Citizen Science: A Valuable Outreach Tool for Conservation Organizations

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Abstract

Citizen science is not a new concept, however its application is gaining usefulness in a diversity of areas. One benefit includes increasing public understanding of science through community engagement. Nonprofit conservation organizations can be agents of change by facilitating citizen science; at the same time, participation in these projects may also have organizational benefits. This paper investigates the usefulness of citizen science for nonprofit outreach, and discusses critical points to consider when choosing and implementing a citizen science project.

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Research and conservation efforts often face criticism due to failure to share information or poor public consultation, but nonprofit organizations (NPOs) have an opportunity to change that. In the past, career researchers were not taught how to do outreach; although, this is now being remedied (Friedman, 2008). While professional criteria for rating scientists do not put much stock in outreach efforts (Martín-Sempere, Garzón-García, & Rey-Rocha, 2008), funding bodies like the National Science Foundation are showing support for community education by requiring outreach from the researchers they support (Gura, 2013), thus encouraging a new paradigm of science education. Conservation professionals have learned, by doing, that stakeholders need to be engaged in order to become invested in an issue (Adetoro, Lawal & Jenyo-Oni, 2011; Waylen, Fischer, Mcgowan, Thirgood, & Milner-Gulland, 2010). The challenge facing every conservation-based NPO is to select an effective mode of stakeholder engagement that suits their mission. Community participation is key in cultivating a well-informed society, increasing buy-in of conservation programs, and encouraging a stronger relationship between the public and science (Bäckstrand, 2004).

Citizen science (CS) and participatory action research (PAR) are ways to bring both transparency and community participation into research (Bäckstrand, 2004, Bonney et al., 2009). Citizen science projects are typically designed by researchers who involve the community in data collection and analysis (Cooper, Dickinson, Phillips, & Bonney, 2007). By recruiting volunteers, researchers are able to expand the scope of their projects across large geographic areas and over time periods that would not be possible on a typically limited research budget (Bonney et al.,

2009; Devictor, Whittaker & Beltrame, 2010; Dickinson et al., 2012). PAR is an iterative process that focuses more on local issues (e.g. land use and resource management) and continuously cycles back on itself to incorporate community feedback to improve both the process and the end result; participants have more control because they are responsible for determining whether a satisfactory result has been achieved (Bacon, Mendez, & Brown, 2005; Gaffney, 2008). PAR encourages transparency of researcher motivations and advantages, and promotes benefits for both the researcher and local communities (e.g. training, sustainable livelihoods, and infrastructure) (Bacon et al., 2005). For the purpose of this paper, PAR will be included as a type of CS (Wiggins & Crowston, 2011).

The role of nonprofit organizations

Researchers are not always prepared to be effective communicators for community or grade school audiences (Brewer, 2002; Martín-Sempere et al., 2008; Moreno, 1999), therefore many NPOs have evolved to fill an intermediate role by digesting information produced by scientists, and sharing it with the community in a format that can be widely understood. In this way, NPOs can facilitate science outreach. However they can also help by encouraging researchers to form relationships with the community, thus facilitating participatory research and science education (Bäckstrand, 2004; Bacon et al., 2005; Moreno, 1999).

Types of citizen science

Wiggins and Crowston (2011) define "five types of citizen science projects: Action, Conservation, Investigation, Virtual, and Education" (p. 2). Investigation projects encompass the

more traditional forms of CS where participants collect data from their environment; virtual projects are similar, yet function through a web interface (Wiggins & Crowston, 2011). Action projects focus on using science to investigate local issues. Education and conservation projects both place emphasis on outreach, while conservation projects delve deeper into ecology and resource management (Wiggins & Crowston, 2011). Each type of project may have a different approach, including on-the-ground community monitoring, and the more virtual web-based crowdsourcing (Dickinson et al., 2012; Wiggins & Crowston, 2010; Wiggins & Crowston, 2011).

CS projects can have multiple objectives including "recruitment, research, conservation and education" (Bonney et al., 2009, p. 978) and some projects may focus more on one of these aspects than another. Multi-faceted projects such as Project Feeder Watch and Bird Sleuth designed by The Cornell Lab of Ornithology (CLO; www.birds.cornell.edu) provide support for the use of CS in conservation and education, and indicate that CS may be a valuable outreach tool for topic-specific messages (Bonney et al., 2009; Brossard, Lewenstein, & Bonney, 2005; Krasny and Bonney, 2005).

Choosing a citizen science project

Goals and approaches. CS projects offer numerous opportunities for outreach, many of which can help serve an NPO's mission. CS may be either reactive or proactive in its approach (Wiggins & Crowston, 2011). NPOs with an activist approach might choose to use CS for information gathering in response to a current issue. Education and management based NPOs might use CS data for monitoring, or to engage a particular audience.

