# Citizen Science, the benefits and challenges: How do you make citizen science both fun and useful?

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## Abstract

Citizen Science is gaining in momentum and popularity as a means to aid and benefit academics and natural resource managers. However, the benefits of Citizen Science are so much more. Citizen Science advances community education, scientific knowledge and innovation, it can reduce the costs associated with the management of natural resources and it facilitates collaboration.

Citizen Science is also not without its challenges. Data collection taxes a community group's time and resources. How do you make the data useful and what are the legal, technical and financial hurdles and pitfalls around which a community group must navigate? How do you make citizen science both fun and useful?

Wildlife Queensland manages many community science projects from simplistic online based systems to those projects funded to the order of $100,000 annually and supported by a team of skilled employees. These projects all have their own benefits and challenges. A number of these projects employ innovative techniques and new technologies, they certainly generate useful data and they engage communities and are collaborative by nature. Wildlife Queensland can bring useful awareness to those interested in pursuing, advancing or using citizen science within their organisation.

## Introduction

Citizen science is defined as the involvement of volunteers in science (Tweddle *et al*, 2012). Though Citizen Science is a new term the actions are not. Silvertown (2009) shows us that Benjamin Franklin (1706) was a printer and politician and Charles Darwin (1809) an unpaid guest of Captain Fitzroy on the Beagle. Neither made a living as a professional scientist. Despite citizen science's deep rooted beginnings there are few papers dealing specifically with Citizen Science. Silvertown (2009) stated in January 2009 the ISI Web of Knowledge database contained only 56 articles specifically dealing with Citizen Science, 80% of these published in the last 5 years. Yet hundreds of scientific publications investigating large-scale pattern and processes are based upon data gathered by citizen scientists (Silvertown, 2009), (Devictor et al., 2010). Though the growth in Citizen Science is partly due to re-branding (Roy *et al*, 2012) there is real growth. A recent check of ISI Web of Knowledge database revealed there are 1,433 articles on the topic of Citizen Science under the criteria of Environmental Science and Ecology. Scientific America likewise shows there is an abundance of exciting and worthy community science projects (Scientific American, 2013). The drivers of this growth are stated to be increasing costs and logistical difficulties faced by scientists and increasing confidence in the accuracy of Citizen Science data (Roy *et al*, 2012). Advances in technology, such as iPhones and their ability to take GPS referenced images enable the growth of Citizen Science.

Wildlife Queensland advocates and supports Citizen Science. The Wildlife Preservation Society of Queensland (WPSQ) is the oldest, largest wildlife-focused conservation group in

Queensland. Currently WPSQ manage 9 Citizen Science projects. The most notable are Quoll Seekers, Queensland Glider Network, Moreton Bay seagrass monitoring and Moreton Bay Mangrove Watch. Many of these projects are successful and it's perhaps not surprising as biodiversity monitoring lends itself well to Citizen Science (Roy *et al*, 2012). This paper will examine a number of these projects with the aim of providing insight into the benefits, costs and innovations that arise from Citizen Science.

## Projects

The success of a project is generally determined by the enjoyment the volunteers gain by participating in a project and the confidence they have in the usefulness of the data they collect (Roy *et al*, 2012). Wildlife Queensland's Citizen Science projects have very specific aims and use robust methodologies, which are learned through formal class and field training and mentoring.

- Quoll Seekers Network (QSN) was established to raise community awareness of quolls in Queensland, gather information on quoll populations, and help people enjoy living alongside quolls. http://www.wildlife.org.au/projects/quolls/
- Queensland Glider Network (QGN) aims to raise awareness about gliders and their habitat requirements. The QGN aims to improve community knowledge and interest in gliders..
  http://www.wildlife.org.au/projects/gliders/
- Moreton Bay Seagrass Monitoring works with the award winning Seagrass Watch (SGW) program based at James Cook University. SGW aims to raise awareness of the condition and trends of seagrass populations and to provide an early warning of major coastal environmental changes. Methodology can be viewed at http://seagrasswatch.org/manuals.html
- Mangrove Watch is a response to an urgent need to preserve and protect threatened tidal wetland ecosystems. James Cook University Marine Scientists have devised the mangrove monitoring methodologies used by Citizen Scientists. The overall aim is to have baseline data from which to assess future change. Methodology can be viewed at http://www.mangrovewatch.org.au/

These projects fall into one of three classes of Citizen Science.

