



UNEP Year Book 2014 emerging issues update  
Realizing the Potential of Citizen Science





## Getting involved: citizen science

Since prehistoric times people have observed and recorded the natural world in order to survive. However, curiosity about the world around us, and the pleasure we take in it, are other reasons we pay careful attention to and make records of flora and fauna, water bodies, the weather and other phenomena. In China locust outbreaks have been tracked for thousands of years; in Japan the flowering of cherry trees has been marked for 1200 years. Successful agricultural harvests have always depended on knowing what to plant where, and how to make crops grow well.

Today people's inborn curiosity is increasingly being harnessed by science. Volunteers are collecting and/or analyzing data, as well as contributing to scientific studies in different ways. This is called *citizen science*. Simply put, this means public participation in scientific research. Citizen science can help researchers obtain a wide perspective and deep data. It helps answer complex questions about, for example, air pollution, biodiversity conservation, urbanization patterns, and changes in agricultural production and fisheries worldwide. Taking part in citizen science activities also raises awareness, increases local interest, and contributes to more informed policy decisions.

### What is citizen science?

In citizen science people who are not professional scientists take part in one or more aspects of science—systematic collection and analysis of data, development of technology, testing of natural phenomena and dissemination of the results of activities. They mainly participate on a voluntary basis.

Volunteers taking part in environment-related studies can sample wide geographic areas more quickly and at lower cost than professional research teams. Projects that involve 'birders' are among the largest and oldest citizen science initiatives. The Cornell Lab of Ornithology/Audubon Society's Christmas Bird Count began in North America in 1900. They report that 'from feeder-watchers and field observers to count compilers and regional editors, everyone who takes part in the Christmas Bird Count does it for love of birds and the excitement of friendly



© techNyou

For video links please go to <http://www.youtube.com/watch?v=N6eN3PII4U8>

competition – and with the knowledge that their efforts are making a difference for science and bird conservation.'

The Big Garden Bird Watch in the United Kingdom is also one of the world's largest citizen science activities, with over 400,000 people taking part at 228 locations. The Audubon Society's international Great Backyard Bird Count has been conducted since 1998. The first global version of the Great Backyard Bird Count took place in 2013. These projects demonstrate three of the main advantages of citizen science: large numbers of participants are able to provide enormous amounts of data, from far-reaching locations, and data collection may take place over long periods.



© Gill Conquest/ ExCiteS, University College London

## Trends and recent developments in citizen science

Citizen science can go beyond simple data collection to help shape fundamental questions about our world and provide intriguing answers. Participation has grown partly due to the Internet, social media, and other new and increasingly affordable technologies. Once the public was mainly involved in activities concerned with, for example, the environment and astronomy. Today opportunities to volunteer to take part in scientific research have exploded into many disciplines, from analyzing cancer data to tracking genetic mysteries to theoretical physics.

Scientists are increasingly recognizing the benefits of public knowledge and open participation. The statistical power provided by large amounts of data can be used to obtain valuable insights into scientific questions. For example, gamers taking part in FoldIt, an online game whose purpose is to decipher how proteins fold, figured out the structure of an enzyme involved with HIV within three weeks of being given the problem.

Data and other information generated through citizen science projects have been shown to be reliable and accurate. High-quality data generated from these projects are reinforced through appropriate research protocols, proper training and oversight measures, as well as the application and utilization of new statistical and high-performance computing tools that eliminate sample bias and remove measurement errors or spatial clustering. There is evidence that data from citizen science research projects are increasingly accepted in the academic literature.

Not only does citizen science contribute to scientific knowledge, but the experience generated through public participation provides the benefits of better access to information and motivation of local communities.

Technologies contributing to the growth of citizen science include satellites, which provide a wealth of data in need of analysis (possibilities to analyze large data sets are available to citizen scientists), global positioning systems (GPS) and

### Social demand and data collectors

Data are being collected by citizen scientists worldwide. This includes collection of data on radiation following the Fukushima nuclear accident in 2011, to projects like MammalMAP (which aims to put all visual evidence of mammals in Africa into an open access database to help conservation planning), to using cameras attached to kites and balloons to measure and monitor oil spills' impact on the environment.

smartphone apps, which are widely used today throughout the world. Volunteers can become *data collectors and users* even in remote locations.

