

Session 88

Citizen science in support of coral reef protection and sustainability

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Citizen science: the next big leap, ICRS Town Hall Meeting

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Abstract A scientific session and public Town Hall was convened at the 13th International Coral Reef Symposium on the topic of the role of citizen science in coral reef protection and sustainability. Over 50 attendees discussed examples of successful citizen science activities and questions surrounding a broader adoption of citizen science in coral reef research and conservation. Establishing best practices, involving scientists in all steps of the program, and providing clear and continuous direction and communication were identified as some of the important considerations to enhancing the role of citizen science. This paper presents a synthesis of these discussions and their outcomes.

Key Words: citizen science, coral reefs, enhanced reef management, community engagement, data collection

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Introduction

Citizen science is increasingly contributing to coral reef science, management and conservation. There is, however far greater potential to amplify the role of such activities in addressing the issues faced by coral reefs. A meeting of more than 50 citizen science stakeholders at the 13th International Coral Reef Symposium discussed the current status of citizen science in coral reef protection and sustainability, and explored critical questions about how the use and contributions of citizen science can enhance coral reef science, management and policy decisions. Participants discussed four broad questions currently facing citizen science: (1) How can citizen science improve coral reef science

and management effectiveness? (2) How can we measure citizen science value and enhance impact? (3) How can citizen science projects be effectively mobilized in response to short-term marine issues? (4) How can we address challenges for citizen science?

How can citizen science improve coral reef science and management effectiveness?

Engaging the public in collecting data provides increased capacity to enhance its spatial and temporal coverage, thereby complementing traditional research and government monitoring to fill gaps in available datasets. Data can vary widely, including species ranges, species abundance/presence, human activities, fisheries trends, benthic cover, and signs of reef stress. Citizen scientists may include local residents, fishermen, scuba diving operators, recreational divers, traditional owners and students, who can provide quality data with proper guidance and support from scientists. The creation of volunteer networks has resulted in regular reports on local coral reefs in many countries that contribute to reef research and management. In Colombia, for example the Foundation ICRI Colombia created the National Network of Volunteer observers of the Reefs in 2008, which now also receives international reports supported by GPS-referenced photos and videos that monitor different phenomena such as the lionfish invasion and coral reef resilience (Galvis and Galvis 2016). Involving local residents and other stakeholders in monitoring for threats and measuring the effectiveness of conservation efforts is proving a viable and economical alternative to expensive, permanent monitoring techniques.

Citizen science assisted in monitoring the lionfish invasion, including their vertical and horizontal distribution on the Colombian coral reefs over the last seven years, helping to analyze the effectiveness of controlling measures and to help planning new approaches. Citizen science also has proven helpful in the identification of new coral reef areas that should be included in the Colombian Parks' Systems. Citizen science augmented data sets have therefore proven successful in helping to support assessments of management or conservation effectiveness through documenting fish presence/abundance, fisheries trend and long term reef health status trends.

Citizen science programs offer benefits beyond data collection, including meaningful opportunities for community engagement, capacity building, education, knowledge sharing, understanding stakeholder values, and building science literacy. Such programs also offer new pathways for resourcing scientific research through collaborative initiatives that utilise shared strengths and resources, creating potential for philanthropic investment in projects, and sourcing data collection capacity through volunteers. Increasingly, government agencies and philanthropic

foundations are recommending, and in some cases requiring public participation and outreach education programs in funded scientific research.

How can we measure citizen science value and enhance impact?

The diversity of citizen science activities, applications and goals may make it difficult to robustly measure their collective value. Citizen science activities can yield quantitative metrics (e.g., how many coral bleaching reports have been received, how many km of coastline have been surveyed), yet the many qualitative benefits they provide are more challenging to measure.

Session participants recognized that some of the value of marine citizen science lies in qualitative metrics for the individual practitioner (e.g., personal wellness, altruism), the citizen science group (e.g., a sense of shared goals) and society (e.g., improved resource stewardship, strengthening of community, public awareness, educational opportunities). The value of such benefits may be difficult to quantify, and therefore can be overlooked by scientists, conservation managers, and policy makers who must justify expenditure of resources with a measurable return on investment.

