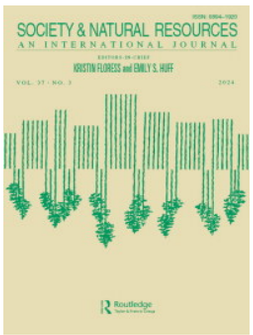

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Misalignment Between Citizen Science Project Leaders and Their Organizations Increases the Challenges They Face Achieving Project Outcomes

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ABSTRACT

Citizen science values include increasing natural resource management, enabling large-scale research, promoting education and scientific literacy, addressing environmental injustice, mitigating climate change, and more. Project leaders often work toward multiple outcomes at once and must prioritize their focus. Prioritization is complicated given the competing interests of scientists, volunteers, funders, and others. According to role conflict theory, this negatively affects the ability of project leaders to carry out their jobs. We conducted a phenomenological study with project leaders ($n=65$) to understand perceptions as they relate to diverse goals and interests. Project leaders who described misalignment between their own goals and what they perceived to be their organization's goals more frequently reported challenges related to balancing scientists' and volunteers' interests, convincing colleagues to trust data, and being part-time employees. Given these results, we describe important implications for how organizations engaging in citizen science can address these challenges and better achieve goals.

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citizen science; funding; goals; organizational culture; project management; project outcomes

Introduction

Anthropogenic changes to the planet are well documented (Vitousek et al. 1997) and expected to worsen (Keys et al. 2019). These impacts include air pollution (Akimoto 2003), water quality and scarcity (He et al. 2021; Michalak 2016), plastic pollution (MacLeod et al. 2021), and biodiversity loss (Oliver and Morecroft 2014). Because natural and social systems are coupled, people are expected to suffer from anthropogenic changes (Liu et al. 2007) by experiencing health impacts (McMichael et al. 2008), challenges related to food security (Gregory, Ingram, and Brklacich 2005), and other effects on ecosystem services (Schröter et al. 2005). Addressing challenges like these

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will require collaborations between scientists, stakeholders, and the public (Hodgkinson, Mousavi, and Hughes 2022).

One way that members of the public can help address these challenges is through citizen (or participatory) science, whereby members of the public engage in science in a variety of ways (Haklay et al. 2021). While these projects can involve community members conducting scientific investigations independently or deep collaborations between scientists and communities, they often involve volunteers collecting or analyzing data for scientist-led research (Shirk et al. 2012). These projects address global change challenges by studying topics related to environmental or ecological phenomena (Follett and Strezov 2015). Such citizen science projects expand the spatial and temporal scales of natural resource research that would otherwise be too expensive for individual researchers to conduct, which has resulted in the protection of several species (Dickinson, Zuckerberg, and Bonter 2010; Lottig et al. 2014; Pocock et al. 2014). Citizen science projects can also contribute to the management and conservation of natural resources indirectly through education, policy, livelihoods, and capacity building (Ballard, Phillips, and Robinson 2018).

Previous research on citizen science shows that volunteers have diverse motives for participating in projects like learning, contributing to research, and interest in the environment (West, Dyke, and Pateman 2021). Other studies have examined educational outcomes like increases in scientific literacy (Peter, Diekötter, and Kremer 2019) resulting in content knowledge gains and intention to engage in environmental stewardship and advocacy behaviors (Jordan et al. 2011; Santori et al. 2021). That said, in some projects, there is little evidence of change in attitudes and behaviors, likely because volunteers join already having high conservation attitudes and behaviors (Toomey and Domroese 2013). While several studies have investigated the contributions of citizen science to science and outcomes for engaged volunteers, fewer studies have investigated how citizen science project leaders achieve these different outcomes. Those that have tend to focus on achieving volunteer goals rather than project-level goals (Davis et al. 2022) and rarely examine the perspective of project leaders (Stylinski et al. 2020).

To achieve intended outcomes like conservation, management, and scientific literacy, project leaders must balance many expectations (Anhalt-Depies et al. 2019). Project leaders often answer to an organizational director or scientist while recruiting, training, and managing volunteers (Anderson et al. 2020). They not only have to balance multiple goals, but also many people's interests, such as those of collaborators, funders, volunteers, and community members (Hoadley 2017). Thus, project leaders require skills related to both scientific inquiry and engagement to be successful (Lorke et al. 2019). This may be particularly problematic given that, in some instances, scientists are more motivated by answering research questions than managing volunteers (Golumbic et al. 2017). While there is some evidence that prioritization of research only occurs for scientists who strictly use data collected by citizen scientists as opposed to scientists who take on project leadership roles (Geoghegan et al. 2016), one study of scientists from an individual project revealed that even those more involved in project management can still experience dissatisfaction related to their goals for engaging in citizen science (Golumbic et al. 2017). If project leaders are dissatisfied in their positions, efficacy decreases and there is a risk they may leave (Adiguzel and Kucukoglu 2019). In this study, we describe the alignment and misalignment of citizen science

project leaders' goals and those of the organizations that employ them. By identifying this potential tension, organizations that endeavor to improve natural resource management through citizen science can more effectively accomplish their goals.

