

Observatree: Key lessons

Qualitative study of the 'Observatree'
citizen science project

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Forest Research

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Acknowledgments

Many thanks are due to Nidhi Gupta for her work conducting additional interviews, and to Peter Crow for providing invaluable information about the Observatree project. We would also like to acknowledge the assistance of Helen Jones from the Woodland Trust in recruiting interviewees. Thanks are also due to all those professionals and volunteers who gave up their time to participate in the interviews. Without them this study would not have been possible.

Cite this report as:

Hall, C., Raum, S., Morris, J. and O'Brien, L., 2017. Observatree: Key lessons. Qualitative study of the 'Observatree' Citizen Science project. Forest Research, Farnham.

Executive Summary

Introduction

Great Britain's forests, woodlands and trees are suffering from increasing impacts of pests and diseases, primarily through the introduction of exotic species, and the consequences of global trade and nursery practices, but also due to changes in the behaviour of native species, and the effects of climate change. Part of the solution to this challenge is to increase the capacity of national plant health protection systems by supplementing the work of professional scientists and tree health practitioners with that of trained volunteers, or *Citizen Scientists*. Through its development of a 'Tree Health Early Warning System' (THEWS), based on citizen science, the Observatree project is an example of this approach. Funded through the EU Life+ programme, led by Forest Research, and involving partners from the Woodland Trust, the National Trust, Fera Science Ltd, and the Forestry Commission, and with support from the Department for Environment, Food and Rural Affairs, the Animal and Plant Health Agency, and Natural Resources Wales, Observatree was a four year citizen science project (2013-2017).

Observatree aimed to develop a GB-wide THEWS to enable early detection of tree pests and diseases, thereby supporting efforts to protect woodlands and forests. This was achieved by building capacity amongst a cohort of trained volunteers to carry out surveys for tree pests and diseases, and to assist with processing and verifying tree health incident reports. Recruited and supported by the Woodland Trust, more than 200 volunteers were trained as citizen scientists, across England, Scotland and Wales. The training that was provided was in monitoring and surveying skills for specified tree pests and diseases, completing and submitting monitoring reports, report verification, and use of the Tree Alert¹ online reporting tool.

As an innovative initiative leading the way in the early detection of tree health threats, evaluation of Observatree is an important part of the overall project to understand both the positive aspects and the challenges encountered, and to suggest how future projects should be designed and delivered.

This publication reports the results of interviews conducted with professionals and volunteers participating in Observatree in order to learn from their experiences. Other aspects of the Observatree project monitoring and evaluation are reported elsewhere. This evaluation study investigated a number of aspects of the experiences of participants, including: their motivations, positive experiences, received and potential benefits, not so positive aspects of their experiences, and suggestions for improvements.

¹ Developed by the Forestry Commission, Tree Alert is an online reporting tool for forestry professionals and those with knowledge of trees and woods. Information about trees showing symptoms of pests or diseases can be recorded and submitted for further verification.



Findings

Motivations for involvement

Motivations have been categorised as personal, professional/organisational, and social and environmental.

A diverse range of motivations were identified, particularly by volunteers. These included wanting to do something useful, worthwhile, rewarding, and of value.

Professionals were interested in the development of capacity in plant health warning systems, motivated by seeing a citizen science project in action, and encouraged by the data and reporting being delivered by the volunteers.

For some of the professionals, involvement was driven by the fact that “it’s part of my job”, and hence, by implication, they had no choice. This latter point could be important as it could impact on the extent to which professionals are positively engaged.

Under ‘social’ motivations both groups were in part motivated by meeting, talking to, engaging with, and working with other people.

Volunteers discussed a deep and broad mix of environmentally driven motivations. This related to an interest in conservation, trees, protection of the environment, pests and diseases, their local environment, long term impacts, spending time outdoors, and a broadly expressed desire to “do something for the environment”.

There is a need to be mindful of all of these motivations when designing programmes so as to appeal to the widest possible range of individuals.

This study shows the importance of considering the motivations of professionals, alongside those of volunteers, and there is scope for further investigation of these since both groups are crucial to successful citizen science projects.

Benefits of involvement

Following on from the range of motivations, volunteers and professionals identified a wide range of benefits that they had either experienced or witnessed themselves or that they believed could potentially arise from citizen science projects. These benefits again were classified as personal, professional, social and environmental.

In identifying personal benefits, the two groups of interviewees expressed some overlapping issues. These covered knowledge development, gaining new skills and awareness raising. Also, both groups identified opportunities for engagement, networking and meeting new people as being positive personal benefits. Improving and developing confidence was also a benefit that both professionals and volunteers experienced. For the professionals, the organisational benefits related to the reputation and profile of the organisation, team culture, collaboration, and having additional data.



The wider social and environmental benefits identified across the two groups were many and varied. Issues that were raised related to the specific benefit of increased pest and disease detection, having wider networks looking for pests and diseases, and having an important add-on to conventional science.

Beyond this were much broader issues relating to protecting the future of the environment because “everything depends on woodlands”, and the likelihood that involvement could lead more people to feel a responsibility to look after their local environment and become “local environmental champions”.

Positive changes, positive experiences and potential

Both professionals and volunteers were able to articulate a range of positive changes and experiences arising from the Observatree project. They stated that the citizen science project adds to conventional science, and leads to behavioural and attitudinal change. They commented that the project gives people new skills, builds networks and demonstrates the value of citizen science. Others believe it has potential to inform policy development but that it depends on people seeing the value of citizen science.

Volunteers had plenty of positive comments about the training that was provided. A range of positive views were expressed about the nature and level of support that the volunteers experienced. Another aspect of the volunteer experience was that of communication and this was discussed positively at length by the volunteers. Some of the volunteers valued the opportunity to work collaboratively, to meet with other volunteers and professionals, and to feel involved with others. Volunteers were clear about the high value placed on collaboration with the scientists. It gave them a sense of the bigger picture, in terms of how the data they collected fed into the project at a national level.

What this study shows clearly is the strong connection between motivations, positive experiences and benefits. This connection could be viewed as being linear but is more likely to be circular².

Problems and negative experiences

Despite the many positive experiences described by those involved there were some not so positive aspects. These related to areas such as training, support, feedback, coverage of the citizen scientist network, communication between volunteers, and knowledge exchange between partners.

² Thus in a linear relationship people are motivated to get involved, and because of their positive motivation they have a positive experience from involvement. This in turn means that personal benefit is gained from the positive experience. However, it is also true that having a positive experience and thus gaining personal benefit is likely to re-inforce and add to motivation.

Improvements and changes

The interviews helped to identify a number of recommendations for Observatree and other similar citizen science projects that could help ensure that the range of potential benefits be achieved.

The key themes under which improvements were needed or suggested were:

- *Volunteer support* – Recommendations under this theme included: Provide more feedback and clearer instructions; manage expectations and remember that volunteers have other priorities;
- *Communication and information* - Recommendations under this theme included: Have more information sharing between volunteers and better data sharing between project partners, and raise awareness of the project;
- *Training* - Recommendations under this theme included: Make sure training is accessible for all, and consider formal accreditation for volunteers;
- *Developing the network* - Recommendations under this theme included: Have more links to other local volunteer networks, and recruit more volunteers in certain areas;
- *Project management* - Recommendations under this theme included: Make involvement more attractive for professionals;
- *Using the volunteer resource* - Recommendations under this theme included: Engage volunteers in multiple roles and keep them feeling 'useful'; and,
- *Getting the technology right* - Recommendations under this theme included: Make sure that technology, such as reporting apps and other online tools, is fit for purpose from the start of the project.

In particular, 'developing the network' and 'improving communication' are highlighted as areas requiring attention.

To conclude, this evaluation study has enabled a broad and deep reflection on the experiences of volunteers and professionals who have been involved in the four year citizen science project 'Observatree'.

Overall, this work demonstrates how to learn lessons from the first phase of the Observatree project, and the key issues that similar citizen science projects should consider so as to ensure that the maximum possible range of benefits are realised.

1. Introduction

1.1. Tree health

The United Kingdom's (UK's) forest and woodland ecosystems are suffering from increasing impacts of pests and diseases, through the introduction of exotic species, patterns of global trade, nursery practices, and wind-borne pathogens. Climate change is likely to further increase threats to forests by speeding up pest and disease life cycles, and by causing stress in trees unable to adapt to rapidly changing environmental conditions. A considerable diversity of pests and pathogens pose a threat to UK woodland ecosystems, including Chalara dieback of Ash, Acute Oak Decline, and Asian Longhorn Beetle. Effective surveillance, detection and identification methods are essential if control responses are to be successful, and also play a key role in supporting research to understand invasive species spread and population dynamics. The requirement for additional surveillance highlights the need to consider alternative and innovative methods for gathering data about disease threats.

