



# ENGAGEMENT AND AWARENESS

A digital resource providing recommendations for engagement and awareness raising surrounding citizen science.





# ABOUT EU-CITIZEN.SCIENCE

The EU-Citizen.Science project is building the central platform for citizen science in Europe. It will be a place to share useful resources about citizen science, including tools and guidelines, best practices and training modules. This will make citizen science knowledge created in Europe accessible to all and enable people to initiate their own activities. It will also enable anyone involved with or interested in citizen science to learn more and get involved.

## ABOUT THIS RESOURCE

This resource aims to support practitioners in facilitating engagement with activities and initiatives and raising awareness about citizen science. The methodology within this resource details the critical components and considerations necessary and will aid practitioners in maximising impact across a range of stakeholder groups. This guidance is developed from Deliverables 4.1 and 4.2 of the EU-Citizen.Science project.



# ENGAGEMENT

For the purpose of this project, “engagement” is defined as the active participation or involvement of an audience member with a citizen science project, activity or event, on one or more occasions. “Awareness” is defined as knowledge of a citizen-science project, activity or event, and summarises a more superficial interaction with a project with respect to “engagement”, limited to a knowledge of its existence, opposed to involvement with it.

In citizen science, there is a strong need to dedicate efforts to prolonged and repeated engagement, particularly when conducting studies over a long period or with broad data (Schade et al., 2017). When attempting to scale a citizen science and broaden the scope of study and number of participants and audiences, engagement is critical (Maccani et al., 2020). A study conducted by Rotman et al. (2014) suggested that while initial uptake of volunteers in a project is high, long-term participation is often much lower and that the reasons for this are complex and due to a range of factors. There are various options available to engage diverse audiences. Broadening the participation in citizen science requires appropriate approaches to engagement, with a strong alignment of priorities with community focus (Robinson et al., 2018). Engagement is a crucial challenge of citizen science projects and is often impacted by the strategies utilised in the initiation and continuation of the project.

These recommendations will provide best practice in achieving societal and policymaker engagement with citizen science initiatives and projects. It is important to note that the following list of recommendations is not exhaustive; understanding of awareness-raising strategies is continuously growing, and will, therefore, be expanded upon across the course of the project to encompass the broad range of experience from different projects, countries and audiences.

## RECOMMENDATION 1: CAREFULLY CONSIDER THE DESIGN OF THE PROJECT

Effective project design is critical for engagement, as well as mobilising the aims and objectives of participants. Projects should be relevant, targeted and organised, identifying areas of interest, appropriate funding and expert planning to sustain engagement and ensure the project works as intended. Projects should design protocols and ways of working, ensuring everybody agrees. They should account for engagement within the design of the project, considering techniques that will sustain participation with the project or activity (Tweddle et al., 2012). Importantly, the type of project selected during project design limits the level of engagement that participants can have. Contributory projects engage participants primarily through data collection, whereas co-created projects are designed collaboratively between project managers and participants, allowing participants to be engaged in most or all aspects of the project or activity (Shirk et al., 2012). For example, understanding what policy makers need before the project is designed and including them in the design stage can help you and them to understand how the project can be relevant, targeted and organized to mobilize the aims of both parties. Researching what communities want and where public pressure upon policy makers lies can help you in understanding how your project aligns with policymakers' concerns, and will increase the success of engagement.

### EXAMPLE

In order to achieve the aims of a project or activity, project managers must carefully consider project design. Existing frameworks of best practise offer guidelines for effective design, ensuring that the project or activity integrates the principles of citizen science and aligns with its projected aims (Steven et al., 2019). Such frameworks are highlighted below in section 4.4 Creating a new project and will also be provided on the EU-Citizen.Science platform. Structuring processes, protocols and strategies that span the project establish ways of working and ensure consistency among all stakeholders (Tweddle et al., 2012).



## RECOMMENDATION 2: PROVIDE A SYSTEMATIC AND TAILORED APPROACH

A systematic and tailored approach to meeting the overall aims of a project, including the engagement objectives, provides a structure that supports the project and its result. Pre-defined protocols and strategies for achieving the aims of the project or activity and for distributing findings and results should be agreed upon to ensure the message and purpose is clear, and that all involved stakeholders understand and work to the same framework. Having a fixed plan or system to all aspects of the project establishes a unanimous understanding of the projects goals and unified ways of working. Clarity among project partners allows them to accurately and sufficiently detail the project, and its aims and ways of working to stakeholders. Opportunities tailored to an audience offer stakeholders the option to engage in a capacity that works for them; methods of contribution range from defining issues and learning more about them to contributing data, weighing in with opinions or advocating for a desirable result (Hollow et al., 2015). Creating a summary document, detailing the goals and outcomes of the project, will grab stakeholder's attention. A summary document will prove effective in commanding the attention of audiences with limited time, in particular policymakers. Policymaker engagement is limited when considering citizen science, with a key limitation being lack of time and inability to recognise the relevance of projects and activities to current issues. Tailored summary documents that extract significant information, with respect to ongoing and future policy debate, prove effective in engaging policymakers (Hollow et al., 2015).



## RECOMMENDATION 2: PROVIDE A SYSTEMATIC AND TAILORED APPROACH

### EXAMPLE

Capturing Our Coast (CoCoast) was a 3-year project, that trained nearly 3,000 citizen scientists to survey rocky shores, gathering data on marine species to create a wider understanding of coastal biodiversity. The collaboration between 8 partners meant that a systematic approach to planning and delivering this project was essential, to ensure unified ways of working and a clear and consistent message. Each partner was responsible for running free training sessions surrounding identification techniques and survey methodology. It was critical that volunteers were trained to ensure consistency across survey techniques and results. The project created and delivered a 'Train the Trainer' course to professionals in the marine conservation sector. The overall aim of this was to expand the geographic reach beyond the partners' locality to cover regions that were previously not covered. It was critical, therefore, to develop a central technique for the training of volunteers and the training of the 'trainers' to ensure a systematic approach and to ensure consistency in data quality and collection. The project had a clear and systematic approach, identifying its target audience and training requirements early on in the project design. Partners acknowledged that a certain level of scientific knowledge was required, thus prompting the decision to provide face to face training and expand their geographic reach via the 'Train the Trainer' aspect of the project. Clear communication channels and a systematic schedule allowed hubs to exchange ideas of what worked well in their regions and apply them to others to implement and trial with their communities.