Theoretical Framework

According to role theory, people's behaviors in social settings can be explained by their social identities, behaviors under social circumstances, and the expectations of behaviors in these circumstances (Biddle 1986; Sluss and Ashforth 2007; Winship and Mandel 1983). Organizational role theory further explains that these roles, social positions, and expectations are determined based on tasks, hierarchical relationships, and norms within "a network of articulated roles intended to achieve the system's needs and goals" (Vandenberghe, Bentein, and Panaccio 2017, 2092). Some role theorists presume that people must adhere to prescribed norms for a role, while others argue that individuals shape their own norms while occupying a role, or perhaps multiple roles, as is the case with many project leaders (Zurcher 1983). In either case, role theory is useful in understanding organizational dynamics, especially if there are discrepant perceptions of tasks expected of a role occupant.

Dissatisfaction and subsequent decreased performance may be explained by ambiguity or conflict around roles (Tubre and Collins 2000). Therefore, organizational psychologists use role conflict theory to explain that people experiencing inconsistent expectations in a role may experience stress, dissatisfaction, and limited capacity to carry out duties (Rizzo, House, and Lirtzman 1970). This theory is used to examine the experiences of people who must balance expectations within their profession. For example, role conflict theory has been used to study how women in science balance professional and familial expectations (Polkowska 2014), as well as the experiences of scientists shifting from academic to industry research settings (Sauermann and Stephan 2013). Role conflict theory has also been used to measure employee stress and burnout when employers and employees have mismatched job priorities (Adiguzel and Kucukoglu 2019). In short, we found this theoretical framework to be relevant for studying project leaders who must balance different groups' interests and manage different types of goals. Specifically, we used role conflict theory to address three questions related to citizen science:

1. What are the different goals for citizen science projects?
2. How do goals align or misalign for project leaders and their organizations?
3. What challenges do project leaders with various degrees of alignment perceive?

Methods

To better understand the perceptions of citizen science project leaders as they relate to diverse goals and interests, we conducted a phenomenological study of project leaders' experiences managing different goals. Phenomenology is a qualitative methodology that documents people's perceptions of a phenomenon through interviews

(Khan 2014). In phenomenological studies, the researcher finds patterns across interviewees' perceptions but does not aim to verify these with additional data. This study was approved by the Institutional Review Board (#2961) at Colorado State University.

Participants Interviewed

We recruited project leaders ($n = 65$) who agreed to be interviewed about their lived experiences leading projects. We defined project leaders as anyone who ran any aspect of a citizen science project, including research related activities, volunteer management, and more. Initial interviewees were identified from the citizen science platform CitSci.org, and those interviewed recommended others to participate in future interviews through snowball sampling (Naderifar, Goli, and Ghaljaie 2017). All but one interviewee led projects based in the United States, though several worked for projects that employed volunteers from different countries. Therefore, the findings in this paper may be most applicable to a US context. The final sample also included interviewees with various roles within their organizations: seven organization directors, 23 scientists, 27 citizen science project coordinators, seven education coordinators, and one individual who started his own project. 31 of the project leaders were from academic institutions, 17 from nonprofit organizations, 16 from government agencies, and one self-started project. The project leaders worked on a range of conservation and management topics: 31 projects studied environmental phenomena (e.g., water quality monitoring), 12 studied plant biology, 10 studied birds, nine studied invertebrates, nine studied mammals, six studied marine animals, and five studied reptiles or amphibians. Finally, 60 of the project leaders led top-down, scientist initiated projects; four worked on projects that had a bottom-up, community driven structure, and one project leader worked on both top-down and bottom-up initiatives.

Data Collection and Analysis

Our semi-structured interviews with citizen science project leaders occurred between March and August 2020. The interview protocol included questions on project leaders' experiences managing goals and expectations (Appendix S1). On average, interviews lasted 40 minutes, for a total of 43.5 hours. Interviews were conducted virtually through Zoom or over the telephone and were audio recorded and transcribed. Data were analyzed using Dedoose Version 9.0.17 9.0.17 (2021).

