteers. However, our volunteers are predominantly middle-income, college educated, white females who are not representative of the population at large of the region. We propose a recruitment strategy to broaden the diversity of our volunteers by better engaging community members who are not typically involved with plant monitoring but are interested in hiking, walking in natural areas, gardening, and restoration activities, and others who would like the opportunity to collaborate with scientists and researchers in addressing an environmental issue.
4. *Practical implication*: Community science plant monitoring programs face challenges in recruitment, retention, remoteness of field sites and data quality. Addressing these challenges through targeted recruitment strategies aimed at reducing structural and cultural barriers to participation, along with frequent program assessment, is necessary to enhance the success of these programs.

KEYWORDS
citizen science, community scientists, data quality, environmental engagement, rare plant monitoring, recruitment strategies, volunteers

1 | INTRODUCTION

A valuable approach to providing high-quality monitoring data on rare species is through inclusion of community (or citizen) science volunteers. Community science (CS) programs involve participation by members of the public in scientific investigations, commonly the collection of monitoring data (Lin Hunter et al., 2023). These programs are important in ecology and conservation, as they can allow the collection

of large numbers of species occurrence records (Lepczyk et al., 2020). Furthermore, CS programs can be preplanned or opportunistic. The former uses a structured approach that requires volunteers to be trained and assigned. By contrast, an opportunistic program, such as the popular iNaturalist (www.inaturalist.org), allows participants to collect data through unstructured observations.

CS programs can be particularly valuable for monitoring species that are challenging to locate, such as rare species. Rare species monitoring is important because most species in ecosystems are rare, represented by few individuals often in restricted habitats across a limited geographic range (Rabinowitz, 1981). Populations of these rare species contribute to biodiversity and ecosystem services (Mouillot et al., 2013), but are susceptible because of vulnerability to overexploitation, habitat loss (Säterberg et al., 2019) and climate change (Vincent et al., 2020). Conservation organizations use rare species location and distribution records in management, planning and decision making (Bland et al., 2019; Rodrigues et al., 2006). However, rare species records are often limited to floristic lists, herbarium records, or other sources that may include collection or recording biases and lack precise location data (Daru et al., 2018; Garcillán & Ezcurra, 2011). Targeted monitoring of rare species is important for conservation planning but is often limited logistically (Choe et al., 2019; Laskey et al., 2020). Data on populations of rare plant species allow agency staff to make informed species recovery plans and habitat management decisions in the face of limited budgets. Participation by locally based volunteers helps foster better agency-public relationships including conservation 'buy-in' from private landowners (Steenweg et al., 2023).

Here, we report on the recruitment, retention, field site remoteness, and data quality challenges associated with the establishment of a pre-planned CS rare plant monitoring program. We raise questions related to the maintenance and growth of CS monitoring programs that are relevant for similar programs.

2 | ESTABLISHMENT OF THE SOUTHERN ILLINOIS PLANTS OF CONCERN PROGRAM

In 2021, we established the southern Illinois Plants of Concern program (hereafter 'the program') using funds from an anonymous donor as an expansion of the 20-year-old northeastern Illinois Plants of Concern program based at the Chicago Botanic Garden. The northeastern program was established in 2001 to monitor state listed and regionally rare species in a seven-county area including Chicago (Goad et al., 2020; Havens et al., 2012). The northeastern program is a highly successful CS rare plant monitoring program that has generated data allowing the population dynamics of rare plants in the region to be quantified (Bernardo, Goad, et al., 2019; Bernardo, Vitt, et al., 2019; Novak et al., 2022).

The purpose of the southern Illinois program is to monitor rare plant species in southern Illinois, USA; a region of high biodiversity (Supporting Information S1). The goals of the program are: (1) Connect people and plants; (2) collect standardized data; and (3) collaborate with researchers and land managers (Plants of Concern, 2023). A dedicated website provides the entry point for both the southern and northeastern programs (https://plantsofconcern.org/) allowing consistency of structure across regions (Collins et al., 2023). The website includes program background, news and events announcements, information including photographs of all listed threatened and endangered species, and mandatory online training videos. Volunteers create an account to take online training and access their monitoring assignments. Program staff access the site to manage volunteer assignments. Land managers create accounts allowing them to view all data submitted for the sites they manage.

