

Editorial

Power of the People?

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In 2011, the global community witnessed a groundswell of political change and reform that few thought was ever possible given how firmly entrenched these regimes were in North Africa and the Middle East. The ‘Arab Spring’ came to fruition by the will of people and their desire to change their lives and reverse the seemingly ever downward trajectory of their society and economies, and reject the status quo. We saw how this revolution moved from one country to the next leading to a series of unprecedented protests and civil disobedience in over 15 nations across the Middle East.

However, all of this would not have had the pace and momentum it did without the use of personal technology (i.e. mobile phones), the internet and social media. These communication platforms and media made it possible to quickly organize, communicate, and raise awareness in the face of repression and internet censorship (Howards, 2011). The imagery and information (i.e. data) came at almost real time and fuelled the winds of change, not without consequences but change nonetheless. The speed and force with which the data were forthcoming had analysts and media outlets scrambling to try to process the volume of information in order to assess the magnitude of the events, predict potential outcomes, and mobilize others (including foreign governments) into action. At the same time, citizens of other countries became empowered and motivated to take action themselves as they watched and listened to eye-witness reports through the internet (e.g. YouTube) that were obtained using a mobile phone camera, and read of the plight of their comrades, via Facebook and Twitter.

I highlight this current event as it underscores the power of people and crowd-sourcing to make fundamental shifts in society, which a year ago any one of us would have thought to be impossible. This comes at a time when we are reminded, on almost a daily basis, that the ocean is being assaulted by a number of stressors (e.g. overfishing and nutrient/sediment run off) which, when added to those associated with climate change, puts the world’s ocean at a very high risk of entering a phase of extinction of marine species unprecedented in human history (Rogers and Laffoley, 2011). While I do not dispute the validity and high probability of this, especially having witnessed considerable decline in the health and biodiversity of the ocean in the last three decades, I reject that this is a fait accompli.

While ocean related media grabbing headlines may sell newspapers, and attract research funds, they also further deepen a sense of hopelessness and apathy among those who are the solution – people. I cannot help feel as a marine conservation and science community that we are not providing enough options, being more solution orientated and considering ways to empower people to make the changes necessary to move away from the extinction prophecy which may lie on our horizon if we do not change. (Vincent, 2011), in a recent editorial for this journal, noted that we need to find new ways to help people recognize and respond to their connections with the ocean, and I could not agree more. Yet this is no easy task and success is dependent on our ability to resolve many of the drivers of ocean stressors, such as the focused drive for economic prosperity and wellbeing,

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development and the absence of political will. We need to make people part of the solution as opposed to the problem and one such way is to seek innovative approaches to engage all sectors and facets of society and to create a force for change in the form of citizen scientists, public ecologists and citizen conservationists. While it may not be the equivalent of the 'Arab Spring', getting people involved is the first step to connecting the uncommitted to the sea and tapping into their interest and engagement for action towards ocean conservation (Vincent, 2011).

CITIZEN SCIENCE

The involvement of concerned and interested citizens in science is not a new idea or concept. Indeed many of the scientists in the 18th and 19th centuries pursued science as a hobby rather than a profession. This included the likes of Charles Darwin (1809–1888) who originally did not join the HMS Beagle as a professional naturalist but rather as an unpaid companion to Captain Robert Fitzroy (Silvertown, 2009). Today citizen scientists come in all shapes and sizes and can find themselves in a great diversity of locales be it in front of their computer at home, using their mobile phone while on holiday to take pictures or on a windswept atoll in the middle of the ocean counting birds – while unique in location, all are collaborators in helping to monitor and respond to the challenges which face the world's ocean in a manner that would not otherwise be possible in the same space and time by a single investigator.

Typically, citizen scientists are people who care about the wild, feel at home in nature, have a passion or hobby which involves the natural environment (flora and/or fauna), want to feel like they are making a difference while exploring new places, seek an experience where they help solve environmental problems, and have some awareness of the scientific process learning new things about nature (Gilmour and Saunders, 1995; Ryan *et al.*, 2001; Bruyere and Rappe, 2007; Cohn, 2008; Goffredo *et al.*, 2010; Evely *et al.*, 2011). Major environmental events or disasters (e.g. the 2010 Gulf of Mexico oil spill, Exxon Valdez, Indian Ocean earthquake) can also motivate people into action in unusual and innovative ways through social networking, blogging and a long list of gadgets.

Within that context, (Bonney *et al.*, 2009) have outlined a useful typology to describe what they term 'public participation in scientific research' (PPSR):

- *contributory projects*, which are generally designed by scientists and for which members of the public primarily contribute data;
- *collaborative projects*, which are generally designed by scientists and for which members of the public contribute data but also may help to refine project design, analyse data, or disseminate findings; and
- *co-created projects*, which are designed by scientists and members of the public working together and for which at least some of the public participants are actively involved in most or all steps of the scientific process.

