Can anyone be a scientist? Exploring the role of citizen science in coral reef research

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Abstract Individuals lacking scientific training have made important contributions in many disciplines historically, but the role and value of public participation in modern professional research is controversial within the scientific community. Beneficially, citizen scientists provide a source of labor, a variety of skills, and capital. This link between the public and research serves as a bridge between science and education, creating a more environmentally informed populace. Through a survey of participants and scientists, this study evaluates and compares the role of both public and student-oriented citizen science (CS) in coral reef research, as well as professional scientists' perception on citizen science's place within the discipline. Results were analyzed using a quantitative Likert scale. Based on responses to a survey, we identified two major points that could improve CS programs: local program context should be related to coral reef studies worldwide, and the CS program should instill ways in which a participant can remain active in environmental activities beyond the program. Addressing these disconnects could optimize the effectiveness of citizen science programming, and resulting outreach within coral reef research.

Keywords: citizen science, coral reefs, perception, Likert survey

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Introduction

Citizen Science (CS) is scientific research or data collected by anyone who is not a professional in that particular field (Kruger and Shannon 2000). CS has many benefits in ecological and conservation research, as it can allow for a comprehensive analysis of large-scale species distributions (Silvertown 2009). Projects requiring large-scale data collection may not be successful without the contributions from citizen scientists (Foster-Smith and Evans 2003). CS can also improve environmental awareness via experiential learning (Dickinson et al. 2012). For the purposes of this project, CS projects included two major components: (1) training in a new skill (e.g., data collection method, species identification), and (2) active oversight and supervision by a professional scientist mentor.

Bell (2007) and Cohn (2008) note that some scientists have questioned the validity of data collected by citizen scientists for publication. However, most studies on the topic reveal that CS participants are capable of accurately collecting data. Bell (2007) demonstrated that volunteers who were trained to identify species of sponges within quadrats were capable of collecting reliable data. Only two species were misidentified 10-20% of the time, however, the author indicated that identifications improved with training. In a study evaluating students' ability to identify crab species, children of ages 3 and 7 years were able to differentiate between species with 80% and 95% accuracy, respectively. Additionally, 7-year-old children could identify crab gender (Delaney et al. 2008). Devictor et al. (2010) noted that citizen scientists have also demonstrated the ability to accurately record observations across large spatial scales. In addition to recording accurate data in these studies, citizen scientists consistently recorded occasions when they were unsure about the accuracy of an observation. This allowed data to be corrected before analysis.

CS in coral reef research

There presently exist a number of opportunities for the public to engage in coral reef science via several non-profit organizations that direct citizen science activities at multiple scales. These entities serve as a liaison between the public and research organizations to arrange public opportunities in which individuals can contribute to an ongoing scientific project at those organizations.

Within coral reef research, opportunities for contributions from citizen scientists vary, including identifying species of marine organisms, coral diseases/coral bleaching, counts of biodiversity, and measuring the spatial variations of organisms. Additionally, CS provides the scientific community a capacity to collect data over, or actively monitor, broad and diverse geographies.

Through the following analysis, we examine the role CS is playing in coral reef research, and explore potential ways to improve existing CS programs in an effort to enhance and expand the use of CS in coral reef research.

Methods

For this study, we surveyed three different CS participant groups: professional scientist mentors of CS projects, university students with some formal scientific training, and public participants in a coral reef related citizen scientist project. Public and student participants of CS are categorized separately to assess variations due to motivation or recent training. For example, students that are gaining experience in their anticipated career field may be motivated to perform at a higher level than members of the public on a similar project.

The surveys were designed to evaluate the value of citizen scientist-collected data and to understand the breadth of the impact that these programs have on students' academic development and professional careers. We evaluated the public's level of environmental awareness and activism in their own communities both prior to and as a result of participation in CS programs.

An anonymous, Web-based quantitative and qualitative survey was created using an online survey tool (i.e., Survey Monkey) and a non-identifying link was distributed to CS practitioners and participants. Relevant Web-based listservs and blogs, the Citizen Science Association, EarthWatch (a CS non-profit), and volunteer organizations such as the Reef Environmental Education Foundation (REEF) and ProjectAWARE were included in the survey. The survey was designed to complete in no longer than fifteen minutes. Survey questions were constructed to evaluate respondents' attitudes and perceptions regarding factors such as their experience with a CS activity, the value of the activity and their contributions, and their level of interest or experience with science. Survey responses were quantified and compared using Likert analyses, which provides a way to numerically represent responses (Likert 1932).

Results

The respondents to the survey included 24 CS project mentors, 7 student participants and 27 public participants.