Citizen science faces a number of challenges in terms of both coordination and organization, but potential solutions exist. These include: the use of innovative information and communication technology, such as online searchable database modularization; well-defined and structured project leadership; and mechanisms to sustain people's interest in participation, as well as to respond to the range of individuals' motives for participating, such as intellectual challenges, direct livelihood benefits, or the opportunity to take part in updating traditional knowledge.



© Jerome Lewis/ ExCiteS, University College London



## Renewing and understanding traditional knowledge

As participation grows, citizen science is having an impact in some far-flung parts of the world. It is not only a valuable hobby for people in developed countries who enjoy helping to acquire new knowledge. It is also a concept of science that serves people. Several research projects have involved working with indigenous people on topics relevant to their environments, livelihoods and cultures. Through these projects, people have a greater voice in the management of their resources.

In Finland major restoration of a river and its catchment areas has been taken place in the Southern Boreal region of North Karelia. Local fishermen (together with *Snowchange*) have led restoration activities on the heavily damaged Jukajoki River. Local people, using a collaborative management approach as well as traditional knowledge and supporting scientific measures, have identified damaged sites in the catchment areas and taken a number of steps to improve water protection. The successful Jukajoki River initiative shows how citizen science and traditional knowledge can be applied in community-based ecosystem restoration.

### Snowchange Cooperative

The Snowchange Cooperative, which began in Finland in 2000, has worked for a decade and a half with both indigenous and local traditional societies to advance their traditions and foster a dialogue with science.

In the Congo Basin, researchers, artists and information and communication technology (ICT) specialists are helping Bayaka communities by developing applications, called Sapelli, which is developed by the Extreme Citizen Science group at UCL, to help them map and patrol their forests. The forest inhabitants use handheld devices to map and protect sacred and valuable trees, and to document logging activities. They have been empowered to monitor the forests in such a way that the data collected have been used as evidence to help negotiate with logging companies.

Similarly, Cybertracker is an innovative software program that can be used by people who neither read nor write. On a

rugged handheld computer a touch screen displays a menu of pictograms linked to a GPS system, allowing observations that are made in the field to be instantly and accurately recorded. By using Cybertracker, the San people living in the Kalahari contribute their knowledge of animal behaviour and tracking to environmental monitoring projects. Wildlife conservation efforts are being strengthened thanks to this traditional expertise. In Northern Australia, indigenous women rangers in remote areas also use Cybertracker to record information about water quality, movement of animals, fire management, and the presence and density of weeds. Over 700 independent projects in 75 countries have used the Cybertracker.

Activities such as these illustrate how various social and traditional groups can make major contributions through citizen science, and how this community approach can help put vulnerable groups on a more equal footing with other environmental stakeholders while helping to protect their resources and ultimately influencing the governance structure with respect to both their natural resources and the environment.

As technological advances are made, enabling more people to take part in the exploration of our world, one opportunity presented by citizen science is the growing capacity to involve communities and strengthen civil society while protecting the environment.



## Improving coordination to achieve greater impacts

One of the recognized benefits of citizen science is that it brings people together, either directly or through social networking – including local communities, administrative authorities and policy-makers. When applied to local natural resources management, for example, it can lead to solutions and decision-making processes that consider the viewpoints of all those concerned.

The current and potential role of citizen science is increasingly recognized regionally and internationally. For example, the European Commission's Green Paper on Citizen Science recognizes the value of the participatory science approach and its relevance to EU strategy. Practitioners worldwide participate in coordination and policy platforms, such as the Citizen Science Association and the European Citizen Science Association. Establishing such communities of practices aims to promote collaboration and knowledge sharing.