- **Contributory projects** – those designed by scientists and participants who primarily collect data.
- **Collaborative projects** – those designed by scientists but participants are involved in more than one aspect of the scientific process.
- **Co-created projects** - those designed collaboratively between scientists and participants.

Many of the projects WPSQ manage can be classified as collaborative or co-created projects. Mangrove Watch and Seagrass Watch are examples of collaborative projects while Quoll Seekers and Queensland Glider Network are co-created projects. Interestingly, Roy *et al* (2012) reveals many citizen science project were contributory projects.

## How do you measure success

When committing volunteer time and organizational resources to a project it is essential to know if the project delivered meaningful results (success).

There are several components to success. Success is achieved when the data is accurate, when volunteer's enjoyment and motivations are met and the project is clearly leading to improved management decisions and or environmental outcomes.

An example of how not to measure success can be found in the key performance indicators associated with federal funding arrangements. Under federal funding Moreton Bay Seagrass monitoring was only required to engage at least 10 community groups and submit a number of financial reports. These KPIs don't improve knowledge or advance environmental protection. Little surprise that the State of the Environment Report (SOE, 2011) found that despite billions of dollars being allocated to the environment the decline in biodiversity has not been reversed (SOE, 2011).

Confirming the accuracy of data collected should be part of any scientific undertaking. Finn *et al.* (2010) confirmed the accuracy of Moreton Bay seagrass monitoring and showed volunteers were as capable as trained staff in seagrass monitoring. Likewise Crall *et al.* (2011) stated volunteers were capable of fairly reliable cover estimates using plot-based assessments if provided training. A point recently covered by Environmental Decision Group publication Decision Point (Issue 73) who showed volunteers were competent at producing usable data from above-ground carbon-stock measurement project (Butt, 2013). Mangrove Watch has also achieved considerable success when it comes to collecting data chiefly through the result of thorough training.

Both Seagrass Watch Headquarters and the Mangrove Watch HUB at JCU provide excellent training. The certificate system in particular initiated by SGWHQ motivates volunteers to aspire to higher levels of competency. These aspirations can lead to a more informed public when it comes to matters of science and coastal management. Brossard *et al.* (2005) suggesting that a well-designed citizen-science project can provide an environment for increasing adult knowledge of science.

**Volunteer's enjoyment and motivation** can be measured by volunteer attrition rate and by attendance.

The seagrass monitoring project has been in operation since 2003.

- Between Nov-Dec 2003 survey period to Jul-Aug 2010 on average 29 of the 54 sites were monitored every survey period (3 surveys per year).
- Between Nov-Dec 2003 survey period to March-April 2013 on average 24 of the 54 sites were monitored.
- Of these sites 6 had been monitored 25 times out of the potential 30 times, 13 had been monitored more than 20 times, and 33 had been monitored more than 10 times.
- At least 6 teams have not changed since they commenced 10 years ago.

There are many reasons why sites are not monitored, weather, availability of vessels or team members and the attrition rate of teams. Heavy rain in late 2010 and floods in 2011 and a reduction in available funds saw volunteer numbers drop. An attrition rate in any Citizen Science project is to be expected. A turnover of 15% a year even in a successful project is not surprising. However, a loss of 15% or greater can readily arise if volunteers are not engaged. If projects funding source diminishes communication does likewise. The outcome in 2011 was expected because volunteer engagement could not be maintained given the size of the project and volunteer base. It is also important to note that volunteers need to be provided opportunities to advance their talents (Roy *et al*, 2012). While in the early stages of a project this is not an issue, in the long-term it is.