1.2. Citizen Science

Citizen science offers the opportunity to create a network of multiple 'eyes and ears' on the ground, able to provide early warning of possible tree health problems and potential threats. By providing volunteers with the skills to observe, record and report potential sightings of key pests and diseases, citizen science offers the opportunity to add capacity to the existing national plant health protection system. It also offers the potential to provide a wide range of additional benefits to participants. Participation may help volunteers to gain a greater understanding of the natural world and issues of importance in their local environment. Involvement may also increase the positive attitudes volunteers have about the natural environment. Further, being a citizen science volunteer may help individuals to increase their understanding of scientific processes and enable them to appreciate how they can contribute to science-based decision making (Gommerman & Monroe, 2012).

As well as these benefits for the participants, citizen science has the potential to support high level positive outcomes for the protection and conservation of the natural environment and ecosystems. This includes outcomes in the fields of education, research, site and species management, community capacity building, and policy (Cigliano et al, 2015).

The routes by which citizen science may improve environmental protection are therefore threefold: through adding to scientific knowledge, by encouraging public engagement and community action, and by informing policy making (McKinley et al, 2017).

However, many citizen science projects fail to generate data that is considered useful for informing decisions, and therefore fail to adequately meet decision maker needs (Newman et al, 2017) and provide the full range of potential benefits.

Interviews with professional biodiversity scientists and citizen science project managers identified a number of barriers to the successful use of citizen science as a research tool (Burgess et al, 2017). These barriers included bias amongst scientists for certain data sources, and a low awareness of citizen science projects amongst scientists. Other barriers included inconsistencies in data quality and a lack of suitability of citizen science for some areas of environmental science.

Overall, despite the opportunities for providing multiple benefits, it is likely that citizen science has so far only achieved a small portion of its potential impact. It may be that to reach its full potential there needs to be stronger connections between the professionals and the volunteer citizen scientists throughout the citizen science process and experience (Theobald et al, 2015). Project design and delivery will be key to ensuring this.

1.3. The project: Observatree

Observatree was a four year citizen science project (2013-2017), funded through the EU Life+ programme, led by Forest Research, and involving partners from the Woodland Trust, the National Trust, Fera Science Ltd, and the Forestry Commission, and with support from the Department for Environment, Food and Rural Affairs, the Animal and Plant Health Agency, and Natural Resources Wales.

Observatree aimed to deliver a UK tree health early warning system (THEWS) to enable early detection of tree pests and diseases, thereby supporting efforts to protect woodlands, forests and trees. The project aimed to achieve this by building capacity amongst a cohort of trained volunteers to carry out targeted survey work, and to process and verify tree health incident reports. The intention was that these volunteers would support surveillance and early detection of tree health threats through their survey work, and by improving the quality of tree health incident reports and speeding up the passage of reports from submission, through verification, to operational response.

Recruited and supported by the Woodland Trust, more than 200 volunteers were trained as citizen scientists, across England, Scotland and Wales. The training that was provided focused on monitoring and surveying skills for specified tree pests and diseases, completing and submitting monitoring reports, report verification, and use of the Tree Alert online reporting tool.

The expectation was that volunteers would focus primarily on surveying for changes in tree condition and sightings of priority tree pests and diseases. Their work would thereby make a positive contribution to knowledge and understanding of changes in tree health and the occurrence of priority pests and diseases at national and regional scales.

The Observatree project had a stated aim and a number of objectives, as follows:

Aim:

- To build capacity to support tree health surveying and the processing and verification of tree health incident reports.

Objectives:

- To recruit, motivate, train and retain volunteers so that they offer effective tree health surveying and support to the processing and verification of tree health incident reports.
- To offer effective support to government tree health professionals.

1.4. Evaluation of the Observatree project

As an innovative citizen science project, monitoring and evaluation of Observatree was a crucial part of project design and delivery.

1.4.1. Evaluation questions

An early evaluation plan (2014) was designed to answer a number of questions directly related to the aims and objectives of the Observatree project.

The first two questions (intended to address the high level aim of the Observatree project) were:

- Is the project building capacity to support tree health surveying and the processing and verification of tree health incident reports?
- Is the project improving surveillance and early detection and supporting evidence-based responses to tree health threats in the UK?

A large number of more specific questions³ were proposed to address the objectives of the Observatree project.

1.4.2. Approach to monitoring and evaluation

The overall monitoring and evaluation of Observatree was expected to involve a range of approaches. Evidence of the social and environmental impacts of Observatree was to be gathered through numerous methods:

- Project activity log
- Project task log / Summary analysis of activity within verification portal
- Analysis of interactions and activities within the forum

³ For brevity these are not detailed here.

- Feedback forms (from events)
- Surveys (volunteers; scientists; Plant Health officers)
- Semi-structured interviews (scientists; PH officers and other operational staff)

The survey yielded responses from 45 volunteers (19% response rate) and 28 professionals (47% response rate). It investigated topics such as motivations for involvement, challenges, and suggestions for improving the experience of being involved in Observatree.

Following the questionnaire survey with volunteers and professionals the evaluation approach was revised. The decision was taken to carry out semi-structured interviews with professionals and volunteers. This report focuses solely on the findings from the interviews. Other aspects of the monitoring and evaluation work are reported elsewhere.

1.5. Structure of report

The next section outlines the approach taken to investigate the experiences and perceptions of the volunteers and professionals involved in the Observatree project. Following that, results are presented, possible improvements to future project design and delivery are suggested, and then some of the implications are discussed to conclude.

2. Methods

2.1. Interviews

As described above, in-depth qualitative interviews were designed to investigate in more detail some of the issues that arose from the questionnaire responses, and the interview questions were written to be in line with the following research questions (RQs).

Research Questions for the interviews with professionals

1. What factors (capacity, capabilities and motivations) predict levels of involvement by professionals in Observatree over time?
2. How do professionals perceive the potential of Observatree and citizen science in supporting early detection of tree pests and diseases, and its use for evidenced based policy/decision-making?
3. Can some of the most prominent issues and challenges of professional involvement in Observatree that are emerging from the quantitative data be verified, and how can we best address or overcome these?
4. What are the benefits (at an individual level as well as wider societal level) of project involvement to professionals, organisations, environmental resilience, and what project elements contributed to these benefits being delivered most strongly?

Research Questions for the interviews with volunteers

- A. What factors (capacity, capabilities and motivations) predict level of volunteer involvement in Observatree over time?
- B. Can some of the most prominent challenges of Observatree volunteering that are emerging from the quantitative data be verified, and how can we best address these?
- C. What are the benefits of project involvement to volunteers, and what project elements contributed to these benefits being delivered most strongly?

Interviews were conducted by telephone following recruitment by the Woodland Trust volunteer co-ordinator. Interview protocols are included in appendices.

2.2. Aim and objectives for data analysis

Before the analysis of the interview data began, the RQs were further refined and developed to produce a clear aim and associated objectives to aid in the process of analysis and reporting.

Thus the aim of the qualitative interviews was defined as:

- To investigate the experiences and opinions of professionals and volunteers in order to learn from Observatree and inform the design and delivery of future citizen science projects.

In order to achieve this aim, a number of objectives were identified:

- To develop understanding of the motivations for involvement in a citizen science project
- To investigate the opinions of professionals about the positive changes brought about by Observatree, and the potential of citizen science projects to address tree health challenges
- To examine the positive experiences of volunteers in Observatree
- To identify the benefits that can arise from involvement in a citizen science project
- To investigate the challenges identified by volunteers and professionals involved in Observatree
- To present suggestions for change and improvements for future citizen science projects.

2.3. Data analysis

With the interviewees' consent, the interviews were recorded using a digital voice recorder, and subsequently transcribed in full. All transcriptions were imported into NVivo⁴ (V8) and coded. Coding is an interpretive technique used to organise qualitative data and to identify key nodes (or themes). A coding framework is normally used and can be based on a combination of pre-specified high level themes (or nodes), and inductively-derived themes. These themes are labelled with a code that provides an indication of what is included within that theme. Inductive coding requires the researcher to carefully read the data and identify themes within it (Braun & Clarke, 2006). For this project, an initial coding framework was pre-designed, based on the Research Questions and interview questions. These provided Tier one and two nodes. These are shown in Figure one.