To ensure the trustworthiness of our analysis, we engaged in iterative coding and peer and expert debriefing (Creswell and Miller 2000). The first and second authors iteratively co-coded sections of the data to compare agreement over codes (Braun and Clarke 2006) while debriefing with the third and fourth authors. We co-coded 20 interviews before achieving an intercoder reliability of 90%, after which we clarified our codebook for a final time and re-coded all of the data until there was full agreement (O'Connor and Joffe 2020).

We conducted a thematic coding (Braun and Clarke 2006) using role conflict theory as a lens to inductively identify codes and interpret our findings (Charmaz 2006, Bowen 2020). In other words, being attuned to codes related to role conflict theory

Table 1. Thematic hierarchy for determining goals. The full codebook for goals is available in Appendix S3.

Goal codes	Sub-themes	Themes
Answer research questions	Data related goals	Science goals
Collect data		
Collect high quality data		
Conserve and manage species or habitat		
Improve data management		
Meet grant deliverables		
Publish papers		
Engage in decision-making	Data use	Social goals
Data use by policymakers		
Inform organizational advocacy behaviors		
Awareness	Educational	
Content knowledge		
Develop volunteer science identity		
Engage in advocacy behaviors		
Engage in stewardship behaviors		
Increase accessibility of science		
Scientific reasoning		
Scientific skills		
Volunteer communication about science		
Volunteer communication about project findings		
Building partnerships, collaborations, and social networks	Facilitate connections	
Connect people with nature		
Connect people with science		
Connect people with scientists		
Connect scientists with local or indigenous knowledge		
Empowerment	Other social goals	
Environmental justice		
Supporting livelihoods		
Supporting local economy		
Diversifying perceptions of who a scientist is	Diversify citizen science	Citizen science goals
Diversifying volunteer base		
Acceptance of data quality	Project legitimacy	
Expand the scope of the current project	Project sustainability	
Maintain the project as is		
Project survival		
Build community with volunteers	Volunteer management	
Develop volunteer identity with the project or organization		
Engagement		
Incorporate volunteer or community interests into the project		
Recruit volunteers		
Retain volunteers		

(i.e., *a priori codes* included: role, goals, challenges, solutions, evaluations) allowed us to construct a codebook that included nine novel codes related to goals. These were subsequently collapsed into three themes: science goals, social goals, and citizen science goals related to the management of the project (Table 1). Interviewees also indicated the various challenges that they experienced (Table 2; thematic hierarchy available in Appendix S2). Our full codebook for the goals is available in Appendix S3 and for challenges in Appendix S4.

We also looked for alignment between project leaders' personal goals and their perceptions of their organizations' goals and categorized them as completely aligned, partially aligned, and misaligned (Table 3). Alignment was determined by the researchers unless the interviewee specifically mentioned a degree of alignment in their interview. While we focused on alignment between themes (i.e., science, social, and citizen science goals), we also examined alignment within goal-related sub-themes. Finally,

Table 2. Thematic hierarchy for determining challenges listed in the study. A full list of challenges described in the interviews is available in Appendix S2 and the full codebook for challenges is available in Appendix S4.

Challenges codes	Themes
Resources to develop web technology	Funding
Resources to hire more staff	
Resources to increase current staff time on the project	
Resources to maintain current staff time	
Resources to maintain the project long term	
Resources to manage large scale projects	
Resources to start a project	
Scientists outside the organizations' perceptions	Project legitimacy
Scientists within the organizations' perceptions	
Scientists within the projects' perceptions	
Volunteers' perceptions	
Bureaucratic interests vs project interests	Balancing interests
Organizational goals vs collaborating organizations' goals	
Organizational goals vs funding agency interests	
Organizational goals vs personal goals	
Personal goals vs funding agency interests	
Volunteer interests vs organizational interests	
Volunteer management vs scientific outcomes	

Table 3. Definitions and examples for type of alignment in the thematic analysis.

Type of alignment	Definition	Examples for analysis of sub-themes	Examples for analysis of themes
Complete alignment	Personal goals are the same as organizational goals or they explicitly mentioned perceiving that their goals aligned with their organization's	*Personal volunteer management goal:* recruit and retain volunteers *Organizational volunteer management goal:* recruit and retain volunteers	*Personal goals:* science and citizen science *Organization's goals:* science and citizen science
Partial alignment	Personal goals included in organizational goals, but organization also has other goals	*Personal data need goal:* collect high quality data *Organizational data need goal:* collect high quality data and conserve endangered species	*Personal goals:* social and citizen science *Organizational goals:* science, social, and citizen science
Misalignment	Personal goals not included in organizational goals	*Personal educational goals:* foster volunteer stewardship and advocacy behavior *Organizational educational goals:* increase awareness	*Personal goals:* science *Organizational goals:* social and citizen science

we investigated how project leaders' perceptions of challenges differed based on the level of alignment they described.