Meaningful outcomes can take many forms. Table 1 shows some of those achieved.

| Project | Identified success |
|---|---|
| **Mangrove Watch (video methodology)** | • 2 Training Workshops.<br>• 1 Community art--show and data presentation event (attended by several hundred)<br>• 50 community members trained.<br>• 20 Mangrove Watcher participants.<br>• 178km of shoreline filmed (as of April 2013) across 11 locations. A significant amount of baseline data now available for anyone to use.<br>• >100 hours of volunteer time.<br>• 50 km of shoreline assessed. Report provided to state agencies and councils. Provides guidance on potential restoration sites.<br>https://www.dropbox.com/s/ehxak0nmnwq3wlk/MangroveWatch%20Moreton%20Bay%202012%20Data%20Summary_200613.pdf |
| | 271 GB of video and photographic data. |
| | A plan to revisit all monitored sites in 2014 is underway. |
| **Moreton Bay Seagrass monitoring** | 54 sites across 20 regions in Moreton Bay set up.<br>355 volunteers on the database with 252 trained.<br>Over 10 years of data collected providing a significant source of useful seagrass data.<br>Temperature monitoring (4 hourly over several months) at sites undertaken over several years. |
| | Dugong feeding sites found on Western side of Moreton Bay (Ormiston and Wynnum). This information used to alter Marine Park permit conditions. |
| | Impacts of 2009 storm damage to Amity Banks captured and recovery of the seagrass meadows documented via photographs. Providing some insight into natural recovery. |
| | Data used with remote sensing applications.<br>An Integrated Field and Remote Sensing Approach for Mapping Seagrass Cover, Moreton Bay, Australia (Roelfsema *et al*., 2009).<br>Remote sensing of Moreton Bay intertidal seagrass meadows (MBSGW). |
| | Lyngbya monitoring across Moreton Bay. (Early warning system). Used by EHMP Healthy Waterways. |
| | Quality assurance of others data. i.e. able to make objective comment on the potential impact of dredging operations. |
| | Quality assurance of MBSGW data: (Finn et al., 2010) |
| | Photographic and video library of MBSGW data has been collated and made publicly available. |
| | Data provided to State agencies, Local Councils, consultants and researchers on request. |
| | Volunteers formed the foundation of the anti-Fin Fish Farm project in Moreton Bay. |
| **Queensland Glider Network** | Developed remote camera monitoring of glider nest boxes. |
| **Quoll seekers** | Remote sensing camera successfully used to monitor presence of quolls. |
| | Recently identified a quoll in Scenic Rim. |

Table 1: Table of achievements.

WPSQ Seagrass and Mangrove monitoring projects use internal reports to help determine success.

WPSQ projects are designed to improve our understanding about our natural environment; the belief is you can’t manage well that which you don’t understand. The same applies to WPSQ’s projects. Reporting is used to help understand how the projects are performing. WPSQ reporting covers the following topics.

1. Volunteers – status on numbers, participation and recipients of publications.
2. Workshops and training – what was undertaken and when.
3. Locations and sites – status on sites.
4. Monitoring – what was monitored and when and review outcomes.
5. Data summary – the data is summarized, basic trends and analysis undertaken.
6. Overview of seagrass/mangrove condition – an assessment is made.
7. Data accuracy and consistency – a review of quality assurance.
8. Budget – a review is undertaken. Projects are audited annually.
9. Future directions – discussions and recommendations. Innovation undertaken/planned.

## Data and innovation

Wildlife Queensland supports open source data that is, data that is stored and shared with others. The Terrestrial Ecosystem Research Network (TERN) share a similar view stating sharing data increases the capacity of the science community to advance science and contribute to effective management of our ecosystems (TERN, 2013). Perhaps more importantly, volunteers want to know their data is useful and being used.