⁴ A software package designed for analysing qualitative data

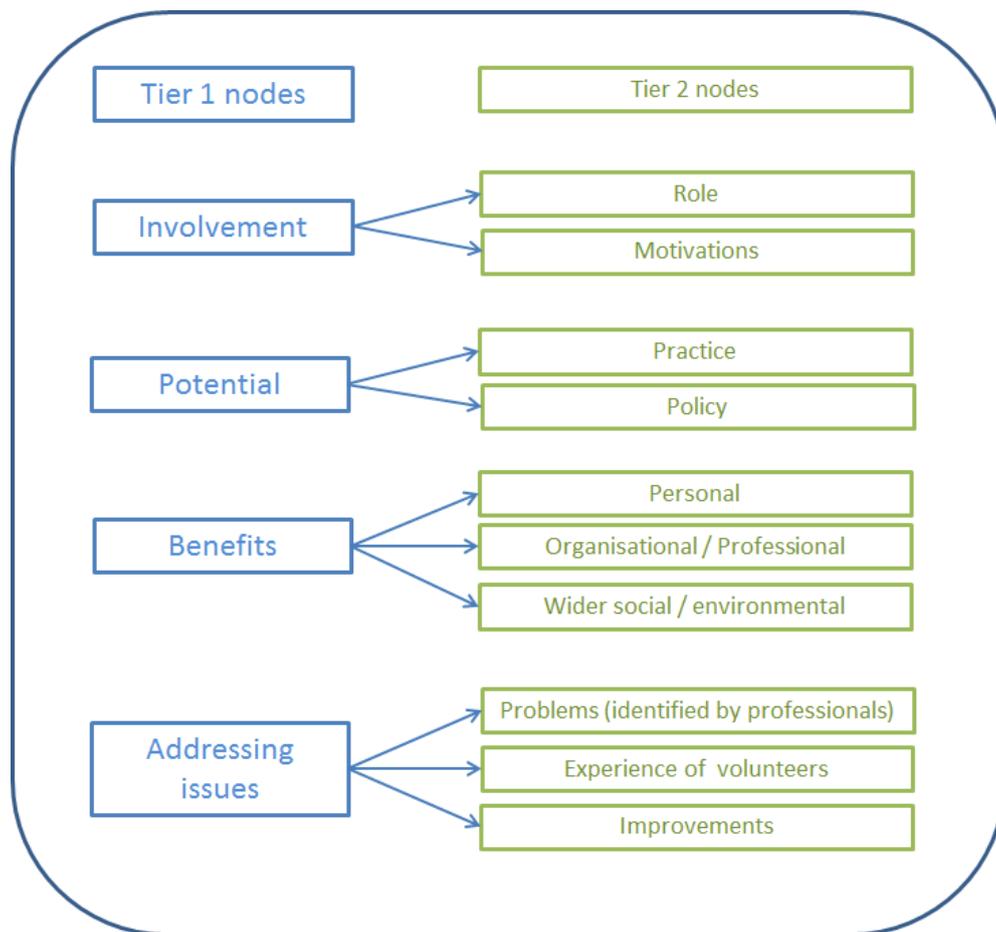


Figure one: Coding framework showing tier one and two nodes

Subsequently, a third tier of nodes was added, based on inductive analysis of the data, thereby relying on the themes that emerged from the responses of the interviewees.

Following coding, a process of affinity mapping was used for some sections of the report to facilitate clustering and presentation of the results. Constructing an affinity diagram is a process that presents a way to express common ideas without quantifying them. An affinity diagram can be a useful tool when there is a need to organise and summarise a large amount of qualitative information, and present a coherent story from the thoughts and opinions of a diverse group.

The tier two nodes provide the structure of the results section of this report, while the tier three nodes provide the detail included in each section.

In some cases, direct quotes are provided to illustrate the points being made. No quotes are attributed by name to any individual.

3. Results

3.1. The interviews

Sixteen interviews were completed⁵, eight with professionals involved in a variety of roles connected to Observatree, and eight with volunteers recruited by the Woodland Trust to be the Citizen Scientists. They were carried out by telephone during April and May 2017. The interviews lasted for approximately 30-40 minutes.

The interviewees were from locations across England, Scotland and Wales.

The roles fulfilled by the professionals who were interviewed were varied, and ranged from those involved in tasks directly connected to the volunteers, such as training and providing support, through to high level decision-making and directing at the level of project board and partner lead.

In between, there were roles involved in the development of learning materials and reporting tools, project management, funding, promotion and project initiation and piloting.

The roles fulfilled by the citizen science volunteers in Observatree were more simply defined along the lines of the broad task areas to which they were originally assigned, namely, quality checking volunteer reports, and carrying out tree survey work, looking for pests and diseases.

3.2. Motivations for involvement in Observatree

Both the professionals and the volunteers were asked what motivated them to get involved in the Observatree project. They were also asked what motivations had sustained their interest and involvement over time. Analysis revealed a wide range of motivations for the professionals and volunteers involved in Observatree. The responses from both groups of interviewees have been grouped together and displayed in table one. Note that the entries in the table have not been re-written but are expressed as contained in the interview transcripts. Motivations have been classified as personal, professional, social, and environmental.

Notably, the volunteers referred to a much broader range of motivations for getting and staying involved in the project, than did the professionals. Perhaps of primary interest is the extent to which their motivations apparently differ. There are only limited similarities in motivations between the two groups of interviewees. Further detail follows in the sections below.

⁵ Interviews were carried out by two interviewers: Susanne Raum and Nidhi Gupta.

3.2.1. Personal motivations

When considering personal motivations, the volunteers articulated a wider range of issues than the professionals. These included wanting to do something useful, worthwhile, rewarding, and of value. Volunteers also wanted to be appreciated, and to do something new and challenging. They expressed motivations to do something they were interested in and enjoyed. At a practical level some volunteers were motivated to be involved because they could learn new knowledge and receive training in new skills. A couple of these aspects were echoed by the professionals, some of whom expressed being motivated because they thought it was a good idea, and others being motivated by the opportunity for personal skills development.

3.2.2. Professional motivations

Perhaps unsurprisingly, the professionals identified more motivations under the category 'professional'. Hence they were interested in the development of capacity in plant health warning systems, motivated by seeing a citizen science project in action, and encouraged by the data and reporting being delivered by the volunteers. However, for some of the professionals, involvement was driven by the fact that "it's part of my job", and hence, by implication, they had no choice.

This latter point could be important as it could impact on the extent to which professionals are positively engaged.

3.2.3. Social motivations

Under the 'social' category of motivations both groups were in part motivated by meeting, talking to, engaging with, and working with other people. Also, to some extent the behaviours of others are important, specifically, the enthusiasm and motivation of other people can be an inspiration that keeps some individuals engaged and involved. Hence, collaboration and opportunities for interaction with others are key here.

3.2.4. Environmental motivations

Volunteers discussed a deep and broad mix of environmentally driven motivations, in contrast to the professionals. This range of motivations of the volunteers related to an interest in conservation, trees, protection of the environment, pests and diseases, their local environment, long term impacts, spending time outdoors, and a broadly expressed desire to "do something for the environment". Some of the professionals also expressed a motivation to be involved in something that would be "for the greater good" and that would therefore "help the trees and forests" in their area.

Table 1: Motivations outlined by interviewees for getting involved and continued involvement

Motivations: High level	Motivations - Professionals	Motivations - Volunteers
Personal		Motivated by seeing the value in what I'm doing
		Doing something that feels personally rewarding
		Doing something useful / worthwhile
	Thought it was interesting/ a good idea	Had just retired- Wanted something useful to do
	Motivated by volunteer motivation	Being appreciated
	Personal skills development	Valuable at a personal level
		Interest
		Enjoyment
	It was a challenge	
	It involved learning / training	
Organisational / Professional	Develop plant health capacity	Built on professional knowledge
	Motivated by seeing CS project working	Wanting to do something different to work / for work-life balance
	Encouraged by data/ reporting from volunteers	I was lacking practical experience (for career change)
	"It's part of my job"	Followed on from other volunteering work
	Personal skills development	
Social		To develop contacts and networking
		Meet new people
		Talking to people about it
	Help volunteers/ pass on knowledge	Getting other people interested
	Motivated by volunteer motivation	Other people are enthusiastic
	Work/ engage with people	Raises awareness
		Being part of a bigger picture
		Knowing I'm part of a combined effort
	Feel involved in society	
Environmental		Interested in conservation
		Wanted to do something for the environment
		Prevent loss of trees
	Develop plant health capacity	Monitor pests & diseases
	For the greater good - as in, to help the forests and trees	Issue of tree diseases
		To develop interest in trees
		For the benefit of my local area
		Wanted to be outdoors
	Knowing it will have effect in the long term	

Much of the literature around citizen science focuses on understanding the motivations of citizen scientists. Given the findings here, there is scope for probing more deeply into

the motivations of professionals involved in such initiatives since successful projects rely on both groups.

3.2.5. Reasons for not being motivated

Finally, volunteers also referred to a few reasons for not being motivated, and these are recorded here.

Firstly, when personal motivation is lacking some volunteers felt the need for stronger leadership to drive them forward. It was felt this was sometimes lacking. The professionals whose role it is to guide and support volunteers need to find the right balance between recognising that volunteers are not employees, whilst also being aware that some volunteers may need to be more strongly directed than others.