Positionality Statement

We acknowledge that our lived experiences affect how we interpret our data. The first author was a graduate student studying citizen and community science projects. The second author was an undergraduate researcher and pre-service science teacher. The third author is the founder and director of CitSci.org, an organization that works with citizen and community science projects to meet their different goals. The final author is a discipline-based education researcher who works in environmental education and participatory action research in science education settings. Given our collective

experience in meeting citizen science, community science, and participatory science goals and our roles as social scientists, we recognize we may have been predisposed to focus more on social goals, like education. The first two authors reduced biases by debriefing together and re-listening to audio recordings for inflection and greater context when applying codes. When necessary, expert debriefing with the last two authors helped ensure that codes were applied consistently.

Results

Identified Goals

Project leaders described their personal project goals and their perceptions of their organization's goals. We identified nine goal-related sub-themes that were then collapsed into three overarching themes: scientific goals, social goals, and citizen science goals related to management of the project itself (Table 1). Scientific goals were those that benefited scientific research, habitat management, or species conservation. For example, one project leader for a statewide water monitoring initiative said, "I took the job because I want to make a difference in water quality, and [my state], and environmental quality in general." She had scientific goals related to improving the quality of her state's rivers. Social goals focused on education, data use by those other than scientists, and facilitating connections. One beach monitoring project leader saw herself as connecting residents to scientific solutions and collaborators: "We're trying to help towns [monitor] on their own and also help them find and fix pollution sources. So, bringing in collaborations, bringing in partners when needed, to help bring the science to these local municipalities and sort of bridge that gap between them and explain the science in a way that's more relatable to other people." Citizen science goals were those related to the project itself like managing volunteers, diversifying project volunteers, ensuring project longevity, and defending data credibility. When discussing increasing the diversity of project volunteers, some project leaders discussed "connecting with audiences that aren't white," while others focused on age: "If you look at our volunteers, we've had a lot of folks who are retired who are involved […] but I'd say it's a little homogeneous. It'd be nice to have a little more diversity." Thus, goals were sorted into themes related to scientific data use, social behaviors and outcomes, and project characteristics and logistics.

Our study examined how project leaders perceived their personal goals and their organizations' goals. While personal goals for each theme were reported with approximately equal frequency, more often, project leaders perceived that their organizations prioritized scientific goals over social and citizen science goals respectively (Figure 1).

Goal Alignment

Overall goal misalignment within the 9 sub-themes was high (Figure 2a). Specifically, 77% of project leaders experienced misalignment between their personal goals and their perceptions of their organization's goals within sub-themes. Level of misalignment varied by role. Unsurprisingly, the project goals of the individual who created their own project were aligned with organizational goals, and directors experienced a higher

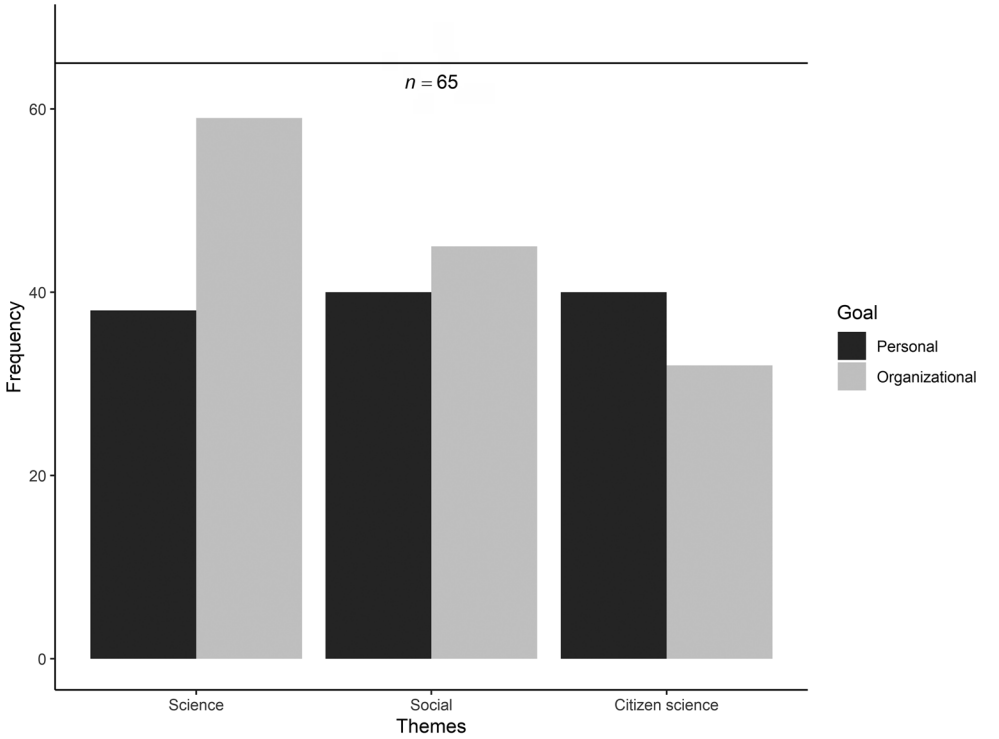

Figure 1. Project leaders reported perceptions of science, social, and citizen science goals with approximately equal frequency. They perceived that their organizations more commonly had scientific goals than social and citizen science respectively.