After completion of training, volunteers are given assignments by program staff. These assignments match the expertise, experience, and preferences of the volunteers. Some volunteers prefer to work in teams, whereas others are more comfortable working alone. Regardless, a staff member accompanying volunteers on their first assignment ensures familiarity and compliance with monitoring protocols. The monitoring protocol requires volunteers to use a specifically designed mobile app. Data are entered in the app on the population numbers of the rare species that are recorded along with ancillary location, associated native and invasive species, and environmental data. These data can be entered in the field even if they are out of cell phone range and are automatically uploaded to the database later. A staff member checks the entry and sends data to the Illinois Department of Natural Resources database three times a year.

In the first 3 years of the program, 82 volunteers spent 4515 hours monitoring. Volunteer retention rate increased 25% from 2021–2022 (46%) to 2022–2023 (71%) (Table 1).

One thousand and twenty-one reports on 145 rare species were submitted across 242 sites. These reports covered 70% (92 out of 132) of threatened and endangered plant species in southern Illinois. Some of the species were more common than expected

TABLE 1 Southern Illinois Plants of Concern Program summary statistics 2021–2023.

Year	Hours	Reports	Species	Volunteers	Sites	Landowners
2021	1991	420	101	54	154	15
2022	1610	323	96	35	128	14
2023	914	273	76	44	116	19
All	4515	1024	146	82	242	24
All years only TE[a]	3375	756	92	77	205	23

Note: Numbers of volunteers does not include program staff, but sum of hours includes program staff time.

[a]State threatened and endangered species.

based on previous records, allowing delisting proposals to be submitted to the Illinois Endangered Species Protection Board. These records contribute to scientific research on rare species in the region (Hudgens, 2021).

We conducted an anonymous online survey of volunteers who had completed training in December 2023 (Supporting Information S2) with a response rate of 26% ($n = 82$ invitations, with 21 responses). The survey received IRB approval (see Acknowledgments). Our volunteers predominantly self-identified as female (70.6%), young (47% 25 to 34 years of age), low middle income (44.4% $10K–$50K annual income), and 100% white (Figure 1). Most of the volunteers were still active in the workforce (75%). Although 40% reported having formal education experience, such as a degree related to conservation, 70% also reported a personal interest in conservation and botany.

3 | CHALLENGES

There are several challenges to implementing, growing, and sustaining a CS program in ecology and conservation (Lepczyk et al., 2020; Richard et al., 2023). Some of these challenges are generic for these types of programs; others are more specifically related to the characteristics of the region and type of taxa being monitored (e.g. plants, birds, fishes, insects), and expansion from a single to a second region (Collins et al., 2023).

We discuss below the main challenges in establishing and sustaining our program, that is recruitment, retention, remoteness of field sites, and data quality. While some aspects of CS programs focused on rare species have been assessed, for example data bias and their contribution to conservation (Fontaine et al., 2022; Robinson et al., 2018), the challenges we focus on have had less attention but are of broad relevance for CS programs in general.

3.1 | Recruitment

Recruitment of volunteers into the program has been successful following presentations to local groups, especially natural history groups including local chapters of the Sierra Club and Master Naturalists. Additional volunteers are drawn from state