Secondly, and as noted by numerous interviewees, some volunteers lost motivation because they had not found any pests and diseases, and hence had nothing to report. While finding nothing is a positive outcome it can make volunteers feel they are wasting their time. In these cases, it is important to stress that recording 'null returns' is just as relevant as recording possible sightings, as it can help to pinpoint when problems first arise if there is a long-term record of absence in certain areas. Emphasising this point might help to reassure volunteers that their records are needed and of value.

3.3. Benefits from Observatree

Both professionals and volunteers were asked to detail the benefits they had received, observed or perceived from involvement in the citizen science project. These benefits covered personal, organisational / professional, and wider social and environmental benefits, and are detailed in table two. Note that the entries in the table have not been re-written but are expressed as contained in the interview transcripts.

3.3.1. Personal benefits

In identifying personal benefits, the two groups of interviewees expressed some overlapping issues. These covered knowledge development, gaining new skills and awareness raising. Also, both groups identified opportunities for engagement, networking and meeting new people as being positive personal benefits. Improving and developing confidence was also a benefit that both professionals and volunteers experienced. However, for volunteers this development in confidence was intertwined in many ways with other benefits. These included doing something that was personally rewarding, doing something that "provides a sense of self worth", having "a sense of participating in something bigger" and doing something worthwhile, useful and of wider benefit. This gives a deep understanding of how involvement in a citizen science project might add to an individual's confidence.

At a more practical level the volunteers identified additional personal benefits associated with physical activity and experiences. For example some had "found new places to

enjoy” through involvement in Observatree, and others stated that they now “spend more time outdoors”. Although not widely expressed, there was some acknowledgement that personal benefit may include some health benefits from being outside surveying in woodland areas. However, many stated that they were already in the habit of walking and spending time in local woodland areas. Generally, people were hesitant to claim that the volunteering had greatly increased their level of physical activity, instead wanting to state that *perhaps* they were now spending a bit more time in greenspace.

Volunteers also stated that involvement “provides a better work-life balance”, and has provided an “increased appreciation of trees”.

Other personal benefits identified by professionals were that it has “changed awareness”, “changed attitudes” and “provided inspiration”. For one professional it also “changed the way I work”, in a positive way.

Overall, both groups of interviewees identified a wide range of personal benefits that had arisen or can arise from involvement in a citizen science project.

3.3.2. Organisational and professional benefits

In terms of organisational and professional benefits, as might be expected, there was some considerable divergence between what the professionals identified and what the volunteers identified. For the professionals, the organisational benefits related to the reputation and profile of the organisation, team culture, collaboration, and having additional data. For the volunteers, some of the professionally related benefits were gaining new skills and experience of relevance to job applications and interviews, and future opportunities.

3.3.3. Social and environmental benefits

The wider social and environmental benefits identified across the two groups were many and varied. Issues that were raised related to the specific benefit of increased pest and disease detection, having wider networks looking for pests and diseases, and having an important add-on to conventional science.

Beyond this were much broader issues relating to protecting the future of the environment because “everything depends on woodlands”, and the likelihood that involvement could lead more people to feel a responsibility to look after their local environment and become “local environmental champions”. Other wider issues that were raised related to international trade, the provision of a “second line of defence” behind border security and quarantine, policy making and the provision of data.

Many of these were expressed as ‘potential’ benefits, rather than observed and experienced. Nevertheless, it can be concluded that one benefit of such a project is that it leads those involved to begin considering such bigger issues and their roles in them.

Table two: Benefits arising from Observatree

Benefits	Professionals	Volunteers
Personal	<p>Skills Knowledge development Raised awareness</p> <p>Engagement/ networking</p> <p>Improved confidence</p> <p>Changed the way I work Changed awareness Changed attitudes Provided inspiration</p>	<p>Skills Knowledge and understanding Raises awareness</p> <p>Meeting new people</p> <p>Developed my confidence Personally rewarding Provides a sense of worth A sense of participating in something bigger Doing something worthwhile, useful, of benefit</p> <p>Found new places to enjoy Spend more time outdoors Health benefits Provides better work-life balance Increased appreciation of trees Developed my interest</p>
Organisational / Professional	<p><i>For the organisation</i> Networking/ engaging/ collaboration Raised profile of organisation Developed organisational reputation Changed team culture</p> <p><i>Plant Health</i> Provided additional data Broadened the pests & diseases being looked for</p> <p><i>Practical</i> Led to new learning materials Serves as a hub for other Citizen Science projects</p> <p><i>Attitudes and awareness</i> Changed attitudes to Citizen Science Raised awareness</p>	<p>Networking</p> <p>Encouraged me to study forestry</p> <p>Provided skills needed to get a job Helped in an interview Provided additional experience for future</p> <p>Keeps me updated on pests & diseases Adds to my work role</p> <p>Makes me think I would have liked a different job</p> <p>Has not helped</p>
Wider social / environmental	<p>More pest & disease detection Developed local networks looking for pests & diseases Provides important add-on to conventional science</p>	<p>Everything depends on woodlands Continued enjoyment of woodland It's needed for our future</p> <p>Makes you think about international trade</p>

	<p>Trained the plant health staff of the future Learning materials are publicly available</p> <p>Greater environmental awareness and engagement, and thus sense of responsibility to help protect it People take on role of local environment champion Behavioural change</p> <p>Demonstrated value of Citizen Science Helped people start a new career</p>	<p>(in plants) Prevents tree diseases becoming established Provides a second line of defence (behind quarantine and border controls) Adds to Plant Health capacity Provides valid data Influencing policy</p> <p>Have been able to raise people's awareness and get them interested in volunteering Volunteering helps people get balance in their life</p>
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3.4. Citizen Science and Observatree – positive changes, positive experiences, and potential

Professionals were asked what positive change they believed Observatree had brought about, and what was the potential of Observatree and citizen science for changing and influencing policy and practice. Volunteers were given the opportunity to describe their positive experiences of being a citizen scientist in the project, across a range of issues including the training provided, the support received, the nature of communication, and opportunities for collaboration. Results from responses are presented below.

3.4.1. Positive change and potential

Many of the positive changes identified by the professionals overlapped or re-emphasised the benefits that are reported elsewhere in the results. For example, they stated that the citizen science project adds to conventional science, and leads to behavioural and attitudinal change. They commented that the project gives people new skills, builds networks and demonstrates the value of citizen science. Whilst these positive changes could be true of any citizen science project, changes specific to Observatree were identified as being the value added to pest and disease detection, and the capacity added to plant health protection systems.

When it came to the potential for informing policy and decision making, there was some hesitation from interviewees about this. Some did say that the project helps to improve policy, as demonstrated in the following quote: "I think that it also helps to improve policy by engaging a wider range of stakeholders".

Others believe it has potential to inform policy development but that it depends on people seeing the value of citizen science. As one interviewee said "...if one appreciates the work that citizen science delivers, then it will inevitably get taken into

account in policy development and improve it, I think, because it adds an extra data source, and an independent source of data as well which is often quite useful”.

3.4.2. Positive experiences of volunteers

- *Training*

Volunteers had plenty of positive comments about the training that was provided. For illustration purposes a number of quotes are presented. These demonstrate that the training was considered to be interesting, a good combination of presentations and practical demonstrations, and aimed at the right level.

“The training we have has been really interesting and really good”.

“The last one I went to was a good mix of a bit of training, some presentations on things that we are likely to see ... and then actually getting us out in the trees and in the woods and putting it into practice and I felt that was a good way to do it”.

“I think the training was pitched at the right level, and of course it’s got to address a range of abilities and knowledge, and it seems, in my view, to do that pretty well”.

“I think the broad mix that’s being used currently is working well, particularly the combination of introducing particular topics through face-to-face and contact with the professionals in the field, and then reinforced by more technical input through webinars, which has been very effective I think, and allows for reviving and revisiting those topics with time”.

- *Support and feedback*

A range of positive views were expressed about the nature and level of support that the volunteers experienced. Comments related specifically to the role of the Woodland Trust in looking after volunteers and understanding their needs. Volunteers were also appreciative of the support from experts and scientists involved in the project. There was specific praise for the volunteer support officer. Volunteers were full of praise for those professionals who made them feel welcomed and supported. On another positive note volunteers expressed confidence that they knew there was always someone there who they could ask for help and advice, if needed.

“I think the positives are the Woodland Trust is really, really on the ball regarding looking after volunteers”.

“I give them ten out of ten for their efforts and their understanding of what volunteers need and how to manage volunteers”.

“The people who have been the key contacts with us have been so warm and welcoming and supportive; that makes a huge difference, I think, about making you feel better about what you’ve done”.