degree of alignment relative to other roles. Misalignment was especially common among education coordinators (Appendix S5A). There were no clear patterns in alignment by organization type (Appendix S5B).

One project leader of a large-scale water monitoring program experienced this type of goal misalignment. She noted that organizational goals were "just increasing scientific literacy to get more people understanding freshwater issues." However, her own goals were different. "Personally, […] I think our goal is to actually get communities involved in decision making, getting good data, and being able to advocate for themselves." This project leader believed that she and her organization shared educational goals (overall theme) but that her organization focused on increasing awareness and content knowledge, while she aimed for behavior change (sub-themes). She explained that when she first started working for the organization that her goals, like theirs, were focused on content knowledge:

> When I first started working on this project, the goals from my organization were quite educational focused. Then I started working with the communities, and I realized they actually knew a lot of stuff already and that was quite patronizing. They had a lot of local knowledge and observations. I was like ok this is not why I'm doing this; I'm not trying to inform people. I'm trying to give back to them.

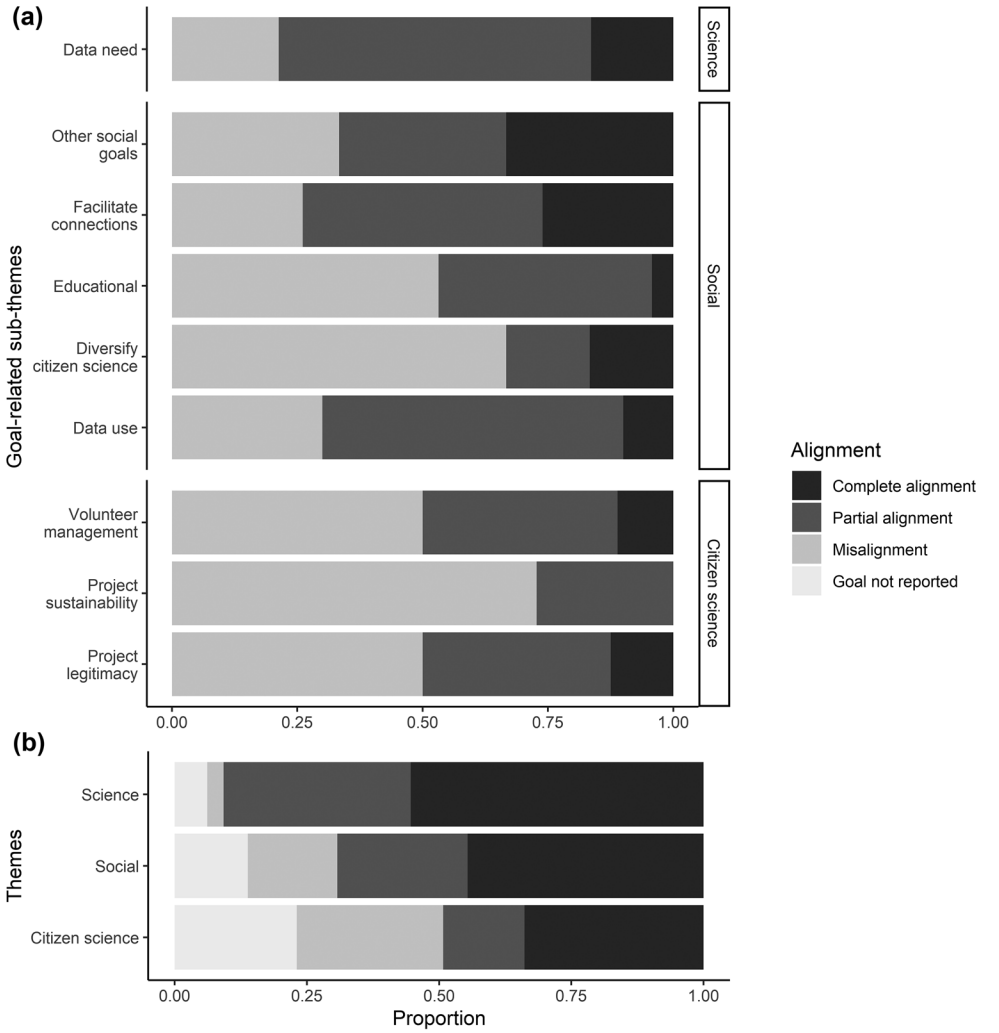

Figure 2. Proportion of alignment between goals within sub-themes (a) and within themes (b). These graphs show the proportion of project leaders who described each goal as a personal and/or organizational goal. Those who did not perceive a given goal were excluded to account for the seemingly high levels of alignment amongst less commonly reported goals. "Complete alignment" represents project leaders who had the goal and perceived that their organization also had the goal, while "goal not reported" represented project leaders who did not perceive that a given goal was their personal or organization's goal. Those categorized as "goal not reported" experienced alignment.

For this project leader, goals like increasing content knowledge and awareness were not only misaligned with her own goals, but she perceived that they were patronizing to community members. She wanted to support community members in citizen science because "…getting them involved starts to be a part of their identity. Then they vote for policies that make broader national changes, really big changes. But you don't get those national policy changes unless you get single people voting for those policies. You get the single people voting for those policies because they care about them."

For her, identity change and behavior change were more important educational goals that were accomplished by supporting communities in their citizen science efforts.

Fewer project leaders perceived that their personal goals were partially aligned (18%) or completely aligned (5%) with organizational goals. There was the highest level of complete alignment between sub-theme goals related to other social outcomes (33%) and facilitating connections (26%). Other social outcomes included building partnerships and collaborations, empowerment, environmental justice, and supporting livelihoods and local economies. There was no alignment over the need to sustain the project long-term.