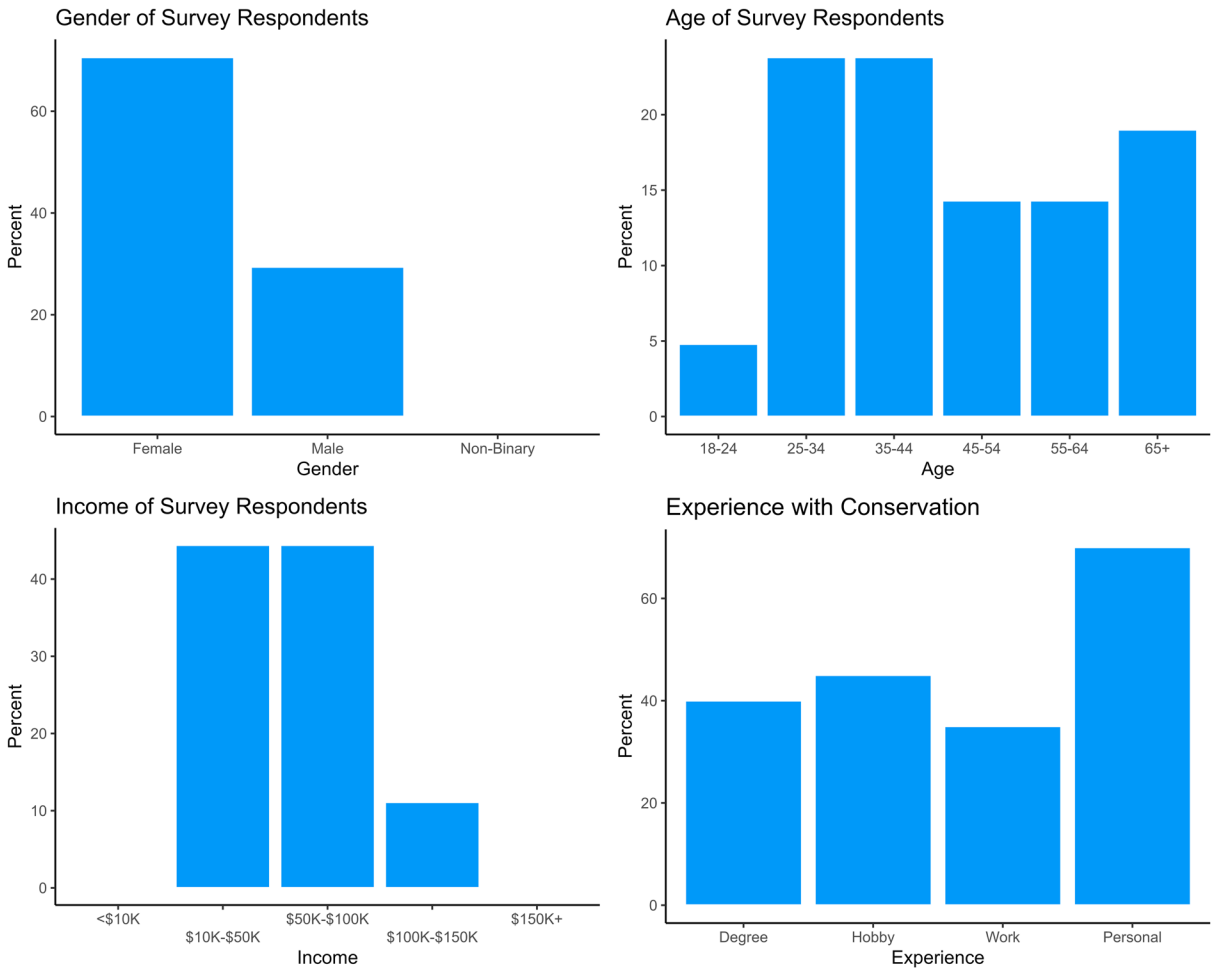

FIGURE 1 Bar graphs showing the percentage of southern Illinois Plants of Concern community science volunteers from 2021 to 2023 by gender, age, income, and experience. Number of respondents = 21. Respondents were allowed to choose more than one option for experience thus bars show the percentage of respondents making each choice.

and federal agency professionals (e.g. Shawnee National Forest), who participate as part of their work assignment or during personal time. Some of our key contacts in these agencies are our most active participants. Some land managers have adopted the protocol and mobile app to easily add data in a consistent way and internally coordinate monitoring by staff or volunteers within their organization.