“I always felt that if I didn’t know something I could go and ask somebody”.

“Very good support from the experts and scientists”.

Another important aspect of the support received by volunteers related specifically to the volunteer co-ordinator who was seen as an essential part of their experience. As one interviewee put it: “Having a volunteer coordinator is critical for times when you need help or you need an immediate answer from somebody”.

It was widely acknowledged that the co-ordinator was very good at her job, with volunteers commenting that she was “very accessible” and “really helpful”.

As one interviewee stated: “I think one of the big positives is the high level of support and professionalism that I think we get from the project officer” (referring to the volunteer co-ordinator).

Volunteers were also happy that the feedback they received was good, for example when they submitted reports. Further they had positive experience of things being dealt with promptly if they raised concerns or had issues that needed addressing.

Overall, the comments made by the volunteers paint a very positive picture of the support they experienced throughout their time with Observatree. This is positive for continued or future involvement of the volunteers.

- *Communication*

Another aspect of the volunteer experience was that of communication and this was discussed at length by the volunteers. Again, experiences were largely positive. They felt that the expert scientists communicated with them in a way that made them feel they were on an equal level. Their experience of updates and explanations of process from the Woodland Trust was good. Some appreciated the clarity of communication they received.

“I think the clarity of what’s been given to me has been fine. They’re very, very good on communication. We get a monthly update through the Woodland Trust, which is excellent”.

“Sometimes if you’re talking to people, you know, who are very qualified in plant science for example, they don’t exactly talk down to you, but they may treat you as not being on the same level, but I’ve never found that with the people at Forest Research. You know, they’ve always ... been fine”.

“The Woodland Trust have been very good at updating on current tree diseases and what to look out for, how to manage what you do, the protocol, that if a tree does get a disease, what’s the process. So that’s been good”.

One specific aspect of ‘communication’ that was important to some of the volunteers was the information materials they received, the online information that was available, and

the webinars that were provided. Again, there were many positive comments relating to the amount, quality and content of the information provided.

“The online webinars have been very good because I’ve been at a distance”.

“I think there was enough evidence online”.

“One of the good things is access to an awful lot of information online which I would say is almost self-training, in that, if you don't know, if you are stuck for identifying a blotch on a leaf, say, there's a very good system for sending in a photograph and getting an opinion”.

- *Working together*

Some of the volunteers valued the opportunity to work collaboratively, to meet with other volunteers and professionals, and to feel involved with others. This helped them to feel that they were not on their own, and also allowed them to discuss and reflect on ways of working. Some volunteers felt reassured if they could talk about what they were doing with someone who was doing something similar to them. They appreciated the value of networking with other volunteers and the trainers.

“The volunteers, I think, make you feel you’re not on your own. You know, the volunteers help you formulate your ideas as to whether you’re right or wrong, or could you have thought about it differently or approached it in a different way”.

“Actually the best time that I’ve felt has been really good has been when I’ve been one to one with somebody that’s doing similar work to me”.

“It’s the opportunity to be with people analysing something together; you’re physically seeing it together and talking about it – that’s been excellent”.

“I think it’s important to get people together from time to time. Not only to take advantage of training opportunities that are available, but this is the way of networking between the volunteers and trainers”.

- *Collaboration with scientists*

Volunteers were clear about the high value placed on collaboration with the scientists. It gave them a sense of the bigger picture, in terms of how the data they collected fed into the project at a national level. It also gave them a sense of credibility in what they were doing. They also appreciated the opportunity to question the scientists to add to their own understanding. Volunteers were also positive about the different ways to connect with the scientists, at the training sessions, and through the website and webinars. Some considered the collaboration to work in two directions, pointing out that it could help the scientists understand more about what was happening on the ground. They also pointed out that if they, the volunteers, were doing the ‘leg work’ out in the woodlands,

it freed up the professionals to use their skills more usefully and their time more efficiently.

“Collaboration with the scientists gives you a sense of the bigger picture. Without that you feel very localised and actually – ‘where is this going’, you know?”.

“I think having contact with the scientists gives you that credibility, it gives you national importance”.

“It puts it at a level that you feel that you are making that wide a difference, and it brings you much more in terms of your own knowledge; so to be able to question somebody about something and them to be able to explain it, you know.....just so much widens your perception and understanding – that’s very good”.

“The collaboration is good; if they continue with the scientists coming to the training sessions I think that’s good, and contributing things to the website and running webinars – that’s exactly where we would connect with the scientists”.

“I think it's important because it helps the scientists have a better understanding of what's actually happening on the ground, on the shop floor, if you like”.

“Because one scientist can only cover a certain amount of ground whereas a couple of hundred of us can cover an awful lot more, so in that respect I think it means the scientists use their expertise probably more efficiently”.

3.5. Problems and negative experiences

In addition to being offered the opportunity to describe the positive aspects of the project from their own observations and experiences, the interviewees were asked to discuss some of the problems and challenges they encountered during their involvement.

3.5.1. Problems identified by professionals

The professionals who were interviewed expressed a number of concerns about how the project operated, and identified some challenges and problems that would need to be addressed in any future similar projects.

- *Volunteer network*

The geographical coverage of the volunteer network was seen to be patchy, with some areas having much larger numbers of citizen scientists than others. This meant there was a lack of volunteer contact in some regions. There was a recognition that this is inevitable due to the distribution of centres of population. However, this meant that there were not necessarily the ‘right’ numbers of volunteers where they might be most valuable for the purposes of an early warning system for pests and diseases.

Although more than 200 volunteers were trained through Observatree it was felt by some that the project had not lead to the development of a particularly large network, and had perhaps not lived up to expectations in this respect.

It was also acknowledged that the volunteer network was missing representation from some of the socio-demographic groups, particularly with regard to age and working status.

- *Volunteer motivation, understanding and commitment*

Some of the professionals were concerned about the challenge of maintaining volunteer motivation through time, and were also concerned about some volunteers not understanding all the issues. However, alongside this it was acknowledged that there will always be limits to what volunteers can be asked to do, and a recognition that the professionals need to accept that volunteers have limited time, and other responsibilities and priorities.

- *Data quality and project outputs*

As often discussed in the literature on citizen science, some of the professionals believed there were questions over data quality that presented a challenge for the success of the project. In addition, there were concerns that the project had required a lot of staff time and commitment for too little result. These concerns could present considerable barriers to the future involvement of some professionals in citizen science projects.

- *Early delays and problems*

Other problems that the professionals flagged up related to there being a lack of direction at the start, and early delays in development and progress. Some institutions were also slow to engage in the project, losing the opportunity to be involved in decision-making about project direction and development. There were also acknowledged problems with the Tree Alert technology in the early stages.

- *Knowledge exchange*

Some had experienced a lack of knowledge exchange between partners and other professionals which they considered to be a negative issue that could stand in the way of future involvement.

- *Impact on policy*

Finally, when asked what had not gone so well, one of the professionals pinpointed the fact that the Observatree project had not had an impact on government policy-making and operational delivery. They stated that policy makers have not changed their way of thinking as a result of Observatree, and have not recognised the value of citizen science to their policy making and operational delivery. This could be related to the timescales involved and it may be unrealistic to expect an impact on policy within a few years.

3.5.2. Negative experiences of volunteers

- *Training*

Volunteers expressed a number of issues with the training that was provided. These related to location of the training, which was sometimes too far away, the level that the training was pitched at, which in some early sessions was found to be too high, and the fact that some topics were repeated unnecessarily, specifically using GPS and survey methods.

“The downside sometimes, I think, has been, for myself, the location of the training”.

“The training has been certainly about two hours travelling away, and so it’s difficult to do that”.

“It was perhaps pitched a bit high in the first one I went to, I think they assumed a fairly high level of knowledge”.

“One thing I would say is that there seemed to be a repeat a couple of times of doing GPS and survey methods”.

- *Feedback*

Despite the many positive comments about the feedback that was provided to volunteers, experiences were not 100% positive. Specifically, one of the volunteers expressed frustration about the feedback received after submitting samples for analysis. S/he commented that “you wait forever for the results to come back. You have to chase them as well”. They further commented that the results tend not to be communicated back to the volunteer(s) and not disseminated.

- *Volunteer co-ordinator*

While there was overwhelmingly positive praise for the volunteer co-ordinator in the Woodland Trust, there was also one comment questioning the amount of communication received.

“In fact she [volunteer co-ordinator] probably over-communicates”.

- *Expectations about role*

There was some dissatisfaction relating to expectations people had about their role as a citizen scientist. These suggested that their expectations had not been met, as they thought they would be asked to do more. Some of the volunteers expected to have a greater role to play and more surveying work to do.