Levels of misalignment were lower when we examined alignment of the three, higher-level, goal-related themes. Altogether, our analysis revealed misalignment between 43% of project leaders' goals and their perceptions of their organizations' goals, while 38% experienced partial alignment, and 18% experienced complete alignment. When interviewees experienced alignment of goals, it was most often related to scientific outcomes, while social or citizen science goals were more commonly misaligned (Figure 2b). This might be because science goals were also the most commonly perceived as organizational goals (91% of interviewees). A bumblebee project leader explained that organizational goals were related to "document[ing] declines of bumblebees," which aligned with her personal goals "to look at associations between presence of particular bumblebees and […] what types of habitats support these bees." Her personal scientific goal, to answer research questions and conserve endangered species, aligned with her beliefs about her organization's scientific goals.

Interviewees more commonly experienced that their social and citizen science goals were misaligned with the organization's (Figure 2b). One project leader working to control invasive species perceived that there was a "dual perspective" when it came to personal and organizational goals. Their organization had a heavy focus on scientific goals like "…[testing hypotheses] in a couple of study sites […] in different soil types, different habitats, different plant communities, different photoperiods, different dryness, all these different ecological regimes," However, they highlighted how their goals differed: "*My* goal is to do everything I can so that a [volunteer] feels positive about the experience" (emphasis added by interviewee). In general, project leaders focused on citizen science goals, but they believed that the goals of the organization were focused on scientific outcomes. Furthermore, 15 project leaders did not report personal or organizational citizen science goals.

Challenges of Projects by Alignment Level

Perceptions of challenges differed depending on level of goal alignment between personal and organizational goals. The dominant challenges concerned funding (capacity), project legitimacy (credibility), and balancing competing interests and goals (tensions). Funding and balancing challenges were perceived more frequently by project leaders who experienced misaligned goals, followed by those with partially aligned, then aligned goals. Data quality challenges were perceived equally by those with misaligned and partially aligned goals, and least by project leaders with alignment (Appendix S6). The following sections outline each challenge more fully.

Funding Challenges

71% of the interviewees identified acquisition of funding to be a major challenge, such as maintaining projects long-term. A butterfly monitoring project leader pointed out, "… there's a lot more willingness to fund new things. And I think one of the values of a lot of citizen science is monitoring […]. There's value in doing the same thing over and over and over." While citizen science is often used for long-term monitoring, interviewees believed that funding agencies would rather support novel initiatives than preexisting ones, creating challenges for projects studying long-term environmental phenomena. Interviewees also indicated that resources are needed to hire more staff. The leader of a wildlife camera trap project explained that: "I wish we had the funding to put together a proper team. I wish we had a database manager, and I wish we had a social media manager, and I wish we had a dedicated computer scientist. I wish I could focus on education, or I could focus on research, but we don't have the manpower to do that. So, it's a lot of running as fast as you can to stay on top of everything." This interviewee was overwhelmed with the workload for one person.