Critically, the project listened to community needs and identified new opportunities, showing a willingness to tailor their approach to suit the needs of the participant.

Project URL: <https://www.capturingourcoast.co.uk/>  
Start date: 2015



## RECOMMENDATION 3: HIGHLIGHT THE BENEFITS OF CITIZEN SCIENCE

It is important to highlight the numerous benefits, particularly those that appeal to them. When engaging with policymakers, discuss the benefits of engaging the public with science; communities that have a direct understanding of issues feel empowered to act for them, which could increase support for individuals who are legislating for said issues. This could be done through utilising citizen science data in legislation or running focus groups with participants (Figueiredo Nascimento et al., 2016). The involvement of citizens in the evidence base for critical issues increases transparency and promotes participation in the development of policy (Thornhill et al., 2016). Increasingly, importance is placed upon increasing engagement with legislation, with studies suggesting that policy is at its best when members of the public can understand and contribute in some way (Hollow et al., 2015). Scientists with limited time or funding may wish to establish a citizen science method; a 2017 study determined that for each hour of training delivered, participants invested 9 hours of sampling, equating a large return on investment (Martin, 2017). Citizen science offers valuable opportunities, skills and knowledge to participants, resulting in a more informed society. A maintained interest and increased self-efficacy are just some of the benefits of incorporating citizen science in the curriculum, which may appeal to educators (Vitone et al., 2016). It is important to publicise these benefits and inspire participation from stakeholders.

### EXAMPLE

Industry professionals, scientists and legislators working in the agricultural sector recognise the importance of early detection of invasive pest species in order to implement responsive and preventative procedures. A 2016 study identified the benefits of utilising citizen science for such purposes, highlighting the ability to obtain data rapidly as essential to fast action (Maistrello et al., 2016). A prime fruit-growing region of Italy first recorded evidence of the Asian brown marmorated stink bug in 2012 – citizen science surveys enabled researchers to gather data sets in a short period of time and identified key areas in which breeding populations were established and posed a high risk of damage to crops. In utilising citizen science, professionals were able to see its value, as early detection of potential risks allowed for pre-emptive management strategies to be employed in other at-risk areas (Maistrello et al., 2016). The activity has been developed into an extensive monitoring programme, while data obtained and strategies employed provided a global model that can be used to identify the invasive pest. Both provide extensive benefits to industry professionals.

## RECOMMENDATION 4: CONSIDER CURRENT POLICY CONCERNS AND ALIGN PROJECTS WITH CURRENT POLICY STANDARDS

Research suggests that decisions guiding involvement are determined by the purpose and nature of the topic or issue (Hollow et al., 2015). Suggestions can be made, therefore, to consider ongoing or future policy concerns within a project design. In some cases, there is a scientific or societal need for a topic to be researched; in this instance, projects may wish to identify alignment with policy or gather interest among policymakers. However, some projects may wish to identify current or upcoming concerns among policymakers and use them to inform the project topic or design. This increases the relevance of the project to society and offers opportunities to use results to influence policy. Similarly, projects should adhere to the standards and processes appropriate to policymakers, including rigorous and justified methods of data collection, reporting and analysis (Hecker et al., 2018). Pollution is an issue that is widely reported on and is often in the news. Interest from the public, surrounding health and the environment, has led to pollution becoming a topic of mass debate, and so policymakers are already interested in the subject area. Contributing scientific data that can support this debate and aid legislation will be valuable to policymakers. Similarly, pollution is often of local concern and so will attract interest from other key stakeholders, which could further motivate engagement among policymakers, such as local council people.





## RECOMMENDATION 4: CONSIDER CURRENT POLICY CONCERNS AND ALIGN PROJECTS WITH CURRENT POLICY STANDARDS

### EXAMPLE

The Volkswagen emissions scandal was widely reported upon across Europe; the company had been cheating emissions tests and cars had been releasing between 250,000 and 1 million extra tonnes of polluting gases than initially thought (Topham et al., 2015). These gases include Nitrogen Dioxide, which is linked to severe environmental damage and poses a risk to human health, including respiratory problems such as bronchitis (Bosson et al., 2019). Antwerp has high levels of Nitrogen Dioxide, owing to the extensive and busy road systems that span the city, a cause for concern among local residents (<http://www.curieuzeneuzen.eu/en/>). CurieuzeNeuzen is a citizen science project that addresses the concern, enabling residents of Antwerp to measure air quality in their local area. Participants mounted an air quality measurement device outside of their street-side window to measure levels of Nitrogen Dioxide. The results implied that a high percentage of sampling locations had project levels that exceed the maximum level detailed by the World Health Organization (<http://www.curieuzeneuzen.eu/en/>). Following the study, a survey of participants indicated a rise in the use of bicycles in Antwerp. Similarly, interest in policy options to improve air quality in the city rose, and many participants reported increased positivity and interest in suggestions such as low-emission zones and car-sharing schemes (<http://www.curieuzeneuzen.eu/en/>). The project produced accessible and clear data that indicated a key cause for concern; concrete data of this calibre supports the need for debate and can aid legislation by the provision of scientific evidence.

Project URL: <https://curieuzeneuzen.be/>



## RECOMMENDATION 5: IDENTIFY AND RESPECT THE UNIQUENESS OF COMMUNITIES

Successful projects consider the interests and concerns of target audiences and adapt accordingly in order to promote sustained engagement (Roy et al., 2012). It is important to respect the uniqueness of communities and plan for the targeted demographic, considering the varying motivations, needs and issues of importance to different stakeholders. Conducting projects based on subjects that are of local interest could facilitate continued engagement. For example, alignment with local interest acts as a catalyst for sustained engagement and allow communities to act synergistically and contribute to issues that they identify as pressing to them personally (Rotman et al., 2012). Consideration of the unique interests and needs of audiences is also critical for establishing relationships among participants and project managers, demonstrating consideration of participant motivations (Richter et al., 2018). Frameworks for designing and implementing citizen science projects suggest planning a range of activities that represent the diverse and unique interest of communities. Tailoring supporting materials or activities to specific stakeholders shows respect for diverse interests and motivations (Tweddle et al., 2012).