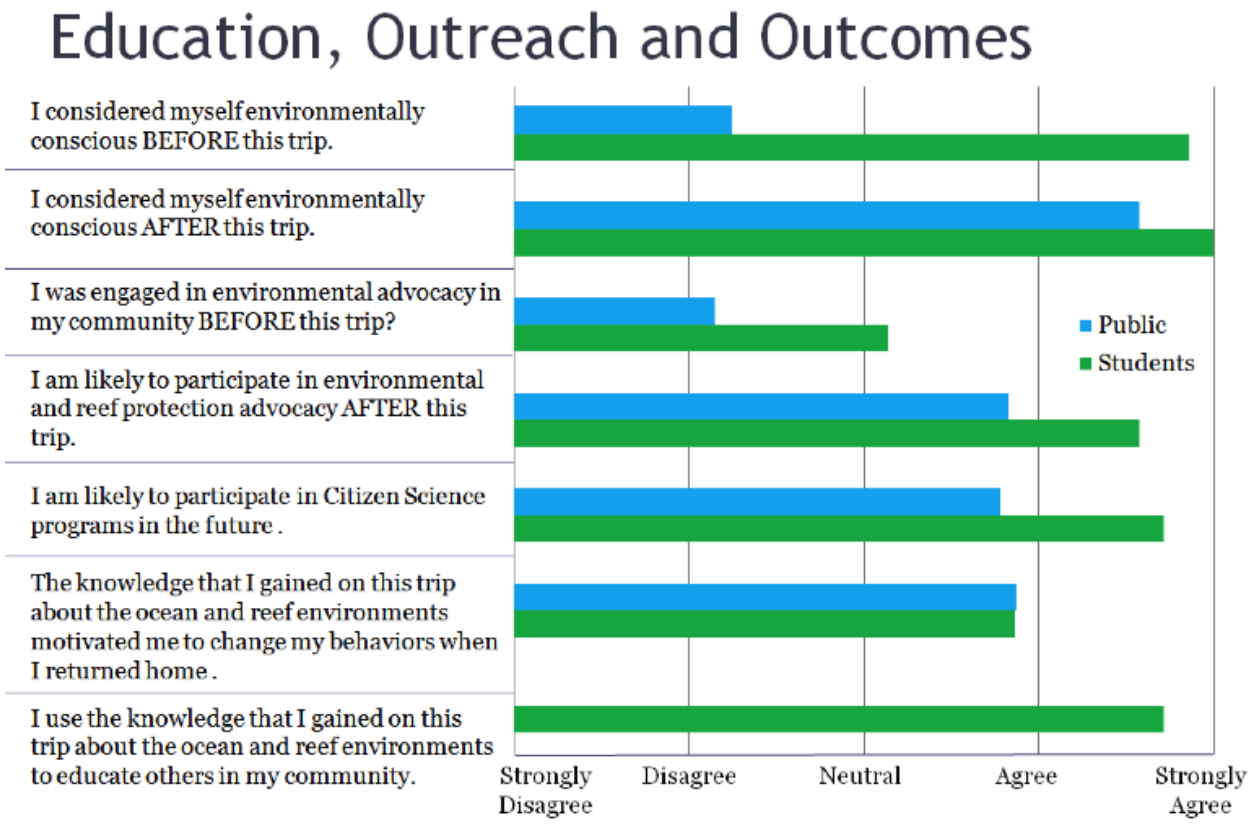

Fig. 1 Results regarding the education of participants, success of outreach and other outcomes of coral reef-related Citizen Science projects. Mentors were in agreement with participants being more environmentally conscious and better stewards of the oceans after their participation, as indicated on the figure

Participants

Public participants expressed a higher increase in environmental knowledge than did students, though, both groups showed a similar increase in motivation to participate in environmental advocacy after their program. However, when asked if participants made behavioral changes after their program, such as recycling, using fewer plastic bottles/bags, or using reef safe sunscreen, both groups responded between Neutral and Agree, despite responding close to

Strongly Agree when asked if the knowledge that respondents gained during participation was used to educate their community when they returned home. In essence, respondents were spreading the knowledge that they gained, but not making any environmentally advantageous behavioral changes (Figure 1).