- *Tree Alert*

Reflecting one of the issues highlighted by the professionals, an issue that was flagged up in the volunteer interviews was that there was a delay in getting the Tree Alert system up and running. This meant that people received the training in surveying and reporting and then could not begin. As one interviewee put it “I felt that I was treading water” and “we couldn’t actually get to grips with it for quite some time into the project”.

- *Collaboration with other volunteers*

One negative aspect of the volunteer experience of Observatree was that in some cases there was a lack of collaboration with other volunteers. For some, there was frustration because they knew of volunteer groups that were in place but at too far a distance. This made it difficult for volunteers to meet up with other people. This was clearly a disappointment for one volunteer who stated: “I would have loved there to have been something that I could have done with somebody”. Such a comment suggests a loneliness in the volunteer experience for this individual.

In other cases, volunteers stated that they did not get opportunities to collaborate with other Observatree volunteers, and in fact one interviewee stated: “I actually wouldn’t even know where they are within the area”. Again, this suggests that the Observatree volunteering role was a somewhat lonely activity for some of those signed up as citizen scientists.

This lack of collaboration was further emphasised by another volunteer who stated that they had not had much contact with other volunteers, other than through the training days.

Overall, these comments present a picture of some disappointment and feelings of isolation for some of the volunteers.

Nevertheless, it is important to note that the results presented in this section from the interviewees do, in the majority of cases, paint a positive picture of the experiences and perceptions of those involved, either as professionals or volunteers. In the next section there are suggestions for improvements and changes that could be made in future citizen science projects to help make the experiences even more positive, to help the projects deliver an even wider range of benefits, and to address some of the issues and challenges identified above.

4. Improvements and changes

Section three has described what motivated participants to get involved and stay involved in the Observatree project. It also elaborates on the benefits that can arise from citizen science projects, for the participants, their organisation, community, wider society, and local and global environment. Further, it presents evidence of the positive and not-so-positive experiences of those involved in the Observatree project, from the perspective of both volunteers and professionals.

This section seeks to build on that evidence and the core aspects of the 'citizen science experience' within Observatree, and elaborate key areas where future similar citizen science projects might need to improve and change. This section thereby represents some of the key lessons learnt from the Observatree project.

4.1. Introduction to the themes

Having described their not-so-positive experiences of Observatree and citizen science, interviewees were asked how issues and challenges could be overcome, what improvements might be implemented in any future similar initiatives, and what changes might be needed in project design and delivery so as to ensure that the widest possible range of benefits are realised.

Seven themes emerged from the comments received from both professionals and volunteers. Four of these are overlapping themes addressed by both groups of interviewees (figure two) and are discussed in depth in the next section.

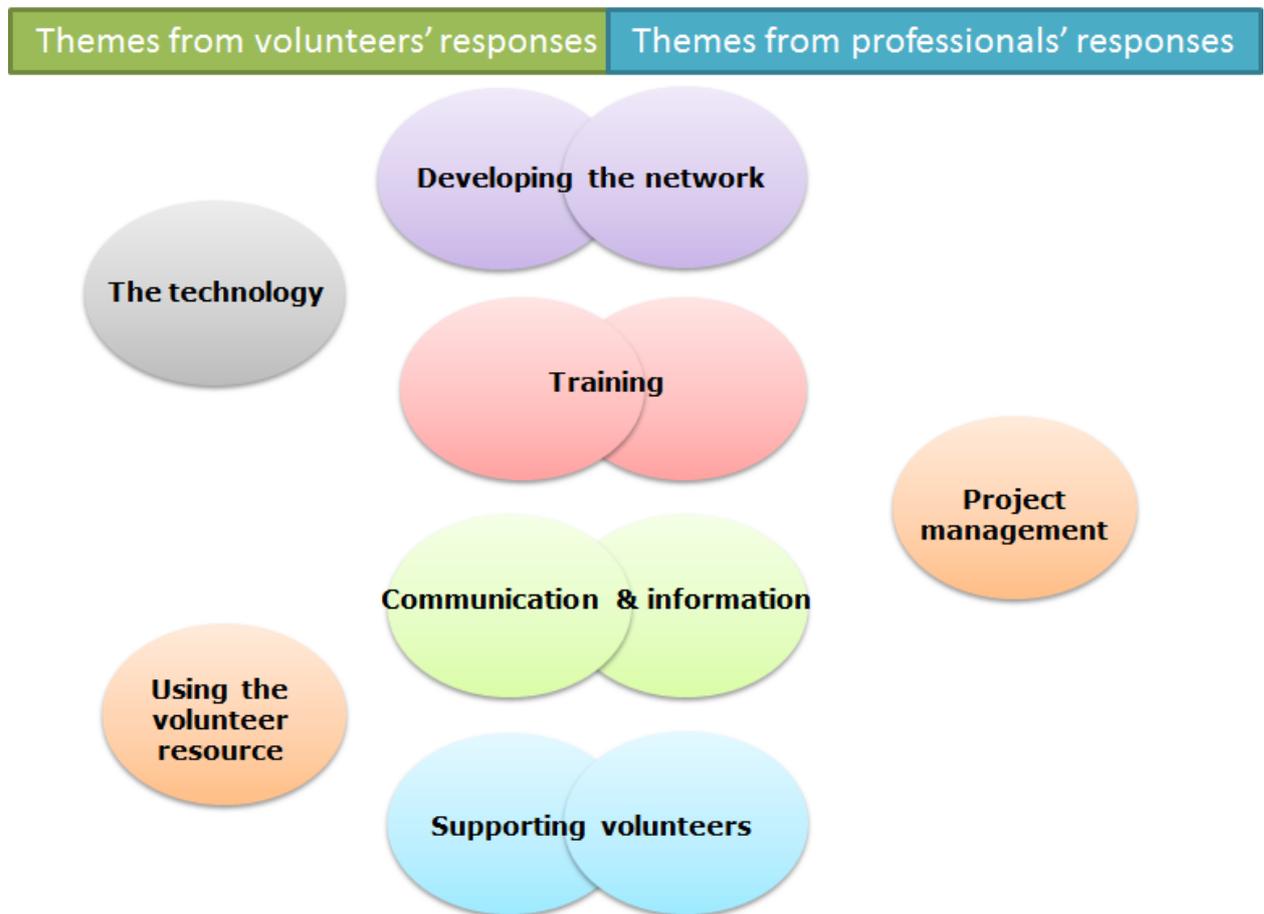


Figure two: Themes where future citizen science projects could focus improvement

4.2. Themes common across both sets of interviewees

In the text that follows, the focus is on those four themes common across both groups of interviewees. These four themes represent the key areas recommended for improvement.

4.2.1. Developing the network

As has been shown, participants in citizen science are motivated by wanting to feel part of something wider, part of a bigger whole. One area of benefit that citizen science can provide is in the creation of a network of individuals working on the same issue in different locations. However, some peoples' experience of Observatree was that the network was not sufficiently developed in some places and hence not as strong as it could be. For some, this limited opportunities to collaborate and made them feel somewhat isolated. For others, they saw gaps in the geographic coverage of the network and were concerned about the lack of involvement of some socio-demographic groups.

Building partnerships and a project network requires time and commitment from all participants. Whilst extensive progress had been made throughout the four years of Observatree, some participants believed that any future project required further development of the network. Thus, common to both groups of interviewees was the belief that there was value in extending the network and getting more people involved.

This encompassed:

- recruiting more volunteers,
- involving schools, and
- having more links and connections to other local organisations and their volunteers.

It was also stressed that there was a need to:

- keep hold of existing volunteers, and
- have targeted volunteer recruitment in certain areas and for specific socio-demographic groups currently poorly represented in the citizen scientist cohort.

4.2.2. Training

Some of the Observatree participants were motivated by the opportunity for knowledge development and learning new skills through the provision of training. It was widely recognised that the opportunity to provide and receive good quality and highly relevant training through a variety of delivery mechanisms was an area of benefit offered by the project. However, the experiences of those involved were not uniformly positive, with some people not always able to access training sessions because of the location, and others feeling that the level was not always suitable, particularly in the early stages of the project. Also, some of those delivering training had had some negative experiences of poor turn-out for some training sessions. Where concerns existed about data quality and project outputs these could also be related to gaps in or other problems with the training. These (and other) issues demonstrated that there were possibilities to improve the training being delivered. Good quality, effective and accessible training is key to developing a valuable cohort of citizen scientists able to provide the data needed, in a way that gives them confidence in the value of their contribution, and supports their sense of personal development and self-worth. Both professionals and volunteers had a number of suggestions for how to improve the training provided within the project.

These included:

- Making sure the training events appealed to all ages and backgrounds, and
- Ensuring the events were in locations and at times and dates suitable for as many people as possible.

