Forest Research

Citizen Science: Social Media as a supporting tool

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Executive Summary

1. A total of twelve case studies were selected to:
    a. Illustrate how the Forestry Commission (FC) and partner organisations use social media in citizen science projects
    b. Comment on the most successful uses of social media
    c. Identify the underlying principles contributing to this success.
2. Case studies were based on interviews with between one and three people associated with the project including scientists, agency end users and social media developers.
3. Social media was used as a supporting tool in a range of approaches to citizen science, but was applied at a limited number of points in the research cycle, and focused most often on the lead into data collection.
4. Social media was most often used as a platform to recruit volunteers in data collection activities, and then retain them through communication including the dissemination of results. Real-time (or close to real time) feedback of results at an individual and community level maintains interest and engagement in CS projects.
5. The full range of social media platforms are not being used, the emphasis is very much on Facebook and Twitter or the development of project specific software.
6. Social media is successful where it has a clearly defined purpose as part of a well articulated project strategy. Critical to success is tailoring the social media messages and channels to recruit targeted types of volunteers.
7. The social media strategy developed will need to take account of the differing needs, motivations and interests of the scientists and the target volunteer community i.e. the differences between the “interested public” or amateur experts (e.g. birders).
8. Third party organisations may be crucial partners reaching specific interest groups likely to be interested in the CS project.
9. Skilled citizen scientists (i.e. amateur experts) should be engaged in the design, development, piloting, and evaluation of digital technologies and associated social media tools. This kind of collaboration ensures that citizen scientists have access to tools they find useful at an individual level, as well as providing scientists with data and evidence useful at a community level.
10. Important barriers remain to the use of social media. These include the absence of a “digital culture” in some organisations, lack of familiarity, perceptions that social media is not “serious media”, and concerns about organisational reputation. Raising the profile of innovative technology for citizen science within an organisation often rests on leadership from senior managers.

Citizen Science: Social Media as a Supporting Tool

1. Introduction

There is now a tremendous amount of interest in citizen science (CS). The uptake and integration of digital technologies within CS projects is a fast developing arena of specific interest to the land-based and environmental sector. "Citizen Cyberscience", the development of mobile technologies and digital interfaces, is growing at an exponential rate[1], alongside the establishment of new CS co-ordinating organisations (e.g. the CS Association[2]), social media in CS projects and discussions (e.g. #TweetforSci[3]) and CS volunteer recruitment websites (e.g. Science starter[4]). Morris (2014) has produced a summary review of two documents recently published by the UK Environmental Observation Framework (Roy et al. 2012; Tweddle et al. 2012) with the aim of drawing out key insights and lessons that can inform the design and implementation of forestry-based citizen science projects in the UK. The objective of the piece of work reported here was to synthesise some key experiences about the use of social media within CS projects of relevance to forestry. Specifically we sought to:

1. Investigate and illustrate how the Forestry Commission (FC) and partner organisations use social media in CS projects.
2. Comment on the most successful uses of social media supporting CS (including type of media, type of audience, and function of social media).
3. Identify the underlying principles of technology, process design and management contributing to this success.

It was important from the outset, to distinguish between:

Social media – which we define as (mostly Web 2.0) digital media platforms that involve social interaction via the creation and exchange of user-generated content (Stewart et al., 2012)

Digital technologies – which we take to mean either internet enabled devices (e.g. smart phones, tablets) or software applications (apps) developed to perform certain tasks with internet enabled devices. Obviously, there is some overlap between social media and apps, but the defining difference for us is that social