### EXAMPLE

Mapping for Change is a citizen science project supporting communities to utilise citizen science in response to concerns over local air quality. Utilising citizen science has enabled communities to gather data in their local area and access and understand the results. Understanding the needs of the involved communities allowed Mapping for Change to tailor the approach to suit participants. For example, methods of measurement utilised were less technical and more affordable, allowing participation from all sectors of the communities, including low-income families and more deprived communities (Mapping for Change, 2016).

Project URL: <https://mappingforchange.org.uk/projects/citizen-science-used-to-map-community-air-quality/>

## RECOMMENDATION 6: UNDERSTAND PARTICIPANT MOTIVATIONS

Understanding participant motivations is a critical component of engagement, as motivations differ widely among stakeholders and often determine an individual's desire to contribute to a project or activity (Roy et al., 2012). Additionally, a key principle of citizen science is that all stakeholders benefit from participation, which is often a result of conducting activities or meeting goals that align with motivations (Robinson et al., 2018). For a project to resonate with and appeal to target audiences, considerations should be made as to why people join initially, which will foster ideas for sustaining engagement. This could be explored through surveys, interviews or questionnaires; West (2015) utilised questionnaires to gather opinions surrounding environmental education projects, the findings of which were utilised to reflect upon the work of practitioners in the field and evaluate individual projects. Understanding why volunteers choose to participate means tasks, activities and events can be aligned with the motivations of key stakeholders, initiating engagement with a project.

### EXAMPLE

An essential component of sustained engagement is the enjoyment of the task, which is often in direct correlation to alignment with motivations to participate and fulfilment of personal goals (Curtis, 2015). Galaxy Zoo is an online citizen science project, utilising the efforts of volunteers to categorise galaxies and identify features within them. Raddick et al. (2013) conducted a survey of 11,862 Galaxy Zoo volunteers to identify their motivations for participating. An interest in astronomy (12.4%) and the opportunity to observe galaxies that many others have not (10.4% "Discovery") are popular motivations for participating with this project. The opportunity to contribute to science and research (39.8%), and the recognition of this, motivates a significant proportion of volunteers. Understanding this has allowed the Galaxy Zoo project to implement changes and streamline the activities to better align with people's motivations and maximise participation. For example, recognising volunteers as collaborators to the research and, wherever possible, identifying them by name aligns with the motivation to be recognised as contributing to science and research (Raddick et al., 2010). This also allows other citizen science projects to be planned and executed in light of this information, increasing participation with projects and activities (Raddick et al., 2013).

Project URL: <http://zoo1.galaxyzoo.org/>

## RECOMMENDATION 7: CONSIDER INSTANT-GRATIFICATION CITIZEN-SCIENCE

Instant gratification, related to congratulatory hits of dopamine and other neurotransmitters, is a motivation for participating in citizen science, including personal interest and enjoyment of gamification/games (Werbach and Hunter, 2012). Beyond the immediate sensation of feeling “good,” longer-term motivations such as altruism are also linked to similar neurochemical processes (Bachner-Melman et al., 2005). Citizens may be classified into three types (Ceccaroni et al., 2017):

- (1) people who care about and contribute to place-based communities converging around a shared, social concern;
- (2) people, not included in type-1, for whom public discourse, social media including games, and citizen science all run through the same router;
- (3) people not included in the first two types.

This recommendation focuses on type-2 citizens. Ceccaroni et al. (2017) define “immediate civic response” (ICR) as the response generated in cases in which instant gratification is linked to participation in citizen science, which is often blunted by significant requirements of long-term commitment: type-2 citizens may not want to go through the trouble of membership of the communities that type-1 people appreciate. We now have digital tools fast enough to keep up with citizens’ empathy trigger. If people want to help, they take part in a specific, one-off action and suddenly they are part of the solution. ICR potential can be considered together with the socio-technological advances empowering citizens to act as a decentralised super-organism: a pan-humanity sensor-array capable of sensing where problematic issues are, and collecting responses in real-time.

### EXAMPLE

Humans participate en masse to BioBlitz’s. Being part of the solution feels “good” on a neurochemical level. On the next “Fukushima-style earthquake and nuclear accident”, celebrities could tweet for the activation of a global, citizen-science action to collect background radiation measurements (and, more generally, to empower people with data about their environments). Of course, initially, the involvement of celebrities will be felt as an unwelcome invasion of the scientific territory. This involvement can be part of concerts, video footage on consequences of invasive species, or flashing BioBlitz information.



## RECOMMENDATION 8: MANAGE EXPECTATIONS OF PARTICIPANT WORKLOAD

It is important to consider strategy and workload extensively, limiting demands of complicated or time-consuming tasks unless otherwise requested. In a studied group of citizen science volunteers, 44% cited they did not have enough free time to continue contributing, highlighting the importance of managing volunteer workload to reflect demand (Farley, 2013). It is recommended that project managers manage their expectations regarding workload. While some volunteers will have lengthy time commitments and will want to contribute a lot, many volunteers cite feeling overworked as a reason for disrupted engagement. Indeed, a lack of clear expectations – in combination with insufficient information to complete a job well – is a known risk factor for volunteer “burnout” (Maslach et al., 2001). Some projects choose to employ microvolunteerism, providing the opportunity for volunteers to make small contributions and vary the time contributed (Bernstein et al., 2013). Bioblitzes – rapid field-based surveys in which volunteers document as many species as possible in a defined location during a defined period (Parker et al., 2018) – allow volunteers to make more varied contributions in terms of intensity and time, and reduces their risk of physical or mental exhaustion.

### EXAMPLE

Running a short scale trial will allow you to gather feedback on the workload and whether it is suitable for your target audience. You may choose to allocate tasks equally among volunteers or register interest and time availability, in order to allocate tasks accordingly. Volunteers who sign up may wish to know the minimum contribution required prior to involvement with the project or activity. The Zooniverse platform encompasses a collection of projects that utilise volunteer effort to analyse large data sets (Cox et al., 2015). Members who sign up to the platform have the option to opt in to be beta testers. During the introduction of new projects to the Zooniverse site, a dedicated community of volunteers test the activity and offer feedback on qualities such as clarity, task design, instructions and ease of completion. As part of this process, Zooniverse requires citizen science project designers to consider, “How much time do you estimate each task (or group of tasks) will take?” and, “Are there any 'easy targets', such as existing interest groups, online communities or clubs?” as part of a questionnaire designed to help manage expectations of volunteer workload.