If CS projects make people more aware of their environment, then those people may be more likely to use good conservation behavior in the future (Bajracharya, Furley, & Newton, 2005). CS is one way to familiarize people with a research theme or conservation target (Chandler et al., 2012), however it may not be effective in changing how adults feel about the environment (Brossard et al. 2005). The positive side to this is that the adults who choose to participate in CS may already have a good opinion of the environment. In this way, CS may be an effective means of engaging an NPOs membership, which can have overarching benefits in terms of program success, funding, and image. Additionally, volunteers are typically interested enough to pay to participate, which can assist with program sustainability (Trumbull, Bonney, Bascom, & Cabral, 2000; Krasny & Bonney, 2005).

Choosing the right path. Brewer (2002) points out five elements of outreach that highlight multiple avenues for NPOs to take a leading role in CS. Such highlights include "guiding scientists in outreach, connecting with teachers and students, and training participants" (p. 4). Each type of outreach requires different approaches, resources, and funding, allowing NPOs the option of matching a strategy to their own strategic plans and funding resources when choosing or designing a CS project (Wiggins & Crowston, 2011). The EarthWatch Institute is an NPO that links volunteers with research projects through an international travel program (www.earthwatch.org). Chandler et al. (2012) analyzed CS programs run by EarthWatch and found that they have a successful four-pronged approach. "Engaging stakeholders, inspiring action, supporting field research, and informing global and local agendas" are all interconnected activities that can lead to change (Chandler et al., 2012, p. 329).

CS projects may provide good opportunities for smaller organizations to partner and share resources (Bonney et al., 2009), however, it is vital to ensure that the project falls within the mission and goals of both organizations (Krasny & Bonney, 2005). Furthermore, partnerships with volunteers open pathways for sharing information and getting feedback from the community, which is an essential part of community-based conservation (Brewer, 2002; Devictor et al., 2010).

Finding your audience. CS projects are best designed with an understanding of the audience (Devictor et al., 2010); which is something unique to each NPO. Some of the earliest scientists were everyday people making observations of nature (Miller-Rushing et al., 2012). Building on this tradition, CS has evolved to fill many different roles in research, conservation, and education. While participants often have a college degree and make the effort to educate themselves further about their projects (Trumbull et al., 2000), CS is not restricted to professionals. Even young students and community members with no science background can successfully participate (Paige et al., 2012). Because the main principle of community-based conservation is participation, and conservation by communities is often driven by economic need, it is important for NPOs and researchers to understand the motivations of the community they plan to work with (Adetoro et. al., 2011; Campbell, 1998; Geoghegan & Renard, 2002; Granek et. al., 2008; Sharpe, 1998; Waylen et. al., 2010).

Unifying motivations can be identified by seeking out user groups to participate in conservation projects. CS methods can be designed to fall in line with and enhance what user groups are already doing (Alieu, 2010). For example, catch and release fishermen who measure and tag fish, birdwatchers, or students learning the scientific method (Fisheries Conservation

Foundation, 2013; Harnik & Ross, 2004; Loftus, Waldon, Fay, Davy & Lucy, 2000; Krasny & Bonney, 2005; Lodaya, 2013). Working with user groups is a feasible way to engage adults since the CS project then becomes part of their pre-scheduled program or job (Dickinson et al., 2012).

Case studies

Large scale, broad audience: Cornell Lab of Ornithology (CLO). Ideally, projects are very straightforward and have simple methods so that they are accessible to a larger number of people. Using these principles, CLO has been able to involve citizen scientists in data collection, submission, and analysis (Bonney et al., 2009). Participants are collecting more data and progressively committing more time to CS projects each year (Bonney et al., 2009). The process is not entirely altruistic because participants benefit by gaining skills in using the scientific method (Dickinson et al. 2012; Trumbull et al., 2000) and the satisfaction of contributing to the project (Raddick et al., 2013). Large scale established CS projects like eBird and International Coastal Cleanup (Audubon & Cornell Lab of Ornithology, 2014; Ocean Conservancy, 2014) can help NPOs begin to engage their communities without large outputs of resources. Experiences with these projects can help NPOs select and design projects for regional or local impact.

Small scale, regional action: My Science! My Conch! In The Bahamas, a CS project called *My Science! My Conch!* is being implemented by a grassroots NPO called Community Conch (2012; www.communityconch.org). The project is engaging students and community members in an effort to raise awareness about the status of the Queen Conch (*Strombus gigas)* and to collect meaningful data to influence Bahamian legislation (Community Conch, 2012; My

Science! My Conch!, 2014). Participants seek out queen conch middens within their community and measure the lip thickness of each shell using calipers; lip thickness is a proxy for sexual maturity (Stoner, Mueller, Brown-Peterson, Davis, & Booker, 2012). This project uses minimal equipment and simplified methods, which can easily be taught in a single session to teachers or others who can help expand the program. The data generated from this program have positive implications for fishery management and can help participants gain a better understanding of local conservation concerns. Collaboration with national NPOs helps to amplify the results of My Science! My Conch! while assisting NPOs with their local outreach goals.