Convincing scientists and policy makers that contributions from citizen scientists are of a quality sufficient to be incorporated into research or policy decisions can be difficult. Such devaluation appears largely based upon a perceived limitation of scientific competence of citizen scientists. For example, a survey conducted by one session presenter (Camp et al. 2016) revealed that while few responding scientists felt that data collected by citizen scientists ought to be considered nonviable, most also responded that data collected by citizen scientists should be subject to greater scrutiny than data collected by trained scientists.

However, forum attendees were confident that citizen science activities are having a positive impact worldwide, and that those impacts can be both enhanced as well as their contributions measured in ways that improve the perception of and support for citizen science. Attendees identified several key opportunities to achieve these goals. Attendees discussed whether a global community of practice might be mobilized by organizing local-scale projects along common, unambiguous, and documentable outcomes. Preparing a so-called checklist of possible applications and/or limitations for collected data was also discussed. Such a tool would likely improve the robustness of scientific outcomes by reducing the likelihood of misinterpreting data and results.

Another theme related to the concept of wide-scale organization of local efforts was to broaden awareness and dissemination of outcomes and data. One approach to achieving these goals involved centralizing data and research results in a searchable repository. A repository approach

would permit greater discovery of the contributions made or assisted by citizen science, and would enable those who utilize information from the repository to acknowledge those contributions (and contributors) via traceable citations.

There exist many citizen science programs with proven methods, training materials and support resources. However, with such a wide array comes redundancy, and reinvention of practices that have been used elsewhere with success. As much as possible, communicating about established programs and utilising existing frameworks can reduce start up time for new activities, improve their chances for success, enhance engagement, and ensure that outcomes are comparable across projects.

How can citizen science projects be effectively mobilized in response to short-term marine issues?

Citizen science can play a vital role in responding to rapidly emerging environmental issues that affect coral reef ecosystems. Often, recreational divers, fishermen or general members of the public are the ‘eyes on the reef’, providing timely field reports. Such monitoring is often *ad hoc*, but may be enhanced if organized under a citizen science program. For well-predicted events such as the recent global bleaching, mobilization of citizen scientists can be a critical step in obtaining key data that informs an appropriate response. However to be effective, any citizen science response requires coordination, planning, management, and stakeholder engagement. Forum discussions highlighted a number of important considerations in this regard.

Any successful large scale citizen science response requires engagement and ownership by local community groups. These are the people that are passionate about their local environment and will have persevering commitment to protect and preserve their environment. However, these groups also need some understanding of the science that underpins the best approaches. When short-term marine issues arise, these groups must already be engaged and ready to respond, hence response plans should be in place well before the event to ensure the response can be quick and effective.

Vital to engaging with local community members is involving science leaders who will provide a foundational understanding for effective response and management of emerging issues. Such individuals connect the issues to the science and provide leadership within the citizen science groups. It is critical however, that this leadership is collaborative within the group rather than directorial. Often these leaders are also established and respected community members themselves, who are committed to the local areas and have grown into leadership roles.

Reaching a broad group of community members is increasingly facilitated by the availability of connective technology such as social networks and media. Social networks must be established

and mature long before they can be effectively leveraged to address an emerging issue and, more importantly, they need to maintain continual engagement. An active social media campaign is not only an essential tool to be utilised when responding to emerging issues, but a necessity to provide information before, during and after any mobilization activity. A flow of post-event information provides a linkage between an individual volunteer's effort and an awareness of effective outcomes stemming from their actions, thus enhancing future engagement.

Effective citizen science activities address scientific needs or gaps in monitoring and response activities. However identification of those needs and gaps is essential and must be formulated in close consultation with scientists and reef managers. Resource limitations require a focus on where the most impact can be made. Squandering resources or participants' time on efforts perceived as nonessential compromises the entire process and may lead to disinterest. Defined chains of response, activities, and outcomes, and how they feed into management actions are critical aspects of any citizen science program.

A successful citizen science response to an emerging marine issue will provide informative outcomes that feed the chain of discovery, knowledge, management, and policy response. Identifying key gaps in this chain is vital and planning how citizen science can fill these gaps is essential. Dissemination of successful citizen science project methods and outcomes is important to identify the factors that made these activities successful, and can inform future response plans. Identifying unsuccessful aspects of such activities is equally informative to prevent their repetition. Where activities have been successful, promotion through all channels (e.g., word-of-mouth, media, social networks), is necessary for ensuring widespread awareness and adoption of effective practices, and for energizing the broader public to become involved.

How can we address challenges for citizen science?