Other funding challenges included hiring web managers, increasing current staff time, maintaining staff, managing large scale projects, and starting new projects. Project leaders with partially aligned or misaligned personal and organizational goals more commonly perceived challenges related to increasing their time on the project. One partially aligned project leader of a beach monitoring project shared with us that she had three jobs and only, "…10 hours per week on this project. And, truthfully, this job is at least part-time. So, there's a lack of funding and a lack of time for me to be able to prioritize projects." She expressed her frustration trying to accomplish all her job expectations.

Project Legitimacy Challenges

Almost half (48%) of interviewees felt they needed to convince others of the credibility of their data. Across all levels of goal alignment, project leaders perceived that they had to convince scientists outside of their organization of data quality. Another butterfly monitoring project leader with aligned goals explained that "Even after we published our paper and it was peer-reviewed by [scientists], big names in the monarch world, [the academic community] would not accept our findings because we were not affiliated with a university." She described her organization's challenges because they perceived that others questioned their credibility as scientists.

Those with misaligned and partially aligned goals perceived additional challenges with scientists inside of their organizations as well. A state employee who worked with several water monitoring programs explained: "We have a very big organization. It's heavy on the engineering side. So, they don't have this inherent legacy of working with volunteers. They like to have certificates to hang on the wall. So, it's a little foreign to them." He acknowledged that engineers may have been hesitant to accept volunteer data because volunteerism is less common in their discipline. He said it was ironic that "We have folks that are in the office getting paid to do water quality management that haven't even operated a water quality meter, and they're questioning somebody else's data?"

Challenges Related to Balancing Interests

74% percent of project leaders believed that balancing project goals was challenging. Those who had completely aligned goals were more likely to perceive challenges related to running the project, like balancing volunteer management with scientific outcomes or collaborating organization's interests. A nature center project leader with aligned goals discussed this tradeoff: "Project design gets in the way of [balancing goals]. You have to spend so much time managing stuff on the back end that there's no time really to focus on cultivating relationships with your volunteers, which is the most important part." He pointed out that setting up a project can get in the way of developing relationships with volunteers, but he recognized that, "You can have great relationships with your volunteers, but if you don't actually have any data to show for it then the project [doesn't] have any utility." Thus, even if this interviewee can develop these relationships, he acknowledged that there are still scientific outcomes that need to be accomplished for it to be worthwhile.

Those with partially aligned or misaligned goals reported challenges of balancing volunteer management and scientific outcomes, as well as managing organizational interests. One volunteer coordinator's organization required all volunteers to get background checks for insurance purposes. However, the scientists in the organization did not want to lose volunteers, so they would tell their volunteers, "Don't do your background check. It's fine; you can still go out and monitor." Therefore, they not only had misaligned goals, but direct barriers to accomplishing personal goals because other scientists within the organization did not communicate the same protocols to volunteers.

Discussion

Our analysis revealed that citizen science project leaders working in natural resource management often experience misalignment between their personal goals and their perceptions of their organizations' goals. There was an especially high degree of misalignment where more specific goals were concerned (goal-related sub-themes). Citizen science goals related to project management and social goals like education were more commonly misaligned relative to scientific goals, and education coordinators often experienced greater misalignment than those in other roles. When there was goal misalignment, interviewees described additional challenges relative to their aligned peers, like the need for additional funds to support their own effort on the project and balancing project interests with their organization's interests. These results are important for citizen science because they expand how we think about structuring projects for success. They also underscore vulnerabilities that organizations face when critical employees feel stressed and consider leaving (Adiguzel and Kucukoglu 2019).

Role Conflict Amongst Project Leaders

Role conflict occurs when people experience inconsistency in their perceptions of their positions and their organization's expectations for them and can negatively impact one's capacity to carry out the duties of a position effectively (Rizzo, House, and Lirtzman 1970). Role conflict occurred in our study when some project leaders

perceived that their goals misaligned with those of their organizations. Although scientific goals were typically aligned, there was more often misalignment over social and citizen science goals. It is unsurprising that scientific goals were typically aligned because top-down projects, like many in our study, tend to focus on scientific goals (Lin Hunter, Newman, and Balgopal 2023). Alternatively, it is possible that the higher alignment between scientific goals could be because fewer codes and sub-themes were identified related to scientific goals. Given that citizen science efforts have successfully contributed to the conservation of several taxa, it may be beneficial for organizations to prioritize citizen science goals in the future.