- Some of the volunteers wanted to have more locally specific training that was focused on pests and diseases, and tree species they would be likely to find nearby.
- As the e-learning resources were widely praised it was suggested that more of these should be developed in the future.
- There were also views that training events could be opened up to a wider audience so that the likelihood of a poor turn-out was reduced.
- Finally, one suggestion was for formal accreditation to be provided for volunteers to show they had attended the training.

4.2.3. Communication and information

Being able to meet, interact with and exchange ideas and information with other participants formed a key part of motivations for involvement in Observatree. Central to this were the avenues for communication and opportunities for knowledge exchange. Many participants recognised that the provision of new information and data was likely to be a major benefit of the project. However, problems were identified with how successful the project was at disseminating and sharing information, ideas, data and outputs within and beyond the project. Key to a successful citizen science project is effective and appropriate communication between all participants, and information and data sharing which may need to extend beyond the project network.

Reflecting on their experiences in Observatree, both groups stressed the need for better communication, information flow, knowledge exchange, dissemination and data sharing between all parties.

- For the volunteers this extended to greater sharing, not just of information, but also ideas and experiences between volunteers.
- Also, both professionals and volunteers thought that there was a need for more project promotion and hence wider awareness of the project beyond those already involved.
- There was also a specific suggestion that more online information would be of value.

4.2.4. Supporting volunteers

In many cases citizen scientist volunteers stated that they were motivated by the desire to do something that was of value, that was useful and that made a positive contribution. Thus the importance of supporting volunteers in a citizen project cannot be under-estimated, as it is the support and feedback they receive that is likely to provide that re-assurance that their activities are of value. Volunteers reported many positive experiences of the support they had received but some felt their instructions and direction had not been clear and strong enough. Also, amongst the concerns expressed by some of the professionals were comments about the challenge of maintaining

volunteer commitment and motivation over time. Key to this is the support being provided, and ensuring that it is adequate so that volunteers feel they are being supported but not being directed too strongly. There are three main issues that emerged in the 'supporting volunteers' theme.

The first two of these are:

- the importance of providing enough feedback to volunteers, for example, about how their reports and data are being used, and how their contribution is important, and
- the need to provide clear instructions and guidance, and more prescriptive directions to volunteers about their tasks.

The third issue relates to the management of expectations, and this has three facets.

- It is important that volunteers are fully aware of how much time they might be expected to spend on their citizen scientist role, so that they do not have overly high expectations.
- Equally the professionals involved need to be realistic about what volunteers are able to commit to the project and recognise that they have other priorities.
- Professionals might also need to be prepared to commit more out-of-hours working time if they are directly involved with volunteers.

4.3. Themes specific to professionals or volunteers

Regarding the themes that are specific to either professionals or volunteers a number of points emerged from the interviews.

First, professionals noted a few issues regarding project management that needed to be addressed. Specifically, it was felt that working more efficiently and reducing bureaucracy could help to make involvement more attractive for professionals, as would formal recognition of the project by professional industry bodies. All of these points might contribute to professionals being more highly motivated to engage with such projects. It was also felt that a different project management structure might, in the longer term, be appropriate, with a move away from being government-led to being stakeholder-led.

A couple of additional issues were raised by the volunteers that again relate to motivations and feelings of usefulness. Some volunteers felt there was a need to use volunteers more intensively, perhaps by being given a diversity of roles instead of being assigned one role throughout, and through expectations for more frequent reports and activities.

All of the points discussed in the previous sub-sections are presented visually in figures three and four, which are included separately as suggestions for improvements from

professionals and suggestions from volunteers and include summary details of the points discussed above under each theme.

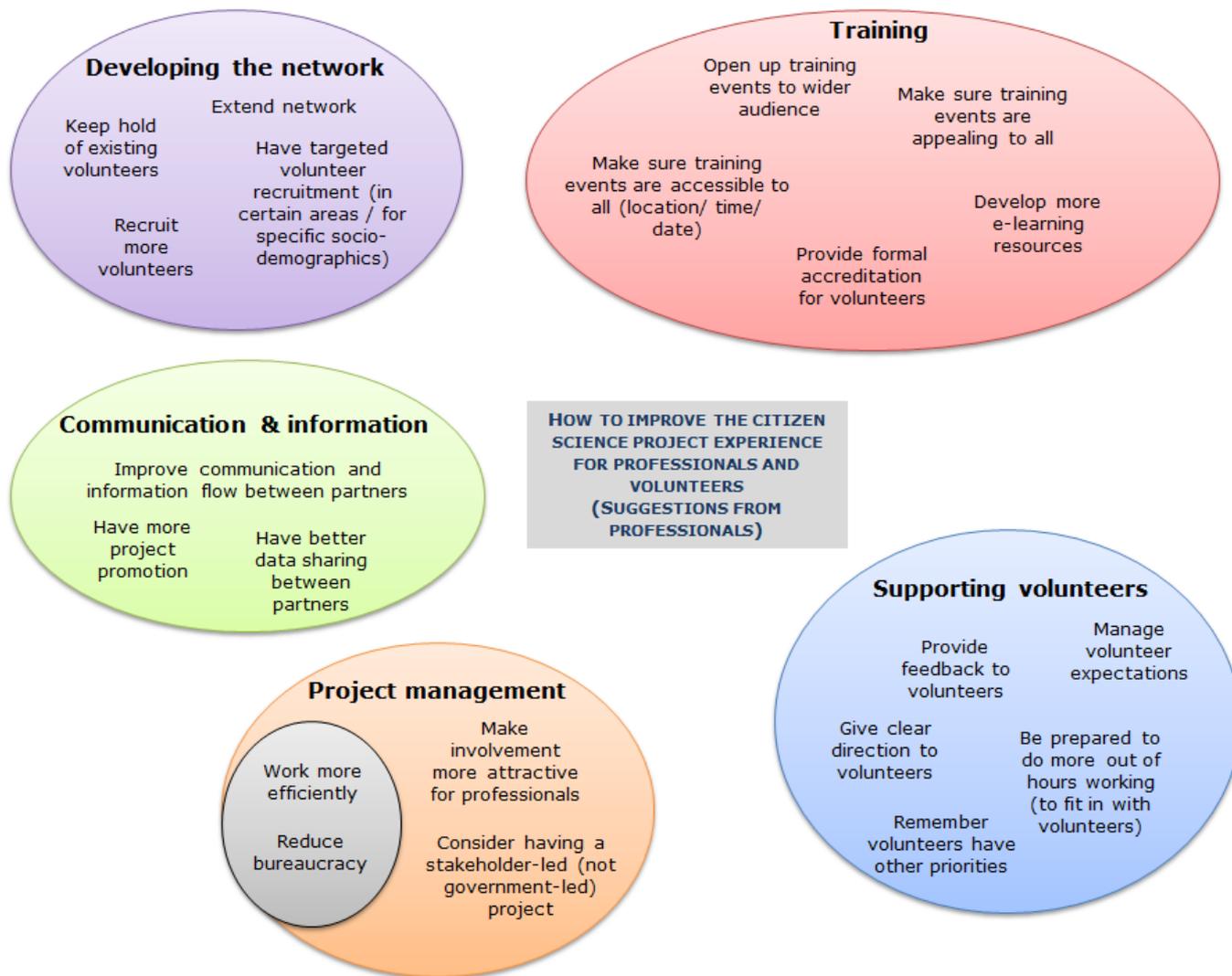


Figure three: Suggestions for project development (from professionals)