Platform URL: <https://www.zooniverse.org/>

## RECOMMENDATION 9: INVOLVE PARTICIPANTS IN AS MANY STAGES OF THE PROJECT AS DESIRED

A key principle of citizen science is to allow participants to be involved with multiple stages of the project or activity (Robinson et al., 2018). Emphasis should be placed on the opportunity for all stakeholders to be involved at multiple points across the lifespan of the project. Early recruitment of participants, for example, allows for the contribution to project design – including aims, protocols, strategies and techniques – providing clarity on the issues of importance to those groups. Involving citizen scientists at multiple stages of the project offers extensive benefits; making participants feel valued and engaged with the intrinsic nature of the project, initiating a sense of belonging and responsibility, and fostering working relationships among all stakeholders (Rotman et al., 2014). These benefits are mutual to participant and project: offering a broader range of knowledge and expertise that could expand the breadth and understanding of the project through a diverse team. It should be noted that there are very successful citizen science projects with highly motivated citizens that are involved only in one activity or stage. It is important to highlight the opportunities in which to involve citizens (see section 4.4) and consider the advantages for the citizens and the project alike.

### EXAMPLE

Farming Concrete, which aimed to determine the amount of food produced in New York City's community gardens, involved gardeners throughout the project. During the initial stages of the project, much of the work involved outreach, where a core team of organisers, community gardeners, and volunteer researchers spoke to community and school gardeners to sign up participants. Once a gardener agreed to participate, they collected data in one or both of two distinct ways: weighing produce throughout the season and counting plants at one to three points in the growing season. This organisational method, whereby participants were involved in multiple stages of the project, encouraged enthusiastic gardeners to partake not just in quantifying their food production, but in outreach as well – providing mutual benefit to the volunteers and project itself (Gittleman 2012).

Project URL: <https://farmingconcrete.org/>

## RECOMMENDATION 10: ESTABLISH POSITIVE WORKING RELATIONSHIPS WITH STAKEHOLDERS

It is important to ensure positive relationships and effective communication with stakeholders, regardless of audience type or level of participation. Often, sustained engagement is promoted via a connection to the project, something that is often aided by well-established partnerships. Effective communication and relationships are critical for stakeholder engagement and are essential in establishing a shared understanding (Tweddle et al., 2012). Indeed, these relationships have the ability to sustain collaboration and the sharing of knowledge and resource. Positive working relationships are also important for influencing policy; this process is grounded in trust and communication, and so establishing working relationships should remain a motivation among all stakeholders (Vann-Sander et al., 2016). To sustain engagement among stakeholders, it is critical to ground effective communication and a shared understanding of projects. Long term participation is cited as a result of an established relationship, cultivated in common goals and communication (Rotman et al., 2014). Importantly, citizen science is unable to have profound implications among policy development if there is not an established relationship grounded in mutual motivation and common outcome (Vann-Sander et al., 2016).

### EXAMPLE

A 2017 study investigating stakeholder perceptions highlights the importance of establishing positive relationships. The study considered the incentives to participate with monitoring in an engineering project on the river Waal in The Netherlands. Stakeholders included citizens, recreational anglers and boaters and shipping professionals. The participatory nature of the project required trust and established relationships between project partners and stakeholders, and so the study also aimed to gather insights into the relationships between project partners and stakeholders, in order to facilitate engagement. The study found that an established relationship, forged on reciprocal trust, was essential for cooperation between shipping representatives and local water companies. Similarly, it was found that establishing relationships formed the basis of the recruitment of participants for activities within the project (Verbrugge et al., 2017).

## RECOMMENDATION 11: USE STATE-OF-THE-ART TECHNOLOGY AND ONLINE TOOLS

New technology and online tools are an efficient way of data collection, and can benefit engagement when utilised correctly. Survey123 is a survey-based platform that can aid data collection. Platforms like this, available via mobile devices and not requiring an internet connection, broaden the accessibility for users, allowing for a broader scope and scale of sampling. Utilising online tools for awareness-raising and support is invaluable. Websites, forums and project platforms act as hubs of information and guidance around projects, and so their design and implementation should be carefully considered. Websites that have a clear user journey, accurate and informative content and easy navigation play a large role in sustained engagement (Newman et al., 2012). Delivering citizen science through media such as online games is a motivating and fun method of engagement. It is important, however, to consider risks associated with advances in technology. Increased risk of audience disengagement can occur when audiences are not acknowledged for their contribution to developing online tools or when the necessity of technologies is not apparent for long term gain within the project (Ceccaroni et al., 2019). This recommendation may be suited more to those creating exclusively online citizen science projects.

### EXAMPLE

Platforms that facilitate the gathering and management of data from participants are increasingly important in citizen science (Lamoureux and Fast, 2019). Survey123 is a free online tool that offers users the option to create forms for an easy and accessible method data collection. In a study of 5 platforms, Survey123 was the only platform that supported web-based surveys and mobile apps that worked on iOS and Android devices (Lamoureux and Fast, 2019). Similarly, the platform also allows built-in databases, the option to import data in various formats and vats options for data management within the app/website and within the overall database. Coastwatch Europe investigates waste found on beaches across the globe, and utilised Survey123 to access data from the global network of volunteers working on the project (Chivite, 2017). Additionally, Glacier National Park utilises real-time functions such as live mapping to assess when and where data is being collected, offering a more visual and exciting way for participants to understand their data (Wold, 2018). The opportunity to access a broader audience geographically is a critical hook for engagement. However, platforms such as this, while free initially, often do incur a cost for more complex analysis and function (Lamoureux and Fast, 2019).