Ensuring our data is available and accurate is leading to several innovations and challenges.

A major challenge is storage. WPSQ video and photographic data is quickly growing to about a terabyte of data. While local and online storage is relatively cheap long term solutions are needed. The ability to effectively move large amounts of data around Australia still relies on Australia Post. While data has been moved onto public and private cloud storage the ability to move large volumes is still difficult. WPSQ is talking with a variety of parties who are keen to store WPSQ's data the goal being to make it publicly accessible.

The desire to improve accuracy and reduce the impact of on ground monitoring has led to the use of video and photographic imagery. While some experts question the value of volunteer gathered transect data their photographs provide compelling evidence.

IPhone technology is providing many new tools to monitor our environment. WPSQ is partly funding the development of an iPhone application that will help anyone identify mangrove species. This will assist Mangrove Watch volunteers and the general community hopefully increasing public awareness and support for mangrove protection.

The Glider Network use remote video technology to monitor nest boxes in public reserves. Rather than using ladders and volunteers to scale those ladders a pole with a remote camera enables those on the ground to safely monitor the occupants. It's good for the possums and gliders and good for the volunteers. Visit http://www.youtube.com/watch?v=9k-y33hnK34&feature=player_embedded

The increased use of GPS capable high resolution digital cameras lends itself to packages such as Coral Point Count (CPCe). CPCe is a Windows based software package that provides a tool for the determination of coral cover using transect photographs (Kohler and Gill, 2006). WPSQ is trialing CPCe to identify seagrass coverage. To date success has been achieved when examining photographs of seagrass taken on certain substrates. The trials continue.

Photographs are also helping those in the team who have remote sensing skills. These volunteers are using seagrass data and photographs to help them analyze changes in intertidal seagrass meadows across Moreton Bay using satellite imagery. While still in the early stages the GPS referenced photographs are proving to be useful. A word of caution about innovation. Not all volunteers want to change what or how they are gathering data. Regardless of the improvement volunteer's views and feelings need consideration before embarking on new methodologies. Better sometimes to introduce new recruits to new methodologies.

## Challenges

Insurance and work place health and safety are emerging concerns for WPSQ. WPSQ is undertaking a review of its policies and insurances with the generous help of Allans (international law firm) to ensure WPSQ keeps pace with changing laws and circumstances. Many contributory and collaborative projects offer no insurance to those who support those projects through their own organizations. WPSQ has in all instances carried the financial burden of insuring its projects. Work Place Health and Safety, First Aid qualification, protection of WPSQ interests and its volunteers represent matters that require significant amount of administration. WPSQ receives no monetary support from State or Federal agencies and certainly no support to navigate the legislative minefield created by government.

Funding continues to be an ongoing matter of concern. While WPSQ can scale back projects to run on minimal funds this is not sustainable in the long-term. Mangrove and Seagrass monitoring has fared well with SEQ Catchments support and our corporate sponsors Brisbane Airport Corporation. Corporate sponsorship offers greater flexibility and certainty though commitments beyond 3 years are rare. Funding through NRM groups is likewise a pleasurable experience and collaborative in nature. WPSQ has nothing but admiration for SEQ Catchments help and involvement. While federal agency funding is available it's plagued with bureaucracy and seems too focused on meeting their administrative requirements. Important to note corporate support is not without risks. These risks however are mitigated when the nature of the relationship is well understood.

Finally managing volunteers requires qualified staff. The success of any project relies heavily on the volunteer coordinator; their people skills determine the success of a project.

## Conclusion – Take home messages

J.B.S. Haldane allegedly said in his 1939 book, Science and everyday Life:

> I am convinced that it is the duty of those scientists who have a gift for writing to make their subject intelligible to the ordinary man and woman. Without a much broader knowledge of science, democracy cannot be effective in an age when science affects all our lives continually (Irwin, 1995).