At the most basic level, citizen science is a technique that enlists the public, typically as unpaid field assistants or volunteers, in gathering scientific information. Volunteers, which can also include vacationers, community groups, school classes, outdoor sporting and recreational clubs, and natural history societies, represent a huge workforce and a free source of skills, local knowledge and computational power. Their involvement allows scientists to gather data on larger geographic scales and over longer (or shorter) time periods than is possible in more traditional scientific research. Indeed, many research and survey programmes would be financially impossible to implement without citizen scientists and, as noted by Boakes *et al.* (2010) and Goffredo *et al.* (2010), citizen scientist-based projects are thus likely to become crucial to monitoring the world's biodiversity. Given the current economic climate and the bleak forecast for the future, we are living in an age where research funds are increasingly hard to come by and funders are wanting more for their money. I therefore believe we need to be martalling this potential valuable resource. While there appear to be few studies estimating cost savings as a result of such programmes, one recent study (Levrel *et al.*, 2010) concluded that the savings to the French government as a result of volunteer monitoring and documenting biodiversity in fulfillment of just one CBD indicator ('trends in the abundance and distribution of selected species') was anywhere between 678 523 and 4 415 251 euros per year, depending on the scenario selected.

While not widely commonplace in the ocean community, the use of volunteers in environmental research dates back to the late 1800s as a means to

track bird migration habits. Since then, various environmental research and monitoring studies involving the volunteering public have been remarkably successful in advancing scientific knowledge (Foster-Smith and Evans, 2003; Schmeller *et al.*, 2008; Silvertown, 2009). The Christmas Bird Count, for example, which began in 1900 as an alternative to the Christmas hunt, has now become a major source of scientific data on the status of North American birds, and in the most recent count tens of thousands of observers counted a total of over 63 million birds (Silvertown, 2009). The use of technology applied to citizen science is relatively recent (1999) and was popularized by the SETI@home project by the University of California, Berkeley, which mobilized home computing 'down-time' that was voluntarily made available to sift through terabytes of radio telescope data in search of alien signals (Hand, 2010). Alien life may not have been found in this citizen science exercise but there is undoubtedly an appetite for participating in unique and well thought out science-based activities. Therefore, while countless observations have been made in the terrestrial (and extra-terrestrial) environs, the marine community is lagging behind comparatively in terms of mobilizing an 'army' of scientists willing to help to address ocean issues on the spatial and temporal scales necessary to make progress and alter the current predicted ocean future.

MARINE CITIZEN SCIENCE

This is not to say that there are not any significant marine citizen science efforts. On the contrary, there are quite a few, albeit not as internationally widespread as one would hope given that the oceans cover over two-thirds of the planet. We therefore need to encourage colleagues and friends to get involved with citizen science and help people both connect, and deepen their relationship, with the ocean. Likewise, funding institutions need to invest more into these efforts if we want to make significant progress in the coming decade and avoid the ocean extinction prophecy. Enhanced environmental ownership or 'citizenship', particularly of marine systems, (see McKinley and Fletcher (2010) for a discussion of this) is often viewed as critical to furthering citizen involvement in the development and implementation of policy.

There has been, and continues to be, a wide range of marine-related research involving volunteers with, importantly, data quality acceptable for publication.

Coral reef biodiversity assessment and monitoring programmes in particular have shown great success with the use of volunteer divers (Schmitt and Sullivan, 1996; Pattengill-Semmens and Semmens, 1998; Barrett *et al.*, 2002; Bell, 2007), including a near global survey by *Reef Check* (Hodgson, 1999; Hodgson and Liebler, 2002) that appears to have been critical in alerting many scientists and governments to the deteriorating conditions throughout many of the world's reefs. New initiatives are being launched regularly with the latest being an online platform which seeks to engage the world's 20 million divers to connect and help monitor the life underwater in real time through science, community and multimedia (Cousteau Divers, 2011).

Volunteers are also being used in a wide variety of other ways including, for example, tracking invasive species (Semmens *et al.*, 2004; Delaney *et al.*, 2008), monitoring seagrass cover (Finn *et al.*, 2010), assessing abundances and/or distribution of species such as seahorses (Goffredo *et al.*, 2004), sharks (Huvneers *et al.*, 2009) and lobsters (Ellis and Cowan, 2001), for tagging, nest monitoring, and measuring of sea turtles (Campbell and Smith, 2006), sand dune monitoring and management (Evans *et al.*, 2008), monitoring of disease conditions (Evans *et al.*, 2000), marine debris monitoring (Rees and Pond, 1995), and maintenance of invertebrate nurseries (Bonney *et al.*, 2009).