© Gill Conquest / ExCiteS, University College London



© Citizen Cyberlab

For video links please go to <http://www.youtube.com/watch?v=HQtfmS-hl4&list=UUhstdtAyejxQmiZ6RjxtYTAW>

Barriers to realizing the full potential of citizen science nevertheless exist. Approaches to overcoming them include:

- Better coordination among scientists, project developers and others to make use of (and collaborate with) relevant already established and proven citizen science projects; this could reduce project redundancy, which can confuse the public and appear to constitute 're-inventing the wheel'
- Stronger recognition by scientific communities of the value of data generated by citizen science) - especially in peer-reviewed processes – so that information and knowledge generated from citizen science projects can gain better appreciation and inspire more confidence
- Coordination internationally to better aggregate and analyze data generated by citizen science, which could help reveal valuable data sets useful to scientists, policy-makers and others



## Further information about citizen science

- European Commission (EC) (2013). Green Paper on Citizen Science <http://www.societize.eu/sites/default/files/Green%20Paper%20on%20Citizen%20Science%202013.pdf>
- Bonney, R. et al. (2014). Next steps for citizen science. *Science*, 343 <http://ccrec.ucsc.edu/sites/default/files/Bonney%20et%20al%202014%20Science%20v.343-p.1436-7.pdf>
- Conrad, C.C. and Hilchey, K.G. (2011). A review of citizen science and community-based environmental monitoring: issues and opportunities. *Environment Monitoring Assessment*, 176(1-4):273-91 <http://link.springer.com/article/10.1007%2Fs10661-010-1582-5>
- Coren, M.J. and Fast Company. (2011, September 20). Foldit gamers solve riddle of HIV enzyme within 3 weeks. *Scientific American*. Retrieved June 9, 2014. <http://www.scientificamerican.com/article/foldit-gamers-solve-riddle/>
- Danielsen, F. et al. (2014). A multicountry assessment of tropical resource monitoring by local communities. *BioScience*, Vol. 64 No. 3 <http://bioscience.oxfordjournals.org/content/early/2014/02/18/biosci.biu001.abstract>
- Dickinson, J. L. et al. (2010). Citizen science as an ecological research tool: Challenges and benefits. *Annual Review of Ecology, Evolution, and*, 41:149–72 <http://www.annualreviews.org/doi/abs/10.1146/annurev-ecolsys-102209-144636?journalCode=ecolsys>
- Dickinson, J. L. and Bonney, R. (2012). *Citizen Science: Public Participation in Environmental Research*. Comstock Publishing Associates <http://www.cornellpress.cornell.edu/book/?GCOI=80140100107290>
- Franzoni, C. and Sauermann, H. (2014). Crowd science: The organization of scientific research in open collaborative projects. *Research Policy*, 43: 1-20 <http://scistarter.com/blog/wp-content/uploads/2013/04/SSRN-id2167538211.pdf>
- Miller-Rushing, A. et al. (2012). The history of public participation in ecological research. *Frontiers in Ecology and the Environment*, 285 <http://www.esajournals.org/doi/abs/10.1890/110278>
- Mustonen, T. (2014). Power discourses of firsh death: Case of Linnunsuo peat production. *Ambio*. 43(2):234-243. March 2014 <http://link.springer.com/article/10.1007/s13280-013-0425-3>
- Mustonen, T. (2013). Oral histories as a baseline of landscape restoration – co-management and watershed knowledge in Jukajoki river. *Fennia international journal of geography*. 191(2) <http://ojs.tsv.fi/index.php/fennia/article/view/7637>
- Openscientist. (2011). Finalizing a definition of “Citizen Science” and “Citizen Scientists”. Retrieved from <http://www.openscientist.org/2011/09/finalizing-definition-of-citizen.html>
- Rowland, K. (2012). Citizen science goes ‘Extreme’. *Nature*. February 2012 doi:10.1038/nature.2012.10054 <http://www.nature.com/news/citizen-science-goes-extreme-1.10054>
- Sullivan, B. L. et al. (2014). The eBird enterprise: An integrated approach to development and application of citizen science. *Biological Conservation*, 169: 31–40. <http://www.sciencedirect.com/science/article/pii/S0006320713003820>