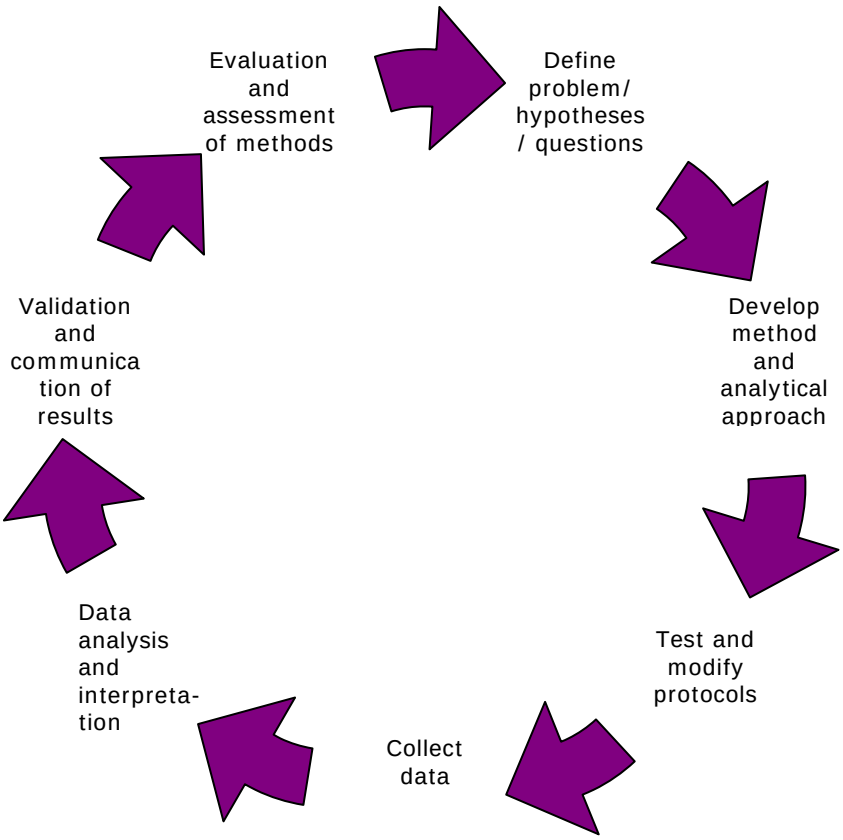
[1] See for example, the outputs of the most recent Citizen Cyberscience summit at http://cybersciencesummit.org/
[2] http://citizenscienceassociation.org/
[3] https://www.facebook.com/hashtag/tweetforsci
[4] http://scistarter.com/

media enables interactive and productive activity rather than passive and consumptive actions.

The **practice of CS** – which is defined as the delivery and project management process involving citizens in scientific work.

The most popular definition of CS is the broad description being propagated by UKEOF as "the involvement of volunteers in science" (Roy et al., 2012). Roy et al (2012) refine this further and recognise three approaches to CS (i.e. contributory, collaborative, and co-created). However, current practice tends to be the involvement of volunteers in "scientist-led mass participation initiatives that are open to all sectors of society" (Roy et al, 2012) with a focus on volunteers as data collectors and suppliers (Riesch et al., 2013). The definition of CS we use in this research includes citizen participation in all parts of the research cycle (see Figure 1), from question and hypothesis formulation, through to data analysis and the evaluation and application of findings.

Figure 1. The research cycle: Opportunities for citizen engagement



2. Method and case studies

This was a small scoping style project so a case study approach was employed. Cases were identified in two ways: Firstly, through web-based searches; secondly, by asking case study participants to refer other people amongst their professional networks using

social media for CS (snowball sampling). Case studies were selected to provide examples of social media use:

- at different points in the research cycle
- for different functions
- using different platforms
- related to different areas of the FC business (e.g. climate change, plant health, business and markets, biodiversity, recreation).

Interviews were then arranged with between one and three people associated with each of the cases. The interviewees included scientists, agency end users and social media developers. Semi-structured interview questions were formulated to investigate the objectives of the CS project, the objectives and use of the social media, development costs and issues, recruitment rates and data quality. Additional material from secondary sources (e.g., associated webpages and published literature), were also collated and used to extend understanding of the case studies.

The twelve case studies researched are listed in Table 1 below.