A recruitment challenge in common with other CS projects has been to include representation reflecting the diversity and demographics of the region (Curtis, 2018; Finch et al., 2022; Pandya, 2012; Pateman et al., 2021). The southern Illinois region (2023 census population 315,763) is predominantly rural with few urban population centres including Carbondale (population 21,717) and Marion (population 16,729) with 76% of our volunteers residing outside these two cities. Participation of volunteers from rural areas allows incorporation of local knowledge into the program, giving them a voice in conservation activities (Stevens et al., 2014). Ethnic diversity of the region varies from 97% White, 0.8% Black (Franklin County) to 65% White, 31% Black (Alexander County), with a maximum of 5.4% Hispanic or Latino (Union County; https://www.census.gov/quickfacts/fact/table/US/PST045222). Our volunteers do not reflect this regional ethnic diversity, an issue reported for other natural history volunteer programs (Rutter et al., 2021). We recognize several challenges in engaging diverse communities in CS projects. These challenges include structural barriers related to cultural differences between participants and volunteers, socioeconomic disparities which can lead to transportation difficulties, lack of spare time to volunteer, ensuring relevancy of projects to the needs and interests of diverse communities, and accommodating participants without a scientific background (Pandya, 2012; Pateman et al., 2021). We have been successful in addressing some of these challenges and plan to continue such approaches to broaden our volunteer base.

To address this recruitment challenge, we initiated a structured recruitment strategy by connecting with diverse community partners and groups with interests not directly related to the conservation of rare plants (Brouwer & Hessels, 2019; Pateman et al., 2021). For many volunteers, it is not necessarily the topic of rare species, per se, that might be attractive, but the opportunity to collaborate with scientists and researchers in addressing an environmental issue. In one instance, we engaged 14 elementary and middle-school teachers from high-need local schools in rare plant monitoring as part of a biodiversity summer institute. They have since used their lived experiences to advocate environmental issues in the classroom and through presentations at regional conferences (Crowell et al., 2022; Lopez Swalls et al., 2022). Additionally, we partnered with University of Illinois Cooperative Extension volunteers to prepare herbarium vouchers of monitored species, allowing us to reach participants whose interest in the project stemmed from the arts, social interaction and/or environmental concern, while also offering a less physically demanding opportunity. To diversify our volunteer base, we look forward to continuing a structured recruitment strategy by partnering with community groups with interests in outdoor activities such as fishers, hunters, artists, and birdwatchers.

3.2 | Retention

The southern program year-to-year volunteer retention rate was encouraging for such a new program. The northeastern program had a similar retention rate of 42%–57% in the first 3 years and 64% after 10 years (Havens et al., 2012). Reviewing retention for the northeastern program, Goad et al. (2020) made the following recommendations for CS programs which we have adopted (our examples in parentheses): flexibility in data collection protocols (e.g. multiple methods of recording data), flexibility to volunteer needs (e.g. weekend versus workweek availability, offering more group monitoring activities and indoor opportunities), recognition of the efforts of volunteers (e.g. hand written thank you letters and distribution of free swag), accommodation of less scientific backgrounds (e.g. mounting of herbarium vouchers), and recognition of volunteers as partners (e.g. acknowledgement through program outreach materials).

3.3 | Remoteness of the field sites

In southern Illinois, rare plant populations are often on large, remote sites far from vehicular access points compared to more accessible sites in northeastern IL. Travel to these remote sites requires a personal vehicle and a considerable amount of time. Southern Illinois includes challenging terrain, from rocky, steep slopes to impassable swamps, as well as hot and humid summers. These challenges require volunteers from local communities (or willing to drive long distances) who can cope with these adverse conditions and have ample time and means available for travel. Nevertheless, none of the responses from volunteers in our survey suggested struggles with the remoteness of the sites, and only one respondent selected physical requirements as an aspect they struggled with. These responses highlight the rarely discussed value of CS programs to record important data in remote locations (Chiaravalloti et al., 2022; Farhadinia et al., 2018; Gómez et al., 2021). However, recognizing the time, travel, and physical constraints of remote fieldwork, we have organized workshops where participants can contribute to the mission through activities such as mounting plant specimens on herbarium sheets. Providing a variety of activities allows increased volunteer participation within the scope of the mission.