While we did not analyze job performance specifically, we found that project leaders with misaligned goals more commonly reported challenges meeting organizational expectations. Several misaligned project leaders were part-time employees, affecting the time they could dedicate toward accomplishing project goals. Project leaders with misaligned goals perceived challenges related to convincing others in their organizations of data quality, in spite of evidence of the quality of volunteer-collected data (see Kosmala et al. 2016 for a review on the subject). When these challenges are compounded, job performance concerns are likely, underscoring the role conflict that project leaders may face. While some studies have found role conflict to negatively affect job performance (Fried et al. 1998), others suggest that the link is less conclusive (Tubre and Collins 2000). Thus, future research should investigate why project leaders experience role conflict and, given the emergent challenges our analysis uncovered, how that impacts project success or organizational culture (Adiguzel and Kucukoglu 2019).

Addressing Project Leader Challenges

Regardless of alignment, several project leaders discussed challenges related to maintaining current staff, which may contribute to the high turnover rate in citizen science employees that our analysis revealed. Alternatively, project leader positions that lack clear career progression may also increase turnover, though this idea was rarely discussed among our interviewees. However, research on nonprofit and academic organizations suggests that low pay and lack of promotion often result in high employee attrition and turnover (Knapp, Smith, and Sprinkle 2017; Sibieta and Tahir 2023). Furthermore, staff turnover can also create challenges for the citizen scientists who participate (Cross 2022). Increased funding for project leaders would require a higher prioritization of citizen science and social goals at the start of grant processes. A systematic literature review of water monitoring citizen science projects found that consistent and adequate funding was one of the attributes of successful projects (Capdevila et al. 2020), and we surmise that this is likely the case with most citizen science projects overall. In addition, incorporating project manager roles in graduate research assistantships and postdoctoral positions could also help address issues related to a lack of career progression while allowing early career scientists to develop interdisciplinary competencies like ensuring data quality, recruiting and retaining volunteers, and communicating findings.

Another challenge that project leaders faced was convincing others of the quality of their data. Regardless of alignment, project leaders had to convince those outside

of their organization of the rigor of their work. Providing documentation of the data quality throughout the lifecycle of data may help address this issue. This can include developing, implementing, and communicating strategies for data quality assurance and quality control and providing such documentation can allow for appropriate reuse (Downs et al. 2021). Strategies for demonstrating data quality include training volunteers, using standardized equipment, developing volunteers' skills over time, replication across volunteers, professional validation, as well as various statistical means of minimizing bias (Kosmala et al. 2016). In addition to demonstrating data quality to others outside of their organization, project leaders with misaligned goals more frequently had to convince colleagues within their own organizations of data quality. A lack of trust among employees in an organization can minimize job outcomes (Jiang and Probst 2015), again highlighting the impact that role conflict may play in citizen science projects. Many project leaders who did not experience this challenge described organizational support for citizen science including its incorporation into strategic plans and provision of financial resources to support citizen science efforts. Therefore, organizational valuation of citizen science may help address this need. Project leaders suggested that communicating the scientific and financial value of a citizen science project in terms of data collected and grant dollars saved was effective at increasing organizational support. Our findings are corroborated by previous studies on scientists engaged in citizen science who primarily valued scientific outcomes (Golumbic et al. 2017).

Limitations

In this study, our objective was to elucidate a more in-depth understanding of how environmental citizen science projects function, including the important role of project leaders in meeting multiple, sometimes competing, goals. While convenient, snowball sampling is often not representative because it is based on the limited networks of researchers and interviewees (Parker, Scott, and Geddes 2019). As a result of this sampling bias, we have an over-representation of top-down, scientist-driven projects compared to bottom-up, community-driven ones. However, studies indicate that most citizen science projects in the field of conservation tend to be top-down (Lin Hunter, Newman, and Balgopal 2020; Dickinson, Zuckerberg, and Bonter 2010), so our findings may indeed represent the experiences of many project leaders. Another limitation of our study is that we examined primarily environmental projects. As a result, our findings may not be representative of projects in other disciplines. Finally, we characterized alignment based on an individual's perspective. While this is the norm in phenomenological research, future studies could investigate organizational case studies to determine goal alignment from various perspectives.

Conclusions

Citizen science can benefit natural resource management through species and habitat monitoring, research in service to practice and social outcomes related to policy,

education, livelihoods, and capacity building (Ballard, Phillips, and Robinson 2018). Yet, our results revealed that misalignment between project leaders' goals and those of their organization may cause challenges accomplishing these goals. Organizations wishing to benefit from scientific outcomes related to citizen science may help best achieve these benefits by increasing the value they place on social outcomes like learning and outcomes related to citizen science such as maintaining funding long-term and communicating the value of a project. Ultimately, this study can help project leaders and organizations running citizen science projects better achieve outcomes leading to greater benefits to the species and habitats that are studied, the volunteers who participate, and the individuals who lead them.

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