Table 1. The twelve social media citizen science case studies

Case study	Website	Area of FC business
o AshTag	https://www.ashtag.org/	Plant health
o Blogging Birds	http://redkite.abdn.ac.uk/	Biodiversity
o Conker tree science	http://www.ourweboflife.org.uk/	Plant health
o EnvHack	https://www.facebook.com/environmentagency/posts/546396505405170	Business and markets
o Foss4G	http://2013.foss4g.org/	Business and markets / climate change
o Fraxinus Facebook	https://apps.facebook.com/fraxinusgame/	Plant health
o iTree ecoproject London	https://twitter.com/LondoniTreeProj	Biodiversity
o MinkApp	http://www.dotrural.ac.uk/minkapp/ http://www.scottishmink.org.uk/	Biodiversity
o TreeAlert	http://www.forestry.gov.uk/treealert	Plant health
o TreeWatch	http://sylva.org.uk/treewatch/	Plant health / climate change / biodiversity
o Treezilla	http://www.treezilla.org/	Plant health
o What's up in the Uplands?	http://www.bto.org/national-offices/scotland/our-work/whats-up	Biodiversity

3. How social media was used

The case studies showed that social media was being used in projects using six different approaches to CS engagement as shown in Table 2. These approaches were:

- Education and general interest
- Experiential and experimental
- Crowdsourcing and visualisation
- Volunteered geographic information (VGI) and visualisation
- Gamification
- Innovative development.

Table 2. Approaches to citizen science engagement covered in the twelve case studies

Case study	Approach to engagement	Explanation of engagement approach
o Blogging Birds	Education & general interest	CS project includes a strong learning and awareness raising element, where education around a specific conservation or natural resource management issue is seen as a primary objective.
o Conker tree science	Experiential and experimental	Projects that involve real-world experiments as part of the CS project
o AshTag o iTree ecoproject London o TreeAlert o TreeWatch o Treezilla o What's up in the Uplands?	Crowdsourcing and Visualisation	May be controlled (i.e. restricted to invited participants) or open (i.e. unrestricted forms of crowdsourcing), with data frequently collected in a spatially referenced (visual) form.
o MinkApp	VGI and Visualisation	VGI provides a platform for users to input spatially tagged information in a map-based system ,which is shared with others.
o Fraxinus	Gamification	Using gaming theory and mathematical modelling as a means of crowdsourcing data analysis through the medium of a game.
o EnvHack o Foss4G	Innovative development	Tackling research questions or using open source data or evidence to generate new digital technologies or ideas for business.

Across the projects, social media was employed for four main purposes. These were:

- Recruitment of volunteers

- Retention of volunteers
- Training, support and signposting
- Data input and analysis.

Recruitment of volunteers

Social media was used to recruit volunteers directly and indirectly. Indirect methods used social media tools as part of educational and learning approaches. This type of engagement was designed to increase public interest in a topic, and then generate traffic to websites which included citizen action and CS projects. One such example was **Blogging Birds** described in Box 1. Direct recruitment used Facebook and Twitter as the main platforms for publicising projects and the associated opportunities for citizen scientist volunteering. Projects undertook direct recruitment using social media themselves, as in the case of the London **iTree Eco project** (see Box 2). Some case studies worked with a third party organisation already engaged with target interest groups to communicate with potential citizen scientists on behalf of the project. This was the case for the Environment Agency Hackathon: Geeks of London were contracted to run the social media recruitment campaign direct to their members and the wider IT expert and Hackathon community.