## RECOMMENDATION 12: OFFER TRAINING AND LEARNING OPPORTUNITIES

A key motivation of many participants surrounds the opportunity to learn and experience new things. Where there is a gap between intended participation and actual participation, many volunteers cite opportunities for training or supporting materials as a factor in initial and sustained engagement (Rotman et al., 2014). Offering training, learning opportunities and support is appealing to many members of society; learning new skills like practical work or species identification promotes new opportunities and increases confidence with the tasks, meaning participants are less likely to drop out due to feeling they cannot complete the necessary activities. This remains important when considering that many participants refrain from contributing or uploading data due to lack of confidence in their skills or results and has the additional benefit of increasing the accuracy of data and reducing concerns surrounding data quality (Tweddle et al., 2012). It is important to stress that informal learning is also an important method of skill development within citizen science; conducting the tasks or interacting with the community can offer incidental learning opportunities and develop participant understanding substantially (Jennett et al., 2016).

### EXAMPLE

The British Trust of Ornithology offers a range of survey types to accommodate a breadth of audiences. Volunteers have the opportunity to contribute to information about populations and health of groups of birds by providing details of sightings on an ad hoc or continuous basis. The trust offers a schedule of relevant training courses that vary in strategy, information and length, to suit a wide array of audience needs. Community groups wishing to participate may choose to opt for a bespoke training specific to their needs and research focus. Many regions host a regional representative, who acts as the point of contact for interested parties to gather information, guidance and resources. For certain surveys, the trust supplies dedicated identification guides and booklets to record findings (The Conservation Volunteers, 2014).

Organisation URL: <https://www.bto.org/>

## RECOMMENDATION 13: ADDRESS CONCERNS SURROUNDING THE QUALITY OF DATA RESULTING FROM CITIZEN SCIENCE PROJECTS

Citizen science has the capacity to produce high-quality data that can contribute to research and solve problems; key factors in this are rigorous protocols, correct design and appropriate evaluation, all of which maintain the quality of data (McKinley et al., 2017). Data quality concerns are a key limitation to the recognition of the results and outcomes of citizen science projects. Addressing data quality concerns is critical in engaging stakeholders, particularly policymakers; addressing concerns increases the likelihood of policymakers accepting data into their formal data streams.

Projects must consider current and relevant scientific standards and methods, and ensure effective and rigorous data collection and evaluation, in order to present accurate and robust data to policymakers. This will increase the likelihood of being considered and utilised. Concerns with citizen science extend beyond data quality, with many policymakers questioning if citizen science projects uphold scientific standards for monitoring, as well as environmental, scientific and policy standards and methods (Hecker et al., 2018). Implementing thorough protocols, training and planning allow participants to contribute high-quality data (Bonney et al., 2014). Emerging technologies can add to the automation of data quality checks, highlighting anomalous data and analysing trends and patterns (Newman et al., 2012).

It is important to implement current and relevant scientific standards and ensure data are correctly collated, certified and analysed. For example, if collecting water samples, strategies should be designed and enforced to reduce cross-contamination. In addition, when designing projects and allocating workload, an allotted time should be dedicated to identify and remove anomalies within data sets. Resources should be dedicated to addressing data quality concerns; effective methods of quality control, data analysis and curation should be among priorities when considering resource requirements (Figueiredo Nascimento et al., 2016).

## RECOMMENDATION 13: ADDRESS CONCERNS SURROUNDING THE QUALITY OF DATA RESULTING FROM CITIZEN SCIENCE PROJECTS

### EXAMPLE

As a signatory on the Convention on Biological Diversity, the UK has committed to a strategic plan, detailing goals, targets and information surrounding biodiversity. As part of this, the UK monitors indicator species to analyse trends and assess progress towards the specific goals. Monitoring of the UK biodiversity indicators allows surveillance of key species that offer insight into the overall diversity of nature across the nation (JNCC, 2019). Observation of these indicators, supported by supporting information, has proved effective in communicating key scientific messages to a broad audience. Indicators are reported on by a range of audiences, from the general public to private industries and NGOs. Citizen science is a common method of gathering data to be used within the reports produced (JNCC, 2019). Commonly, NGOs employ citizen science in their data collection strategies. The Joint Nature Conservation Committee, the governmental body analysing the data and producing the report, works closely with the general public and contributing organisations to ensure the results are meeting the standards necessary. Similarly, NGOs employing citizen science are subject to strict data quality regulations, overseen by statisticians in DEFRA (JNCC, 2019). The data gathered and interpreted in these reports feed into policy on a national and global scale; an example of this is the Convention on Biological Diversity Strategic Plan for Biodiversity 2011–2020 (British Ecological Society, 2013).

Organisation URL: <https://jncc.gov.uk/>



## RECOMMENDATION 14: SUPPORT PARTICIPANTS DURING THE PROJECT AND RESPOND TO COMMUNITY NEEDS

Projects and activities work best when participants are well supported, and support channels and methods are carefully considered. Providing support for participants will not only yield better quality data (a result of increased guidance and confidence) but will also sustain engagement (Tweddle et al., 2012). Communication is critical for sustained engagement; online communities, forums to ask questions, and designated points of contact among project partners all fulfil a variety of support roles to assist participants with issues and facilitate social interaction. Aspects such as quality data and length of engagement are determined by the appropriate support and management of participants. You could offer platforms in which volunteers talk among themselves or fora in which they can submit feedback or suggest improvements. Listen to the community to identify needs and new directions and be willing to adapt and incorporate change. It is important to consider the maintenance cost of support platforms. Monitoring the platform and responding to questions incurs a cost of time from a project manager or volunteer, particularly if supporting a large user base. Investment in resources and person-hours are necessary to provide optimum support, a consideration that should be made when designing the project (Pocock et al., 2014).