Scientific monitoring is essential because you can't manage what you don't know.

Volunteers will increasingly play a big role in improving our knowledge about our natural environment. This is good for science and will help advance public awareness and support for the environment.

The key to success is.

- Value your volunteers; they are the only reason why your citizen science project exists and they bring many and varied skills to one's organization. Ensure opportunities exist for them to grow.

- Value your data, ensure it is accurate and use innovation to improve its value. Data accuracy is underpinned by well trained volunteers.

## Reference


BROSSARD, D., LEWENSTEIN, B. & BONNEY, R., 2005, 'Scientific knowledge and attitude change: The impact of a citizen science project'. International Journal of Science Education, vol. 27, pp. 1099-1121.

BUTT, N 2013. Citizens in the woodwork. Decision Point. Issue #73 / September 2013. Environmental Decision Group (EDG) 2013. Accessed at http://www.decision-point.com.au/images/DPoint_files/DPoint_73/dpoint_73.pdf#page=3 Viewed on Saturday, September 07, 2013.

CRALL, A. W., NEWMAN, G. J., STOHLGREN, T. J., HOLFELDER, K. A., GRAHAM, J. & WALLER, D. M., 2011, 'Assessing citizen science data quality: an invasive species case study'. *Conservation Letters,* vol. 4**,** pp. 433-442.

DEVICTOR, V., WHITTAKER, R. J. & BELTRAME, C., 2010, 'Beyond scarcity: citizen science programmes as useful tools for conservation biogeography'. *Diversity and distributions,* vol. 16**,** pp. 354-362.

FINN, P. G., UDY, N. S., BALTAIS, S. J., PRICE, K. & COLES, L., 2010, 'Assessing the quality of seagrass data collected by community volunteers in Moreton Bay Marine Park, Australia'. *Environmental Conservation,* vol. 37**,** pp. 83-89.

IRWIN, A 1995. Citizen Science: A Study Of People, Expertise And Sustainable Development. Routledge.

KOHLER, K.E. and S.M. Gill, 2006. Coral Point Count with Excel extensions (CPCe): A Visual Basic program for the determination of coral and substrate coverage using random point count methodology. Computers and Geosciences, Vol. 32, No. 9, pp. 1259-1269, DOI:10.1016/j.cageo.2005.11.009.

National Coral Reef Institute 2013, CPCe Software. Accessed at http://www.nova.edu/ocean/cpce/index.html Viewed on Sunday, September 15, 2013.

ROELFSEMA, C. M., PHINN, S. R., UDY, N. & MAXWELL, P., 2009, 'An integrated field and remote sensing approach for mapping Seagrass Cover, Moreton Bay, Australia'. *Journal of Spatial Science,* vol. 54**,** pp. 45-62.

ROY, H.E., Pocock, M.J.O., Preston, C.D., Roy, D.B., Savage, J., Tweddle, J.C. & Robinson, L.D 2012. Understanding Citizen Science & Environmental Monitoring. Final Report on behalf of UK-EOF. NERC Centre for Ecology & Hydrology and Natural History Museum.

*SILVERTOWN, J., 2009, 'A new dawn for citizen science'. Trends in ecology & evolution, vol. 24, pp. 467-471.*

*SOE 2011. Accessed at http://www.environment.gov.au/soe/2011/report/key-findings.html#biodiversity Viewed on Thursday, September 05, 2013*

*TERN 2013. Accessed at http://www.tern.org.au/What-is-TERN-pg22570.html Viewed on Thursday, September 05, 2013*

TWEDDLE, J.C., Robinson, L.D., Pocock, M.J.O. & Roy, H.E 2012. Guide to citizen science: developing, implementing and evaluating citizen science to study biodiversity and the environment in the UK. Natural History Museum and NERC Centre for Ecology & Hydrology for UK-EOF. Available online: www.ukeof.org.uk