Box 1. Royal Society for the Protection of Birds (RSPB) and Dot.Rural "Blogging Birds"

Scientific question / problem: Can "digital conservation" projects generate interest in conservation issues and improve public engagement in specific initiatives through science and learning?
Use of social media: The movements of tagged and tracked red kites generated automated natural language blogs based on kite behaviour and local conditions. Public subscribe to blogs or visit website and click through blog entries, visualisation of kite behaviour is also shown here.
Outcome: An evaluation survey showed audience changed their attitudes to kites, and became more willing to take part in conservation campaigns to help kites. They also increased knowledge about kite feeding and behaviour. An additional outcome was the change towards more receptive attitudes amongst RSPB staff around the use of social media and digital technologies.
URL: http://redkite.abdn.ac.uk/

Box 2. RE:LEAF London Partnership "London iTree Eco Project"

Scientific question / problem: Will the iTree tree valuation exercise result in higher investment into the management of urban trees? Does a CS approach provide a route to lasting public engagement with the city's trees?
Use of social media: Recruit and communicate with volunteers
Outcome: The project has a digital presence on Twitter and Facebook and a recruiting page run by "Team London". Launched late in 2013, the target of 200 volunteer recorders was reached by the end of April 2014. Training courses in the iTree methodology will be given to volunteers later in the summer and at this point "accredited" iTree surveyors will survey trees in allocated areas.
URL: https://twitter.com/LondoniTreeProj

The idea of using third party organisations to engage specific interest groups was also applied by the BTO's **"What's Up?"** project (see Box 3), who partnered, for example, with Ramblers to reach walkers in the uplands. However, this example demonstrates how social media may not always be the most effective method of engagement. The general preference of this segment of the outdoor community was for the use of more traditional means of communication for the submission of ornithological records.

Box 3. British Trust for Ornithology (BTO) Scotland "What's Up?" project

Scientific question / problem: How do we increase bird records for remoter upland areas of the country that are not well covered by the birding community? Can we recruit citizen scientists from other countryside user groups?
Use of social media: Recruit and communicate with volunteers
Outcome: Target groups preferred to communicate and provide bird sightings by conventional media. Records sent through email. A total of 560 volunteers were recruited of which 80% were new to biological recording and came from 'novel audiences' (i.e. hill walkers, countryside managers, estate staff, estate rangers, fisheries staff, landowners, community and youth groups) New recorders were recruited with help from intermediary associations, e.g. the Ramblers. The original target was to achieve 10,000 records in the first year, and this has been exceeded reaching around 46,000 at the "basic level and above. Twitter is used to "follow" hill walkers who then "follow" BTO back. Currently, there are 2,000 followers.
URL: www.bto.org/national-offices/scotland/our-work/whats-up

The numbers of citizen scientists recruited by the examples was variable and ranged from over 400 monthly players and nearly 2000 followers of the **Fraxinus Facebook** game to 500 with **MinkApp** and 200 volunteers recruited to **iTree**. Much of this variation can be attributed to the objectives of the CS project and whether social media had targeted specific interest groups, or was directed at the "public in general". **TreeWatch** (see Box 4) illustrates this quite well: The pear rust survey promoted in partnership with the Royal Horticultural Society (RHS) in 2011, engaged the largest number of volunteers from a specific interest group compared with the other routes into the project.

Box 4. Sylva Foundation "TreeWatch"

Scientific question / problem: Can CS be used to monitor and record the presence and progression of tree pests and pathogens?
Use of social media: Recruit and communicate with volunteers as well as disseminate news about tree health issues
Outcome: The number of tree records and volunteers varies according to the type of survey and promotion route. The highest level of engagement is with the RHS partnered pear rust survey which involves over 1,000 adopted pear trees (over two thirds of the total of 2890 adopted trees from four surveys) and 463 volunteers (from a total of 678 from four surveys). Even though a large number of trees have been "adopted" there is very low rate of tree survey and re-survey which is what generates the data records. Some of the information which is recorded relates to the recorders emotional attachment to trees rather then the data the project asks for. A searchable web-based map of adopted trees provides CS with a picture of their work. The Twitter account has very low numbers of followers (24 in March 2014).
URL: http://sylva.org.uk/treewatch/

The BTO project also showed that even targeting interest groups through Twitter, for example, is not as focused as it needs to be since many of the "Followers" live outside of

Scotland or in lowland areas of the UK and are not necessarily likely to engage in the project. In those case studies that intended to recruit volunteer recorders from the general public, additional media was frequently used for promotion and awareness. **AshTag** for example, benefitted from national media coverage of "ash dieback" to generate the social media traffic which drove between 5-10,000 downloads of the app for Android devices, and generated several thousand data submissions. The scientific opportunity or "task" open to volunteers is as important as targeting interest groups. The **Conker Tree Science** project (see Box 5) managed to achieve a high number of "leafwatch" app downloads and data records. Part of this success was attributable to the connections between the app and the real world experiments recorders were involved with and the support from trained volunteers (Pocock and Evans, 2014).