Local (LEK) and traditional ecological knowledge (TEK) – knowledge which can often constitute an 'expert system' (Campbell *et al.*, 2007; Grant and Berkes, 2007; Mellors *et al.*, 2008; Peloquin and Berkes, 2009) – are often underestimated or overlooked by technical science (Kelsey, 2003; Brook and McLachlan, 2008) yet offer enormous potential in monitoring and management initiatives (Moller *et al.*, 2004). Furthermore, its inclusion in research endeavours not only expands the competency and validity of information but also increases the legitimacy of the final outcome (i.e. when stakeholders consider themselves to be part of a fair process), and enhances or affirms democratic ideals (Webler *et al.*, 1995).

Many fishers, for example, should also be considered as citizen scientists though with the added value of having access to knowledge developed and compiled among themselves that can often span generations. The acuity of commercial fisher observation was made evident in a recent study (Rochet *et al.*, 2008) that was designed to compare fisher knowledge with survey data in English Channel fisheries. It was found that not only did they have an accurate perception of change but they

had greater power than survey data to detect it on short time-scales. The study's authors concluded that there is great potential to use fishers' perceptions as early warning signals. In fact recently there has been considerable momentum in the European Union (see www.gap2.eu) to bring together fishery scientists and managers to develop a participatory process that incorporates their experience and intuitions to influence, particularly within a framework that supports informed stakeholder-led fisheries management.

The potential value of incorporating TEK in the success of marine species conservation has been noted in programmes in Micronesia and Kiribati and marine reserve design in Belize (Drew, 2005). Importantly, too, (Drew, 2005) noted that the process of actively incorporating TEK offers the opportunity for long-term collaboration and advancement of involved communities' scientific understanding. However, and while the benefits of LEK/TEK are being increasingly recognized, its application in many contexts can be an arduous process requiring multi-disciplinary approaches (Huntington, 2000; Wiber *et al.*, 2009). Nevertheless, I feel that this model is one which is notable for connecting people and society to the ocean.

A brief mention should be made of volunteer tourism (or 'participatory environmental research tourism') where travellers contribute time and income to a particular project. Groups such as *Earthwatch*, *Caribbean Conservation Corporation* and *Coral Cay Conservation* offer programmes which involve an active science component, including those working with marine species (e.g. Mumby *et al.*, 1995; Campbell and Smith, 2006). This tourism sector appears to be growing (Brown and Morrison, 2003) and has recently drawn substantial research attention (Brightsmith *et al.*, 2008; Cousins *et al.*, 2009). Somewhat related are 'employer supported volunteer initiatives' in which conservation organizations partner with corporations who are willing to donate staff time to carry out conservation activities.

THE REVOLUTION WILL BE TELEvised – OCEAN SPRING

We live in interesting times where people are shaping democracies and making history in front of our eyes. We live in changing times where unprecedented alterations of our climate and environment are happening at rates never witnessed before or observed in the geological record. We live in fast times

where information travels at breakneck speeds and when an event happens on the other side of the world from the mundane to the extreme, it is in our inboxes and Twitter accounts within seconds – imagery and all. The world is increasingly getting plugged in to the information superhighway – even once remote locations are beginning to be not so remote. Much of this is down to the explosion and proliferation in relatively inexpensive mobile and personal technology. A recent estimate suggested that the number of gadgets worldwide in circulation will top 6.8 billion by the end of 2012, and China and India alone will have more than 1 billion mobile phone subscriptions during the first half of 2012.

We need to take advantage of this opportunity which is presenting itself and design research and monitoring programmes around citizen scientists that draw directly upon the development and proliferation of information and communication technologies, such as electronic field guides, mobile computing, and web-based data collection programs (Stevenson *et al.*, 2003; Balram *et al.*, 2004; Gouveia *et al.*, 2004; Roberts *et al.*, 2005). Already various apps have been developed and initiatives started which specifically use smartphones (iPhone, Android, etc.), for example, in the field identification of European crayfish (De Vaugelas *et al.*, 2011), which are leading by example.

Citizen science is not without its sceptics and detractors, and despite the myriad of advantages some seem reluctant to embrace and accept citizen science (Goffredo *et al.*, 2010). I agree that the non-specialist collecting data may give rise to data quality issues but we must persist in order to improve the quality of the data and ensure that valuable opportunities are not going to be missed.

It is my hope that we will soon see citizen scientists engaged in a greater diversity and number of projects and activities. This will see the generation of massive amounts of data, across large geographical scales drawing upon the full range innovative tools including social networking technologies and platforms, distributed and cloud database solutions, and computationally efficient geospatial analysis and imaging techniques. The sum total of this will not only further the science and our understanding of the ocean and our coasts but will lead to an enhanced appreciation and connection with the ocean by a greater number of people than ever before. With this 'army' of ocean advocates it is hard to believe that we will not see an 'ocean spring' and restoration of ocean health.

I can only hope that society realizes that an 'ocean spring' is possible and may help to connect

people to the ocean and take charge of the ocean's destiny. Perhaps it is time that we as a community lead by example and really stimulate the power of people.

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