### EXAMPLE

Whilst a “one size fits all” approach support does not work because support given needs to be tailored to the individual (Natural England, 2011), the OPAL Bugs Count Survey (developed by the Natural History Museum with the University of York, University of Birmingham and Imperial College) – which investigated the effects of urbanisation on terrestrial invertebrates – utilised a wide range of training materials and supporting resources. They provided identification guides tailored to the audience, including a poster showing where to look for invertebrates in urban settings, as well as an identification quiz and PowerPoint training presentation. They also provided a free-to-download group leader support pack and a teaching supplement containing curriculum links for Key Stages 1 to 4 as well as GCSE and A level, whilst also encouraging participants to engage with each other on social media platforms. Moreover, each support element was designed and tested with input from the target audience (see Recommendation 7: Involve participants in as many stages of the project as desired)

Project URL: <https://www.opalexplorenature.org/bugscount>



## RECOMMENDATION 15: PROVIDE PARTICIPANTS WITH RECOGNITION FOR THEIR WORK

Lack of recognition and feeling undervalued often result in suspended engagement with a project or lack of engagement with future projects. Providing recognition for work should be systematically integrated within a project's priorities and design (Figueiredo Nascimento et al., 2016). Adding an "acknowledgements" section to the paper or mentioning the work contributed by participants is a simple yet effective method of recognising participant efforts. Participants could be listed by name; however, this does have implications regarding general data protection regulations (GDPR). A general statement addressing the group of participants as a whole negates this issue. Additionally, the satisfaction of seeing one's efforts put to good use during the project, as a result of sharing data, detailing its use and providing information of progress throughout promotes future engagement and is an important method of making participants feel valued for their contribution.

### EXAMPLE

In 2016, the National Health Service (NHS) launched a new initiative in England in which people who had donated blood received a text message or email, detailing when their blood had been utilised. The email thanks individuals for their donation and then explains the process of testing and processing the blood, before describing the name and location of the hospital that it has been used in. Additionally, a fact or statistic (such as the one below) is given regarding the blood type donated and what it can be used for (NHS, 2016).

"Over 1 in 3 people share your O positive blood, which means it's always needed to help treat victims of accidents, mothers in difficult childbirths, and cancer sufferers."

This process highlights the importance of giving blood and encourages repeat donations and inspires others to give also. Only donors who provide contact information and opt-in will be contacted, a process which considers GDPR. Recipients of the messages state that they enjoy knowing their blood has been used and that understanding the process and location of their donation adds a personal component to the process, of which they were keen to share with friends and family (NHS, 2016). A similar process could be designed and implemented among citizen science, in which participants receive information regarding where and for what their data is used.

Campaign URL: <https://www.blood.co.uk/news-and-campaigns/news-and-statements/blood-donors-texted-when-their-blood-goes-to-hospitals-to-save-lives/>

## RECOMMENDATION 16: ENGAGE WITH POLICYMAKERS

Policymakers encompass an essential audience for citizen science as critical players in the facilitation, communication and funding of projects and initiatives. Involving them with citizen science has significant benefits for the engagement of citizens with science and can be critical in involving key stakeholders. Engaged policymakers link the effort by participants, on the one hand, and the production of actionable information that is relevant to policy making, on the other hand. Engagement between citizens and policymakers can help to understand that solutions to challenges need to involve several actors (such as, also, the scientists or the media), who should be brought into the discussion. Policymakers can find the data collected via citizen science useful; and projects may be more appealing to funders if policymakers use their data. If citizen-science data are used in policymaking, they can more easily be associated with long-lasting changes. Policymakers can also be valuable in terms of resources for the projects, whether this is through funding citizen science, forging connections between projects and other, more relevant policymakers, or providing a new perspective from which a problem can be considered. Policymaker engagement can motivate citizens, especially if they see the data they collected used and producing tangible changes. Projects can be more attractive to participants and more credible if policymakers are present in the projects. Similarly, having policymakers engaged in a project can facilitate the involvement of citizens in democratic processes, while engaging policymakers in citizen science can drive policy towards new areas, which are particularly significant for the citizens involved.

### EXAMPLE

The Sea Watch Foundation utilises citizen science to monitor populations of cetaceans around the coastline of the UK. Volunteers report sightings of dolphins, whales and porpoise and the resulting data are used to underpin marine policy and protective legislation. Notable impacts of engaging policymakers with this project include specialised protective status to certain species under the Wildlife and Countryside act, international agreements for the conservation of cetaceans in the North and Baltic sea, and designation of Natura 2000 sites to protect areas that are densely populated with cetaceans under the EU habitats and species directive (Sea Watch Foundation, 2020)

Project URL – <https://www.seawatchfoundation.org.uk/>



# AWARENESS

For the purpose of this project, awareness is defined as a knowledge of citizen science or a citizen science project, activity or event, and summarises a more superficial interaction that is limited to a knowledge of its existence, opposed to involvement with it. This definition is in line with the Cambridge dictionary definition “knowledge that something exists, or understanding of a situation or subject at the present time based on information or experience” (Cambridge, 2019). Similarly, Collins Dictionary states that to be aware of something is to know about it, and that a person who is aware “notices what is happening around them or happening in the place where they live” (Collins Dictionary, 2019).

For stakeholders to become involved with citizen science, they must first be aware of the existing opportunities. Lack of awareness acts as a barrier to active involvement with citizen science, with many unaware that opportunities aligning with their values and motivations exist (Burgess et al., 2017) (West and Pateman, 2016). Raising awareness of citizen science is critical for (1) increasing the interest in projects, (2) the recruitment of new volunteers, (3) establishing the importance of the work citizens are conducting, and (4) making this work well known among communities (Bonney et al., 2009). With an increasing value added to science, in addition to the desire of many audiences to actively involve themselves in the scientific activities and projects, it is important to highlight the opportunities made available by citizen science (Robinson et al., 2018).

These recommendations will provide best practice, including how to raise awareness of citizen science among audiences, aided by the expertise of project partners across the consortium. It is important to note that the following list of recommendations is not exhaustive; understanding of awareness-raising strategies is continuously growing, and will, therefore, be expanded upon across the course of the project to encompass the broad range of experience from different projects, countries and audiences.

## RECOMMENDATION 1: ENSURE AWARENESS-RAISING IS INCORPORATED INTO PROJECT DESIGN

In order to achieve the project's aims, participants must be recruited. Unless they are aware that the opportunity exists to partake in citizen science, a project will be unable to achieve its research goals. Projects should be relevant, targeted and organised, identifying key methods of awareness-raising to spread the word and sustain interest. Work collaboratively to design strategies and consider techniques that will spread awareness among established and new networks (Tweddle et al., 2012). Plan for your demographic and have a clear target audience, whose interests and needs you understand. Awareness-raising should be integral to the project design, and should be planned accordingly to access a diverse audience (European Commission Digital Earth Lab, 2019). We recommend considering the seven audience categories we list in section 4.2.2 of this report, adapted to the needs of the project under consideration. Protocols designed to suit specific audiences, require planning, resources and time, and therefore should be considered early in the timeline of projects and activities (Pocock et al., 2014).