Considerations for program development

When investigating CS as a program, and as a method of outreach, NPOs should weigh both the benefits and drawbacks before launching their campaign. For example, CS may require significant resources, whether human, material, or financial (Gura, 2013; Wiggins & Crowston, 2011). There may be challenges in coordinating volunteers or finding people who are consistently available to participate (Gura, 2013; McCaffrey, 2005). Those people who are available may need to be trained, or have varying skill levels (McCaffrey, 2005). Citizen scientists may negatively impact the resources they are helping to protect if they have inadequate training (Loftus et al., 2000). There are potential concerns about the academic rigor of CS; if data collection is a major goal of the project then NPOs should seek to overcome challenges by improving volunteer training and working with researchers to periodically verify the quality of data (Brewer, 2002; Gura, 2013). It is up to NPOs to bridge the gap between researchers and CS

participants, so NPO professionals must understand the research they are promoting and the relative abilities of volunteers (Brewer, 2002).

Despite these challenges it is important to involve the community, as participation can help empower them to inform policy change (Gura, 2013). Strategies can be employed to make it easier for people to participate, such as online databases and web forums that can be accessed anywhere and anytime (Bonney et al., 2009; Wiggins & Crowston, 2011).

Making connections

Linking Science and Education. CS may also be more easily facilitated in the classroom, allowing for the implementation of curricula focused science education and placing a classroom emphasis on outreach. NPOs have an important role here, as schools often lack the resources they need for science projects (Moreno, 1999). CS projects, such as those analyzed by Wiggins and Crowston (2011) under the categories of investigation, virtual, and education, are appropriate for classroom implementation as they can provide the structure to help conform to education standards, encourage students' critical thinking skills, and inspire changes in attitude towards science (Brunsell, 2010). Scholarship in the sciences should be encouraged to support career development and give students the confidence to ask their own questions (Harnik & Ross, 2004; Moreno, 1999). NPOs seeking to form CS partnerships with schools should make an effort to reach out to schools of various socioeconomic backgrounds while being cognizant of potential barriers to participation such as funding and literacy (Dickinson et al., 2012; Harnik & Ross, 2004; Moreno, 1999).

Teachers are also a key component in the successful implementation of class-based CS. Brewer (2002) notes that one of five key elements in designing an effective project is to collaborate with teachers. The classroom approach can aid in maintaining a successful CS program, because teachers are able to provide support to students during project implementation and their involvement provides some continuity for data collection (Brewer, 2002). However, it is important to work with teachers to ensure that the program can integrate well with the existing requirements set forth for students; otherwise teachers may be too busy to implement them (Krasny & Bonney, 2005; Moreno, 1999). The My Science! My Conch! program (2014) is a good example of this; Queen conch is an important cultural icon in The Bahamas and is a valuable marine resource, so it is integrated as a part of the Bahamian biology curriculum (Bahamas Ministry of Science, Education, and Technology, 2013). This means teachers can easily incorporate the CS project without taking away from required lessons.

Keeping People Engaged. CS provides opportunities for partnership between researchers, NPOs, and the community and to help people connect with nature (Devictor et al., 2010). Projects should play into an NPO's membership interests and needs, and if the objectives of the CS project are locally specific, the project should be tailored to the community it is implemented in (Roth & Lee, 2004, p. 19). To keep people engaged in a CS project they must feel included and informed. It is important that results are published or shared in some way as a means to follow up with participants (Bonney et al., 2009). Methods of reporting that have been successful include hardcopy and electronic newsletters, blogs, and peer-reviewed journals (Bonney et al., 2009; Trumbull, 2000). Dedicated websites report results pictorially, and provide a way to share

data (Bonney et al., 2009; Dickinson et al., 2012; McCaffrey, 2005); good examples are the International Coastal Cleanup and eBird (Audubon & Cornell Lab of Ornithology, 2014; Ocean Conservancy, 2014). CLO has hired staff to specifically interact with CS participants and provide a human connection (Bonney et al., 2009). This connection can be expanded on by creating a community amongst participants (Anderson-Wilk, 2009; Gura, 2013). Social media sites such as Facebook, Edmodo, and Google+ can be useful tools to create virtual meeting places for participants, and to share information. Incorporating the thoughts and experiences of a participant in outreach materials could be effective, because readers tend to trust someone who they consider a peer (Nabbah & Kitsantas, 2012; O'Connor, 2008).

Conclusion

While categories exist for the types of CS projects, there is no formula to decide which approach is right for an organization. NPOs should take careful consideration in assessing their goals, audience, and available resources before implementing a new CS project. CS provides opportunities to expand partnership and funding, and open communication with the community. Project sustainability is a concern and should be facilitated by seeking diverse funding sources and ensuring that participation is consistent; user groups are a potential source for participants.

Many adults participating in CS already possess positive opinions of science and the environment so this may not be an effective technique for changing attitudes of adults, but it can be an effective way to engage members and open potential sources of funding. CS does hold potential for changing student attitudes toward science (Brunsell, 2010). Teachers are powerful partners and can aid in making student CS projects successful. All participants should be kept

informed about project progress and routinely engaged to help maintain their interest in the project. If thoughtfully designed and executed, CS projects can further the mission of an NPO while engaging its membership and raising community awareness about conservation targets. Implementing CS can help bring NPOs from the role of delivering science information to facilitators of community participation and knowledge gathering.

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