In addition to benefits, there are documented challenges to implementing impactful citizen science. These include the duplication of programs, acceptance of data by professional communities, maintaining and growing participation, building a financial model to ensure a solid income stream for training, targeted messaging, and connecting with participants.

Citizen science programs engage volunteers to collect a variety of types of data ranging from simple to complex. Robust scientific methods and support are critical elements for successful citizen science initiatives. To increase use, data must be trusted in the science community. Documented methods, quality assurance, peer reviews, and transparent data access build credibility. Authentic partnerships between researchers, volunteers and program facilitators grow trust, utilize strengths,

and address gaps for optimum outcomes. Engaging local communities and stakeholders in citizen science projects from the start, and sharing the outcomes also is likely to encourage community leaders to accept information and results stemming from the activity.

Citizen science is not possible without volunteers. Participants choose to give time, resources, or both, and so the program-participant relationship must be mutually beneficial. There is a growing body of research about what motivates people to become and stay involved in these programs. Science needs and the experience desired by volunteers must align to ensure success. This requires that the experience, training, and timing satisfy the needs of all involved. Efforts to train potential activity leaders (i.e., train the trainers) have been successful for increasing on-ground capacity. Integrating new technology, such as smart phones or digital cameras, into projects also opens up a wider array of citizen science opportunities and can encourage increased participation.

Retaining and growing participation in citizen science often requires a participant to perceive that their efforts have intrinsic value. Such value may be individual or collective. One way to both engage and maintain enthusiasm from the volunteers in citizen activities is to provide a tangible and recognized training program. An effective approach to build programs is to provide the volunteer with a certificate or qualifications that can aid their pursuit of marine science in the future. Another approach to valuing a participant's efforts is a public acknowledgement by those who have made use of the participant's contributions.

Finding and maintaining sufficient capacity to train volunteers reliably, providing ongoing support, maintaining stakeholder communications, ensuring data consistency, and translating data into science products all require resources. A strong, open and lasting financial model to fund the citizen science activity is essential. This is also critical for effective training of participants to ensure collected data are robust and support the desired outcome of the project. Such models may require cultivating financial relationships with, for example, granting organs, philanthropic donors, or even the communities served by the activity. But to ensure the longevity of such relationships, citizen science activities must continually demonstrate their value. A large part of such demonstration is via a strong communications strategy.

Clear communication of unambiguous project goals, outcomes and impacts is essential, and must be targeted to all levels of stakeholders: the local community, the volunteer citizen science participants themselves, funders, the scientist and reef managers and even the local and national policy makers. A unified message that is tailored to each stakeholder group can optimize engagement and align expectations from each group along a common theme.

Developing and implementing citizen science projects that also take into account cultural sensitivities was also identified as important, especially as citizen science can assume a multitude of meanings and interpretations. Therefore, clarifying the approach and ensuring open dialog is crucial to positive stakeholder communication strategies. Furthermore, engaging local communities in citizen science opens the science to incorporating valuable indigenous knowledge, knowledge that may otherwise be overlooked when the science informs management decisions. For example, a single scientist surveying the coral reefs around an island over the course of a month or two to inform the establishment of an MPA may easily miss an important spawning aggregation that occurs once a year in a certain location; an event that would likely become known to the scientist if they were to engage the local community in helping to survey the reefs.

Discussion

The wealth of information contributed by attendees of the session and Town Hall on Citizen Science for the Protection and Sustainability of Coral Reefs indicated that clearly the role and importance of citizen science activities in reef studies and conservation is growing rapidly. With such growth, however, come challenges, and it was evident that much more dialog must occur as citizen science evolves as an accepted means of contributing information critical to coral reef science and management decisions. Key among the factors that attendees felt needed to be addressed were establishing best practices from successful programs, improving perceptions of the quality and consistency of citizen science data, facilitating better access to those data, recognizing the value of contributions made by citizen scientists, developing and implementing sound engagement and communications strategies, ensuring consistent funding for developing and implementing citizen science, and enhancing the role of professional scientists in guiding citizen science activities.

Outcomes from this ICRS conference forum included establishing an electronic list of attendees who are interested in continuing the citizen science conversation, launching a Facebook group dedicated to communicating about coral reef citizen science efforts, and soliciting case studies that could serve as models for establishing a suite of best practices for citizen science projects. Such beginnings can have a broad and positive impact on emerging applications of citizen science in coral reef research and management.

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