Principle 5

Manage data effectively

Citizen science data should be managed on a life cycle basis as valued assets, alongside other monitoring data. How the data are collected, checked, analysed, stored and accessed should be in accordance with agreed data management principles, such as those set out in the UKEOF DAG Advice Note 1[1]. It is also important to ensure that the associated metadata are collected, checked and stored as they will enable future users to decide whether to use the data.

Principle 6

Report and share data

Citizen science data may be of interest to participants, scientists, policy-makers and the media, and should be made available and summarised in an accessible way as required. Sharing non-sensitive elements of the data will allow them to be used by others, maximising the value of the data. Data should be made available in electronic format wherever possible, as this will increase their accessibility to others. Reporting and sharing data widely will help ensure they are fit for purpose and lessons are learnt.

Principle 7

Evaluate to maximise data value

Evaluation is an on-going process through which a project can be improved, and this is particularly relevant to citizen science projects. Learning from mistakes and identifying common issues are key aspects of on-going project evaluation, and enhance the value of the data collected.

Summary

Robust data and metadata collection, quality control, storage and sharing are fundamental to a successful citizen science project. When planned and executed well, citizen science can provide reliable data to increase scientific knowledge, raise people's awareness of the environment and allow like-minded people to share enthusiasm and knowledge. The above principles provide a firm foundation for doing this.

This series of advice notes is prepared by UKEOF's Data Advisory Group.

UKEOF works to improve coordination of the observational evidence needed to understand and manage the changing natural environment. It is a partnership of public sector organisations with an interest in using and providing evidence from environmental observations. Contact us at office@ukeof.org.uk.

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Citizen science data

Citizen science – using volunteers to collect information and data – is a powerful tool for engaging people with science, and increasing awareness and ownership of environmental issues and the local environment. It can also be an extremely cost-effective way of generating large amounts of environmental and biodiversity data. Knowing the strengths (eg large amounts of data generated) and limitations (eg multiple sources of error) of the data, and taking these into account when choosing collection and analysis methods, means that citizen science data can provide a valuable, decision-making resource for individuals, groups and organisations.

Like all forms of data, citizen science data need quality assurance, and to be looked after and valued. There are some specific measures that designers of citizen science projects should put in place to ensure projects produce high quality data that are accessible and usable.

This Advice Note summarises those measures. It aims to support practitioners and data managers who are new to citizen science, as well as those already using this approach, and should be read alongside the UKEOF DAG Advice Note 1: The Principles of Good Data Management[1]. It is based on the UKEOF Guide to Citizen Science (Tweddle *et al*. 2012)[2] and the UKEOF Understanding Citizen Science and Environmental Monitoring report (Roy *et al*. 2012)[3].

[1] See: www.ukeof.org.uk/documents/ukeof-advice-note-1

[2] 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/our-work/citizen-science

[3] 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. Available online: www.ukeof.org.uk/our-work/citizen-science

The principles of planning, collecting and using citizen science data

ADVICE NOTE 2

Is citizen science the best approach?

Citizen science lends itself more readily to certain types of data gathering and analysis than to others, so the required outputs of the project need to be clear before a citizen science approach is chosen. Detailed guidance on reaching this decision is available in the UKEOF Guide to Citizen Science[2], and A Strategic Framework to Support the Implementation of Citizen Science for Environmental Monitoring (Pocock *et al.* 2013)[4]. Figure 1 shows the phases of a citizen science project and illustrates the need to consider all aspects of data requirements, storage and analysis in the early stages of project planning, well before the 'go live' phase.