### EXAMPLE

Lee et al. (2017) considered the importance of awareness-raising strategies to successful recruitment of participants, a sentiment reflected in a study surrounding recruitment messages for Zooniverse projects. Four messages were devised advertising the same project, Gravity Spy, but appealing to different motivations, reflective of different audience types. These motivations were learning about science, social proof, contribution to science, and altruism. The project devised four emails, all with the same content but with different subject lines and first and final paragraphs, each altered to align more with different motivations. The study found that understanding different interests, schedules and priorities was important in tailoring materials and hooks used to raise awareness. The study also highlights the importance of incorporating awareness-raising strategies into the project design. Creating and implementing unique materials and procedures will take time, money and effort, and so should be considered early on so as to be prepared and allocate resources and time accordingly. It is critical to consider this in order to mobilise the objectives of projects and appeal to specific audiences.

## RECOMMENDATION 2: HAVE A CLEAR, SIMPLE AND ACCESSIBLE HOOK WHEN PUBLICISING

Whether producing informative materials or attending events and conferences, it is important to have a clear, simple and accessible hook. Citizen science projects are lengthy and require a lot of design and consideration. However, potential participants often note that being overloaded with information can be overwhelming, limiting the understanding that they have about the project and its aims (Varner, 2014). Using tools such as videos or photos are effective in hooking people's attention and maintaining interest, which increases their awareness of the project. Techniques such as using puzzles to describe the problem that the project is tackling, or asking people to discuss research questions are innovative and engaging ways to raise awareness. It must be considered that different strategies and hooks will have varying levels of effectiveness among different audiences, and often awareness-raising techniques should be tailored to accommodate different stakeholders (Tweddle et al., 2012).

### EXAMPLE

If conducting a project about perspectives and attitudes towards plastic pollution, you could ask individuals to give an example of the plastic item they use most commonly and how they could minimise their use. This could be aided by having common plastic objects out on display. Alternatively, you could show a picture or video detailing plastic pollution and ask individuals what their response is to what they have seen and what they think the key issues, causes and solutions are. As well as raising awareness of the issue and the project or activity, this has the added benefit of acting as a trial for the project, determining if methods employed to gather perspectives are effective and potential issues that could arise. Using interactive tasks, videos or photos can avoid overloading potential participants with information and can help in sustaining interest long enough to raise awareness.



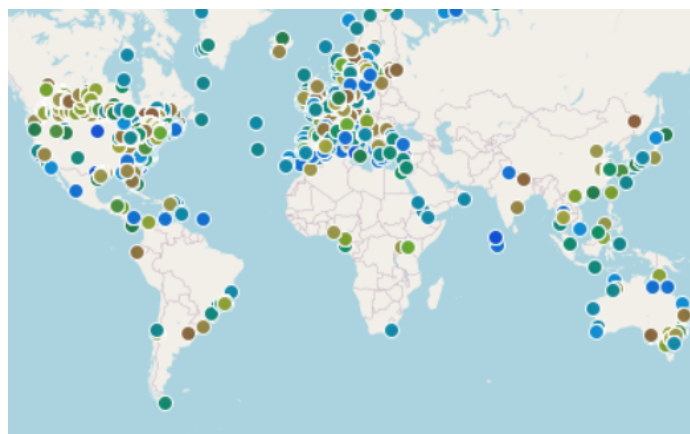
## RECOMMENDATION 3: DEVELOP A PROJECT WEBSITE OR ESTABLISH AN ONLINE PRESENCE

Utilising online tools for awareness-raising is invaluable for projects and activities. Websites act as hubs for information surrounding citizen science projects, and so their design and implementation should be carefully considered. Websites that have a clear user journey, accurate and informative content and easy navigation play a large role in sustained engagement, due to their role as a central hub for guidance and information (Newman et al., 2010). People who may be researching new opportunities surrounding citizen science or volunteering, or who are aiming to learn more could be directed to the website through a search engine or a link from another platform and links to websites can be easily shared among networks. Having a designated platform for the key information of a project or activity allows audiences to feel confident in learning more about citizen science and understand the key aims and objectives. It is important to consider the time and cost that building a website will require, as this could amount to significant amounts depending upon the requirements of the platform. Additionally, projects should consider that their website must be kept up to date with relevant and current information, which will incur further time and cost. Similarly, it is important that the website is of good quality, making important considerations such as ease of navigation, whether the content is representative of your audience, if the text is at an appropriate reading age and uses clear language, whether content is up-to-date, and whether the website is accessible to those with disabilities. Similarly, strategies such as search engine optimisation in which popular words that people might search are used in main headings and site name mean your website is more likely to be found in google searches and broadens the scope of audiences that may visit your webpage. Projects with limited budgets or time could explore using existing platforms, such as social media, to create an online presence, or utilising online citizen science repositories, such as the EU-Citizen.Science platform, to establish a location to host and discuss their project. This could also include listing the website in a directory such as SciStarter.

## RECOMMENDATION 3: DEVELOP A PROJECT WEBSITE OR ESTABLISH AN ONLINE PRESENCE

### EXAMPLE

Citclops is a project that developed systems to retrieve and use data on seawater colour, transparency and fluorescence, using low-cost sensors combined with people acting as data carriers, contextual information (e.g. georeferencing) and a community-based Internet platform, considering actual experiences (e.g. Secchi Dip-In, Coastwatch Europe and Oil Reporter). The project website, fully operational five years after the end of the project in 2015, acts as a critical point of information for existing users and interested parties. The website has an easy-to-use interface, with clear direction to collected data and areas to submit data. The site hosts a set of instructions for collecting observations. These instructions and the accessibility of the site raise awareness among a larger pool of participants. Information about the project is also hosted on other websites (such as <https://www.eyeonwater.org/>), broadening the scope of the audience. Citclops is also an excellent example of website sustainability.