Box 5. Bristol and Hull Universities "Conker Tree Science"

Scientific question / problem: Can we use citizen generated data to provide reliable data on tree pest distribution, spread and predation intensity?
Use of social media: Recruit/communicate with volunteers and disseminate LeafWatch app.
Outcome: Between 2010 and 2013, a total of 8,030 volunteers generated 12,235 records. The researchers were therefore able to test two scientific hypotheses at a national scale. "Mission leaf miner" project (rearing the parasitic moth from leaves collected from local trees) engaged 1,810 school children and 119 members of the public providing 2,208 records of reared insects from the experiments. There were nearly 16,000 downloads of the LeafWatch app, and 70% of records to "Mission: Alien invaders" came via the app through mobile devices. A scientific paper was published in 2014 reporting on the leaf miner work. Other experiments (Mission: Pest controllers and Mission: Bird attack) attracted fewer volunteers, and have yet to report on their results.
URL: http://www.ourweboflife.org.uk/

Retaining volunteers

Frequently updating blogs, Twitter and Facebook accounts was the most common strategy to maintaining volunteer interest in CS projects. An important function of social media was to disseminate results coming from volunteer activities and data records. Visual media, including maps (e.g., **Treewatch**), infographics (e.g. **Conker Tree Science**), and YouTube videos (e.g. **MinkApp**), were all employed to do this. The real time monitoring and feedback of control efforts enabled by **MinkApp** certainly had a positive impact on volunteer behaviour and retention. Social media had a role to play in reinforcing the message that "null returns", i.e. no mink sightings, was actually a positive outcome of the control project, rather than a volunteer "failing". There are now plans to extend the success of the MinkApp project and retain volunteers by asking them to engage with follow-on activities aimed at the control of other invasive species.

Training, support and signposting

In some of our examples, social networking platforms were used to link volunteers with training and support materials. For example, **MinkApp**, **AshTag** and **Treewatch** all linked with YouTube based resources to demonstrate particular survey techniques or species identification. Greater interactivity was promoted through links to iSpot which enabled volunteer discussion and learning around the identification of taxa.

Data Analysis

Our cases studies involved projects where data analysis was largely carried out by professional scientists. **Fraxinus** used social media as a data analysis tool. However, volunteers essentially play a passive role and do not contribute to any meta-analysis. Just two examples (**Foss4G** and **Env[:Hack**) included the active analysis and management of data by citizen scientists but the use of social media in these projects was limited to volunteer recruitment and the communication of results via Twitter and Facebook.

Box 6. Environment Agency "Env[:Hack"

Scientific question / problem: Can Environmental Agency (EA) data be analysed and used in innovative ways that help or promote the work of the Agency?
Use of social media: Recruit, and communicate with, volunteers, who were also offered the opportunity of taking part of the design and delivery of the innovation
Outcome: A small app "Polish Off a Penguin" was produced, which used EA and Ordnance Survey data to come up with the number of penguins on a full ship that would perish when dropped in a user-specified postcode area. This estimate was derived based on local water and environmental quality data; and an algorithm to work out the potential for the penguins' favourite food: Shellfish.
URL: https://www.facebook.com/environmentagency/posts/546396505405170

4. Which citizen scientists engage with social media?

Although evidence about the kinds of people and volunteers engaging with the social media component of CS projects was relatively small, some information was forthcoming. As already noted above, the examples showed that members of the public with a general interest in a topic varied in their responses to projects compared to with people drawn from specific interest groups. The preferences, interests and demographic characteristics of volunteers from these varied communities influenced their engagement with social media. Both the **MinkApp** and **"What's Up?"** projects also demonstrated the problems associated with relying on social media as part of initiatives conducted in rural locations where connectivity is poor.