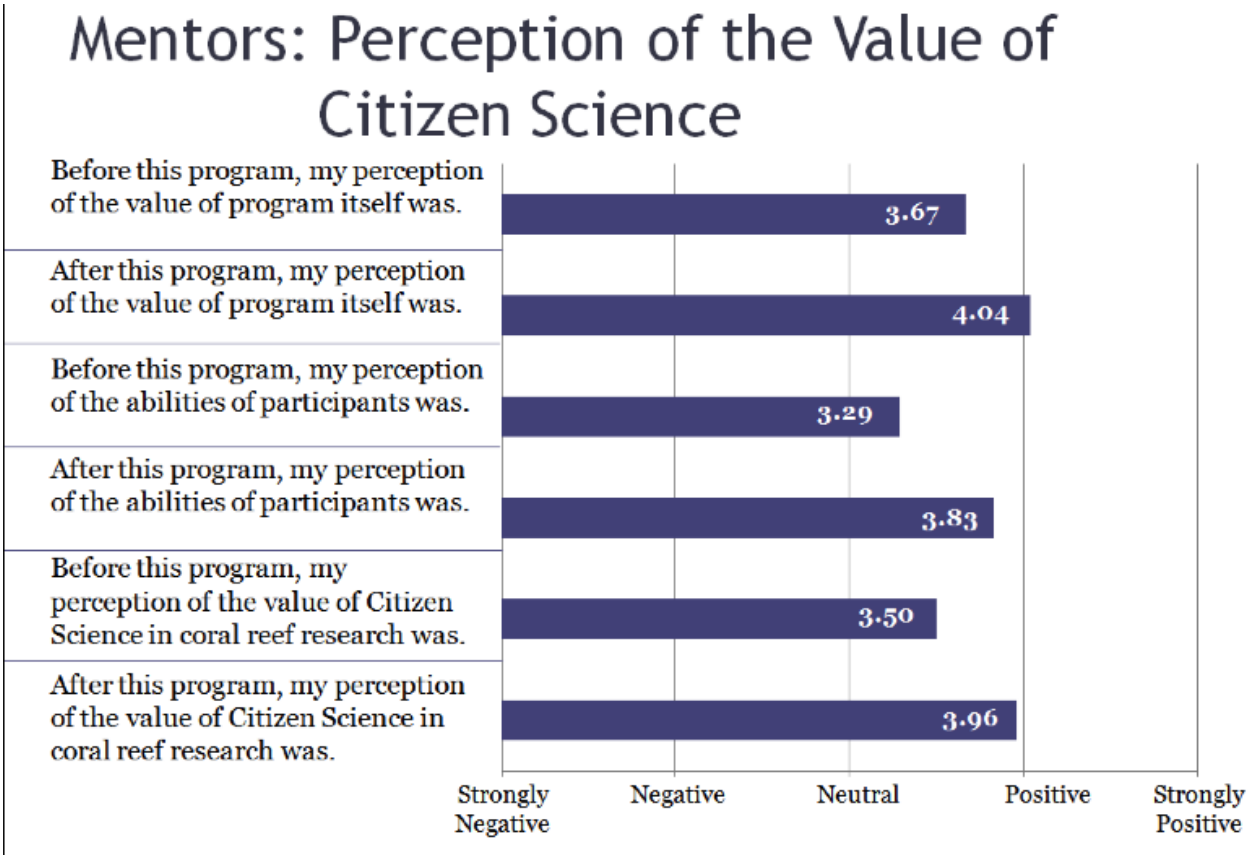

Fig. 2 Results from questions regarding mentors' overall perception of CS and its place in coral reef research

Mentors

Discrete increases in perception of the aptitude of nonprofessional participants' ability to conduct meaningful data collection and perception of the value of CS within coral reef research were seen in mentor responses (Figure 2). Also, while mentors overwhelmingly (80%) indicated that data collected by citizen scientists ought to be overseen more carefully than data collected by trained scientists, fewer than 20% suggested that citizen science data should be deemed nonviable for scientific analysis. Roughly half of mentor respondents described having involved

citizen scientists in the analysis and presentation of project data, and nearly all mentors (87.5%) responded that they have used CS-collected data in their own research.

Discussion

Participant responses indicated a disparity between becoming more environmentally conscious and acting upon environmentally responsibility. This disparity could be for several reasons – it is possible that these CS participants either were already environmentally aware and practiced environmental stewardship, or that they have limited opportunities to engage in environmental activities in their hometowns. This may be an important gap to address by project leaders in an effort to optimize environmental awareness and help extend participants' impact beyond their direct participation in a research project.

After their mentorship experiences, professional scientists generally had a more positive attitude toward nonprofessionals collecting data, and a better understanding of the value of CS in coral reef research. Additionally, the survey demonstrated that scientists are not dismissive of the contributions from CS, and are willing to use CS-collected data if collected under professional guidance. Approaches such as recruiting scientists to develop or lead citizen science projects, making data more widely discoverable and citable, and having scientists acknowledge citizen science contributions in the publication of their research may therefore bolster the role of citizen science in coral reef research.

Citizen Science programs are offering a new opportunity for the public to serve as a source of extra labor, supporting large projects, providing rapid response to environmental impacts such as coral bleaching, and filling in gaps in data collection at multiple scales. Results from this study demonstrate that the general public becomes more invested in environmental stewardship as they interact with the environment.

Acknowledgements

We thank Stetson University for supporting the survey, and the Central Caribbean Marine Institute and the Earthwatch Institute for assisting in data collecting and survey distribution.

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