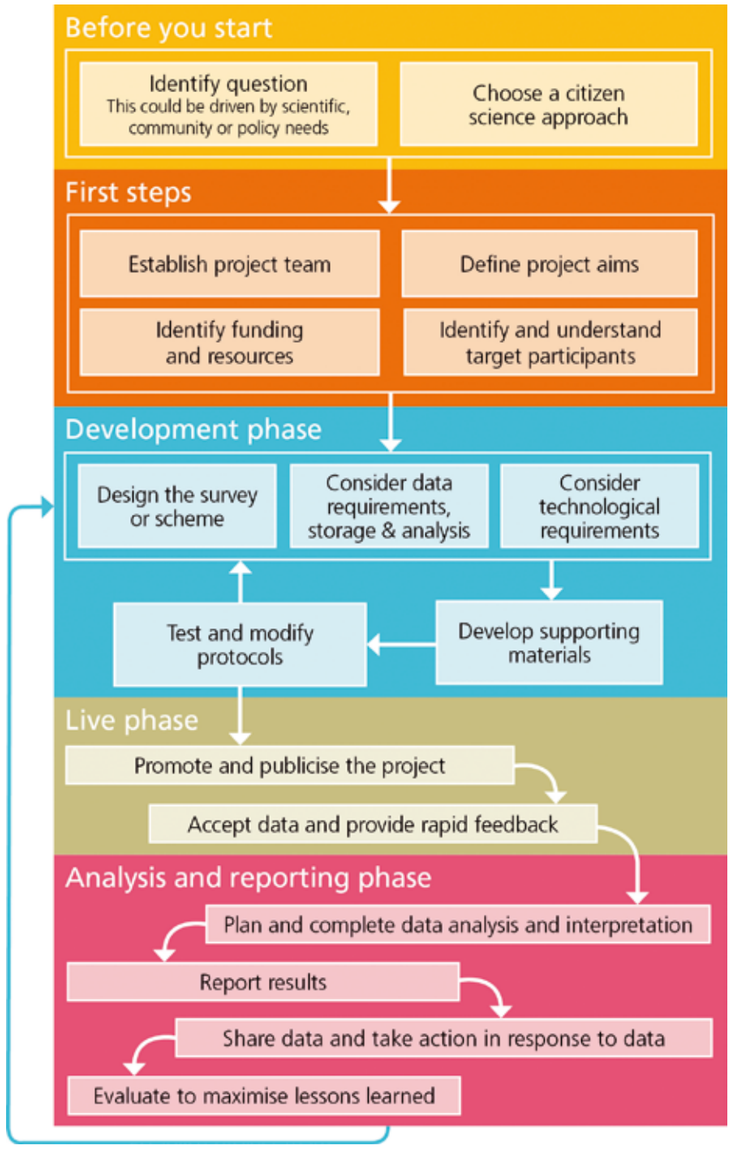

Figure 1: Developing, delivering and evaluating a citizen science project (Tweddle *et al.* 2012)[2]

[4] *Pocock, M.J.O., Chapman, D., Sheppard, L., Roy, H.E. (2013) A Strategic Framework to Support the Implementation of Citizen Science for Environmental Monitoring. Final Report on behalf of SEPA. NERC Centre for Ecology & Hydrology.*

Consider the data requirements

Principle 1

In common with all research projects, the types of data to be collected, collection methods, how the data will be produced and analysed, and formats for storing, describing and sharing data and metadata all need to be considered during the design of a citizen science project. The aim is to maximise the value of the data to both the original project and others in the future by using agreed data and metadata management principles and robust analysis.

Manage volunteers to get the best data

Principle 2

If volunteers are engaged, motivated and well managed, and understand the goals of the project and how their data will be used, they are likely to submit more and better quality data. The accuracy of data collected by volunteers is also heavily influenced by the survey design, training materials, equipment and support provided. Volunteers need to understand how to submit data and have the necessary tools and instructions to do so.

Ensure data quality

Principle 3

Data of known quality are scientifically useful and when robustly analysed are more likely to be used as evidence by policy makers; data of unknown quality are open to scientific criticism. However accurate the data, as with any project, it is important to minimise the opportunities for errors and to understand and describe how data quality varies between samples or participants. This can be done by observing participants and identifying the types of errors they make. Validation and verification of models, data and metadata can reduce error rates. It will also help if volunteers know how to identify and record inconsistencies, constraints or other issues that might affect the quality of their data, and that they understand why this is important.

Harness new technologies

Principle 4

Adopting new technologies can reduce errors and provide significant new opportunities for citizen science projects by using websites, smartphone apps, sensors and other add-ons, crowdsourcing and virtual communities. For example, smartphones produce standardised and accurate location data, whereas volunteer-generated coordinates may be less accurate. Equally, on-line data entry reduces issues of duplication and enhances quality as data can be validated remotely. Benefits and drawbacks of using these new technologies are discussed in detail in the UKEOF Understanding Citizen Science and Environmental Monitoring report[3].

Citizen science in action

Invasive, non-native plant species are spreading quickly across the UK, detrimentally affecting the ecology of many vulnerable habitats, and costing the UK economy up to £2 billion annually. The Plant Tracker app[5] enables volunteers to use smart phones to record data about where they have spotted species. Thanks to these geo-referenced data, the Environment Agency has a much better idea of where to focus efforts to remove these damaging plant species.

[5] *See: www.planttracker.naturelocator.org/*