For some citizen scientists the social aspects of their volunteering are important motivators. In the case of **MinkApp** (see Box 7), introduction of social media and digital engagement increased the overall coverage, but also discouraged some volunteers. Whilst data management and analysis improved using digital technologies, many volunteers missed the opportunities for "real-world" social interaction with the Mink Officers and other volunteers as they had done in the past.

Box 7. Scottish Mink Initiative and Dot.Rural "MinkApp"

Scientific question / problem: Can digital engagement influence volunteer behaviour and outcomes as part of community-based invasive species management programmes?
Use of social media: Volunteer engagement, communication and support materials.
Outcome: Active volunteers across north Scotland are part of the mink control project which involves monitoring, control and eradication of the animals. Records of mink sightings are submitted through MinkApp. Going digital has helped to facilitate a significant expansion of the monitoring network to cover just over 28,000 km^2. The records from 980 volunteers and 39 Mink Officers, monitoring a total 1,019 rafts for mink footprints, led to the development of a habitat suitability map using the their records by the University of Aberdeen (Fraser *et al.* 2013). This was used, along with recorded sites of female mink captures, to identify priority "hotspots" for coverage and eradication efforts. Volunteer numbers increased from around 200 at the start of the project in 2010 to a peak of 600 in 2012 with a slight decline to around 500 in 2013. Data about the volunteers using MinkApp shows that about 40% of them are "concerned residents", with around another 40% coming from industry or professional backgrounds that have an interest in mink management (e.g. gamekeepers, anglers, ghillies). The use of the volunteer network combining data capture with trapping and eradication extended the work of previous projects and has had a significant impact on controlling mink populations (Scottish Mink Initiative 2014).
URL: http://www.scottishmink.org.uk/

5. Challenges and successes

5.1. Emerging challenges

Although the evidence suggests that social media can facilitate citizen engagement in scientific projects, several challenges have emerged. These were:

- Matching social media to scientific objectives
- Investment and resource allocation
- Costs of data management and data quality
- Organisation and reputational risk

Matching social media to scientific objectives

Evidence from the case studies suggests that social media is a cost effective and important addition to CS projects where the role of social media has been properly defined, assessed and matched with the scientific objectives. Where social media has been used as a "default" communication option, it is less effective in reaching the right kind of volunteers and has an impact on the quality of data collected.

Investment and resource allocation

Using social media has costs through the whole of the project, not only at the point of volunteer recruitment. There are recurring, as well as development, costs. Depending on the type of project, costs include system maintenance, website hosting, consultancy, preparation of training materials, and evaluation of the data and data quality by

professionals. The level of resource allocation in our case studies ranged very broadly with figures around £15,000-20,000 common for combined app and social media development. It is not only securing the resource which is a particular issue, it is being able to judge the relative balance of costs against benefits. It is difficult to estimate the number of volunteers likely to join a project and the value of the data they might collect. An additional challenge relates to the timing of CS projects, and opening these at a time when volunteer attention and interest will be captured rather than diluted by competing interests.

Costs of data management and data quality

Social media may increase the number of volunteers recruited, but, depending on the skills of the volunteers and the data collection training provided, there may be no guarantee of data quality. Rather than reducing the costs of scientific projects, the need for additional scientific support to monitor and manage the data collected may represent a significant additional cost.