3.4 | Data quality

Data quality is an ongoing concern of CS programs (Dickinson et al., 2010) necessitating the need for appropriate volunteer training, staff supervision, and data oversight. For rare plants, there is the additional challenge that some taxa are difficult to identify, for example, members of the Cyperaceae and Poaceae plant families (sedges and grasses). In fact, 33% of the survey respondents noted that plant identification was an aspect of the program they struggled most with (other problems included dealing with data record technology [22%] and submitting reports [33%]; Supporting Information S2).

For example, some volunteers reported having problems with login/passwords, and mobile devices that did not work well in full sun (hard to see screens and phones overheating). Volunteer feedback and suggestions allowing us to improve the data collection phone app has allowed for improvements in data quality and enhances volunteer 'ownership' of the program (Skarlatidou et al., 2019).

There is also the need for staff with botanical expertise to find and confirm rare plant locations before they can be assigned to volunteers and then accompany volunteers when they first start an assignment to ensure correct identification of plants and compliance with data collection protocols. Indeed, we find it more effective to ask volunteers to accompany a staff member in monitoring sites to most effectively cover large areas and not be overwhelmed with the task. Workshops for volunteers to help with identification skills will help them find new plant populations while exploring on their own. A comparison between volunteers and staff participating in the northeastern program showed identical plant population size estimates among 80% of compared reports giving us confidence that our volunteers, which receive the same online training, are providing accurate data (Havens et al., 2012).

3.5 | Additional challenges and applied management

Additional challenges identified by Collins et al. (2023) assessing a CS meteorology program, relate to the expansion or scaling-up of existing programs and include ensuring consistency of structure across regions. A common website, a program manager overseeing both programs, and frequent cross-program communication to volunteers have helped us with these challenges. As an expansion of the northeastern program, our program has readily met some of the challenges of other new CS programs such as early engagement of decision makers (Lee et al., 2021), volunteer training, and data recording protocols (including the mobile app; MacPhail et al., 2020), which were already in place. From an applied perspective, data on native and non-native species presence and abundance are collected as part of the rare species monitoring. These data incentivize and alert land managers to threats of invasive species in the vicinity of rare plants as well as information about the habitat and plant communities that support rare plants. Agency biologists then work with land owners on managing their land when rare plants are found.

4 | CONCLUSIONS

Our ability to meet the challenges of establishing a rare plant CS program related to the remoteness of field sites, retention, and data quality is encouraging. However, our greatest challenge has been to recruit a diverse volunteer workforce. Our CS volunteers are passionate about natural history and willing to undertake fieldwork in sometimes difficult conditions in remote areas. However, while our community scientists reflect a broad range of ages and incomes, they are predominantly university-educated (many with degrees in conservation or botany), white females. We advocate targeted recruitment strategies to better engage a racially diverse group of community members who are not typically involved with CS and conservation. A diverse group of community scientists will not only meet the primary goal of the program to monitor rare plant species, but will also raise the importance and value of conservation in the population as a whole. Just as continued monitoring of rare species is necessary for conservation planning, additional program assessment is necessary to understand the efficacy of our response to the challenges we have outlined here.

AUTHOR CONTRIBUTIONS

David J. Gibson wrote the first draft of the manuscript. All authors contributed by providing, ideas, data, and editing the final manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

PEER REVIEW

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DATA AVAILABILITY STATEMENT

Survey questions are provided in the Supporting Information S1. Survey responses are not included owing to privacy concerns.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Supporting Information S1. Setting for the southern Illinois Plants of Concern Program.

Supporting Information S2. Project Participant Survey.

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