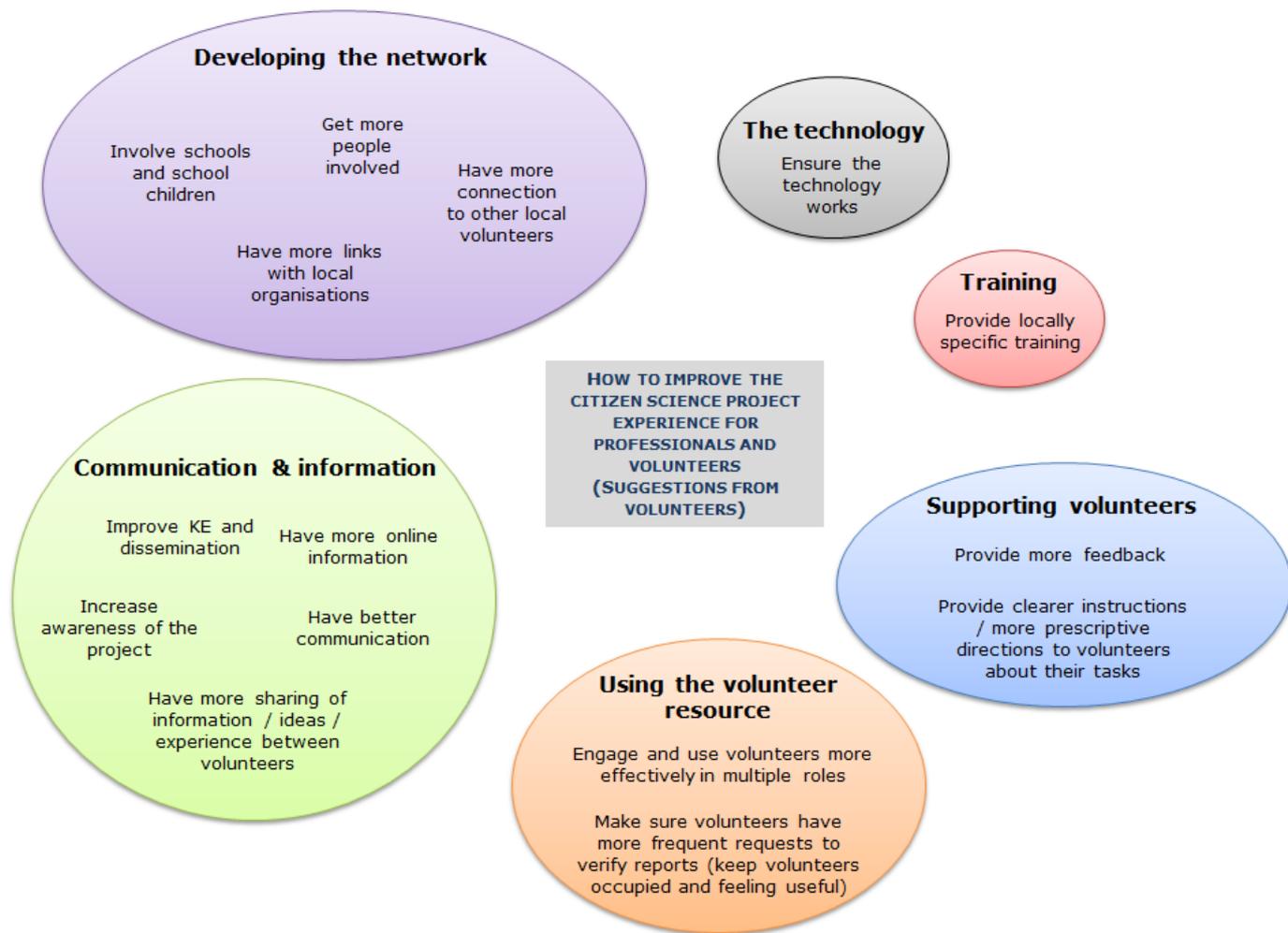


Figure four: Suggestions for project development (from volunteers)

5. Conclusion

This report has enabled a broad and deep reflection on the experiences of volunteers and professionals who have been involved in the four year citizen science project 'Observatree'.

Like much of the literature around citizen science this study has looked in depth at the motivations of the volunteers. However, where this study has added to previous research in this field is in its consideration of the motivations of the professionals involved. It is suggested that this neglected area would benefit from further exploration, as both volunteers and professionals are key to successful citizen science projects.

To add to the in-depth study of motivations this report further considers the benefits that have arisen or might potentially arise from a citizen science project, and builds on these by elaborating the positive experiences of volunteers and professionals across the wide range of issues. These cover issues such as networking, communication, training, doing something useful, contributing to a larger whole, and working for the benefit of local and global environments.

Importantly, this study has shown the clear connection between motivations, positive experiences, and benefits arising, thus presenting an holistic view of how a citizen science project can be experienced.

Nevertheless by questioning the participants on all aspects of their experiences and allowing them to express their thoughts in their own words, it has also been possible to explore the less positive aspects of the project, and provide some recommendations for where improvements could be focused within the Observatree project, with potential to inform other citizen science projects. Four key themes emerged relating to communication and information; supporting volunteers; training for volunteers; and developing the network.

Findings suggest that the areas of communication and network development need to be addressed, whilst training and support, which have been largely successful, would still benefit from some changes and improvements.

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Appendix 1. Interview protocol - Professionals

Interview questions

- When did you become involved, and in what role, in Observatree? What are some of the responsibilities in relation to Observatree in your role?
- What motivated you to take part in the project, the very first time?
- How has your level and type of involvement in Observatree changed over time?
- What factors (capacity, capabilities and motivations) have played a role in explaining your sustained or shifting levels of involvement over time?
- Has your level of support for Observatree and its potential to contribute to early detection of tree pests and diseases changed as a result of your involvement?
- What project elements have been most and least successful in your eyes?
- Do you see opportunities for expanding the role citizen science plays in supporting your role or that of your organisation into the future?
- Did your involvement in the project motivate you to do more Citizen Science?
- Has the project lived up to or exceeded your expectations? In what ways?
- What do you need to get out of a citizen science project to feel your participation has been worthwhile?
- Are there any other positive or negative outcomes that you wish to highlight?
- Do you believe that there remains a role for the Observatree project, either in its current, or a revised form?
- If you had the funds to extend Observatree for another three years, would you be happy to continue with the project? Would there be anything you would like to change about how the project is delivered? How could this be achieved?
- Tell me about ways in which work done by volunteers is supporting your work as a tree health professional?
- Are there any issues with the way volunteers work or the tasks that they perform that limit the usefulness of their work and the data it produces?
- What could be done to remedy these issues?

- To what extent have you, and others around you, experienced a change to your ability to work effectively as a result of Observatree? Is there anything else that you or the project coordinators could change within the Observatree project to improve your or others' ability to work effectively?
- To what extent have you experienced these challenges arising from the quantitative data, and how have they influenced your activity in Observatree?
- If having experienced one or more of these challenges emerging from the quantitative data, what have you done to overcome these? How successful were you?
- Is there anything else that you or the project coordinators could do to overcome these challenges for you or others?
- Based on your experience, how important is the communication and feedback given to volunteers?
- How has your involvement in the project benefitted you (in person or at professional level?)
- To what extent has the improved early detection of tree pests and diseases as a result of Observatree led to increased environmental resilience? In what way?
- Do you consider yourself to have gained better awareness about the important role of citizen science in identifying and combating tree pests and diseases? In what way?
- Has involvement in Observatree enhanced your organisation's connectivity with other organisations? In what way?
- Has involvement in Observatree changed your organisational culture in the sense that it is more open to partnership working and/or citizen science? In what way?
- Do you believe that CS data can be used to provide tree health evidence and can be used for policy or decision making? (Kindly elaborate the reasons)

Appendix 2. Interview protocol - Volunteers

Interview questions

- When did you become involved, and in what role are you involved, in Observatree?
- What motivated you to take part in the project, the very first time?
- Have you ever participated in CS project before Observatree?
- How has your level of involvement in Observatree changed over time?
- What factors have played a role in explaining your sustained / shifting levels of involvement over time?
- Has the project lived up to or exceeded your expectations? [explore why /in what ways the project has fulfilled / failed to fulfil expectations]
- What do you need to get out of a citizen science project for you to feel your participation has been worthwhile?
- Do you believe there continues to be a need for the project or something similar?
- Would you be willing to continue working on the project beyond the current end date?
- What are your general thoughts about the provision of training within the project?
- Was the training pitched at the right level? Was there enough training for you to feel supported in your role?
- How could the training be improved?
- Do you feel you understand what's expected of you as a volunteer within the project (both in terms of what you do and when you do it)?
- How could things be made clearer in the future?
- Do you feel you've had enough support and collaboration with other volunteers / experts / scientists within the project?
- Why is this collaboration important? How could this be improved?

- Based on your experience, how important is the communication from the volunteer coordinator and feedback in terms of what you report, to your continued participation in the project?
- Would you like to work more closely with other volunteers in your area?
- Are there any other issues/challenges associated with your participation in Observatree that you wish to highlight?
- What could the project coordinators do to address any issues or challenges for you or others?
- How has your involvement in the project benefitted you (in person or at professional level?)
- Do you consider yourself to have gained better awareness/knowledge about trees and tree health issues as a result of involvement in Observatree?
- Do you consider yourself to have gained better awareness about the important role of (citizen) science in identifying and combating tree pests and diseases?
- Do you consider yourself to have gained new skills relevant to tree pest and disease identification as a result of involvement in Observatree?
- Has involvement in Observatree changed your attitude or behaviour towards the natural environment in general?
- Has involvement in Observatree provided you with improved job prospects?
- Has involvement in Observatree resulted in valuable new social contacts?
- Has involvement in Observatree resulted in improved health and wellbeing as a result of spending more time outdoors?
- Has involvement in Observatree led to a more positive self-image as a result of contributing to a 'greater good' or supporting a worthwhile activity?
- Did your involvement in the project motivate you to do more Citizen Science?
- Are there any other positive or negative outcomes that you wish to highlight?
- Do you think CS data can be used to provide evidence for tree health policy/decision making? (Kindly elaborate the reasons?)

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