Organisation and reputational risk

The case studies also highlighted that the use of social media is not always viewed positively. There are misgivings amongst some staff about the "seriousness" of social media platforms, the risk of unmoderated negative comments, and the resulting non-professional impression created by social media. There is a perceived organisational risk as a consequence of this. In addition, some of the organisational stakeholders believed that data from social media enabled recruitment efforts that ranged beyond specialist interest groups could be of poor quality. There have also been difficulties for some organisations who argue that social media can increase the level of competition for citizen scientists drawn from relatively small interest groups or organisational volunteer pools. This is a particular issue for projects with a number of different partners. Managing these risks and fears is a significant issue in the design and process of implementing the social media component of CS projects.

5.2. Principles of success

The principles of success illustrated by the case studies are:

- Clearly articulating the purpose of the social media component within project design
- Finding a platform matching the objectives
- Integrating the interests and needs of the citizen scientists

Clearly articulating the purpose of the social media component within project design

The use of social media needs to serve a clearly defined purpose. Projects need to clearly define the kinds of citizen scientists they wish to target (i.e. general public or specific interest groups), and then assess whether social media is the most effective medium to engage these volunteers. Where social media is employed the platform

chosen should match the digital literacy of those groups. The marketing, engagement, communication and supporting function of social media should be carefully considered at different points in the research cycle. A clear purpose at this different stages can aid volunteer recruitment and retention, help assure data quality and support both staff and organisational buy-in to social media use. Social media strategies should assess the full range of tools and platforms (e.g., Pinterest - now the fastest growing social media platform, Instagram, Reditt) of potential interest to the target volunteers. The costs and value of social media can be better assessed where such strategies and targets are clearly articulated.

Finding a platform matching the objectives

There are three different ways of approaching social media development: i. using existing platforms and apps; ii. creating new specialised platforms and apps; iii. adapting opensource resources such as "Epicollect". Existing platforms may limit the way in which social media is used to develop projects, but there may be high costs associated with development of bespoke tools. There is a lack of guidance for organisations navigating the available choices.

Integrating the interests and needs of the citizen scientists

Social media tools and the development of signposting and apps that involve the views of citizen scientists from an early stage onward and allowing for user feedback both before and after introduction of the social media and associated technology are important instruments in achieving support and buy-in to use.

6. Conclusions

The evidence from the case studies suggests that:

1. The overwhelming trend is for social media to be used within CS projects designed and managed by professional organisations and scientists. There are very few available examples of science projects that are citizen generated, using social media and digital technologies.
2. Social media is mostly used as a platform to engage and retain volunteers in data collection activities, and may be used to disseminate results.
3. The full range of social media platforms are not being used, the emphasis is very much on Facebook and Twitter or the development of specific software.
4. The impact of social media is strongest in CS projects where social media tools and/or platforms are an integrated part of the project strategy with well defined objectives. There are two crucial issues in deciding upon a social media tool: Firstly, understanding how social media tools could serve the scientific purpose of the project; and secondly, defining the kinds of citizen scientists the social media will engage. The type of social media employed and the social media strategy

developed will need to take account of the differing needs, motivations and interests of the scientists and the target volunteer community, i.e. the differences between the "interested public" or amateur experts (e.g. birders).

5. Volunteer recruitment through third party organisations may be crucial to reaching specific interest likely to be interested in the CS project. Depending on the interest group, traditional media may be more effective than social media as an engagement mechanism.
6. In the case of newly developed social media tools, prospective citizen scientists should be engaged in the design and development of digital technologies and associated social media tools through pilot studies and evaluations. This kind of collaboration ensures that citizen scientists have access to tools they find useful at an individual level, as well as providing scientists with data and evidence useful at a community level.
7. Using social media to facilitate or enable real-time (or close to real-time) feedback of results at an individual, and community, level maintains user interest and engagement in CS projects.
8. Organisations are often resistant to the use of social media. Important barriers are the absence of a "digital culture", lack of familiarity with the benefits, the perception that social media is not "serious media" and concerns about organisational reputation. Raising the profile of innovative technology for CS within an organisation often rests on leadership from senior managers.

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Forest Research

Social Media & Citizen Science

The Research Agency of the
Forestry Commission