#### **CITCLOPS – Citizens' Observatory for Coast and Ocean Optical Monitoring**

The Citclops project aims to develop systems to retrieve and use data on seawater colour, transparency and fluorescence, using low-cost sensors combined with people acting as data carriers, contextual information and a community-based Internet platform, taking into account existing experiences

Project URL – <http://www.citclops.eu/>

Start date – 2012

Coordinated by – Fundacio Eurecat, Spain

## RECOMMENDATION 4: TARGET EXISTING GROUPS OF PEOPLE WITH SHARED INTERESTS

Gathering support among groups with similar interests is an effective method of raising awareness. Commonly, people are motivated to involve themselves with activities, projects or causes that allow them to express values that are inherently important to them (Curtis, 2015). Accessing groups that have an existing awareness opens up an audience that is already engaged in the topic of choice, and is, therefore, more likely to participate and spread the word. Communicate with local interest groups, clubs or youth assemblages. Often, those who have an interest in the topic are connected to networks that also have an interest and could pass on the word of your project. Considerations should be made that this approach, whilst effective at reaching interested audiences, may not attract under-served audiences who do not typically participate in citizen science or science-based activities. These audiences may benefit more from alternative strategies.

### EXAMPLE

The Riverfly Partnership works to conserve water quality in rivers by sampling Riverfly and their habitats (Riverfly Partnership, 2019). In 2007, the partnership launched the Angler's Riverfly Monitoring Initiative (ARMI). The partnership recognised the unique position of anglers in monitoring the health of water bodies that are frequented by people for recreational fishing. The initiative and its tutors mobilise interest by training them in the simple sampling technique and equipping them with the understanding to contribute to their research (The Conservation Volunteers, 2014). Utilising the position of this group and their current interest effectively, raised awareness of the partnership's work. It provided a unique opportunity for individuals to spread the word among niche social circles.

Project URL – <http://www.riverflies.org/rp-riverfly-monitoring-initiative>

## RECOMMENDATION 5: UTILISE TRADITIONAL ADVERTISING TECHNIQUES

Publicity is a critical component of raising awareness. Traditional advertising such as posters, flyers, radio and television remain helpful in getting the word out about a project or activity. This range of strategies is not exclusive to specific audiences, and the strategies can be used individually or in combination to raise awareness efficiently and among a large audience (The Conservation Volunteers, 2014). It is difficult to target these types of messages to specific audiences, and so project managers should be aware that only general messages can be distributed. Additionally, this method of awareness-raising can incur high costs and demand a substantial amount of time preparing and distributing messages. Typically, messages circulated through these channels have a spread beyond the initial scope, as many individuals will be reached indirectly through social networks (Lange et al., 2019). It is important to consider who you aim to target using this strategy, ensuring that the efforts assigned to this type of awareness-raising are balanced proportionally to the number of people it's likely to reach. Posters are effective for local awareness raising, for example advertising in the location that events will take place, or places frequented by your target audience. Radio and television reach mass audiences, but lack the immediacy of people being able to access your website or communication channels, and so may be less effective at converting awareness into participation. Distribution of flyers can be effective when targeting specific audiences, predominantly those with existing interest, but may not work well for those who have no initial interest or experience with the topic or citizen science. Considerations should also be made to the environmental impact of paper-based advertising techniques.

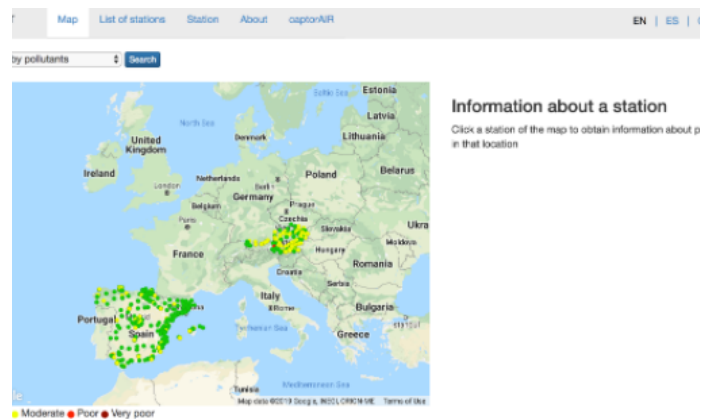


## RECOMMENDATION 5: UTILISE TRADITIONAL ADVERTISING TECHNIQUES

### EXAMPLE

The CAPTOR project aimed to monitor air quality data in areas of Spain, Italy and Austria. The project utilised low-cost devices to measure levels of tropospheric ozone, in an attempt to raise awareness of the issue and engage local communities with the monitoring and upkeep of data collection. The interactive component of this project, namely citizens playing an active role in the data collection, was the “hook” for the mass media. A report released in the local press, followed by a discussion of the project on local news, brought a huge amount of awareness to the project and the air quality problem in the concerned region (Captor-project.eu, 2016).

# CAPTOR



### CAPTOR

Together with researchers and European citizens CAPTOR aims to install and maintain a network of low-costs sensors for Ozone measurement with and for European citizens, in addition to delivering high quality, low cost and valid Ozone data and actively involving and empowering European citizens to stimulate ownership and responsibility

Project URL – <https://www.captor-project.eu/en/>

Start Date – 2016

Co-ordinated by – Universitat Politècnica De Catalunya, Spain

Press release – [https://www.captor-project.eu/wp-content/uploads/2016/03/pressrelease\\_ecologistas\\_10062016.pdf](https://www.captor-project.eu/wp-content/uploads/2016/03/pressrelease_ecologistas_10062016.pdf)



## RECOMMENDATION 6: UTILISE TECHNOLOGY TO ACCESS A BROAD AUDIENCE QUICKLY AND EFFICIENTLY

Increasingly, technology and social media are being utilised to raise awareness of citizen science. New technology is an easy method of accessing a new audience quickly and efficiently (Tweddle et al., 2012). Platforms such as Twitter or Facebook are an effective way to get a clear and effective message to a wide audience in a short space of time. Some platforms have analytical tools that help you to publicise posts and maximise reach. Many social media channels have topics and hashtags that people can follow – using these hashtags distributes your message to an audience with pre-existing interest. You could also look for accounts that can re-share or distribute your content for you, to tap into wider conversations or communities within the social media platform. Online media and technology were a critical component of mobilising the launch of the Galaxy Zoo project, with project managers utilising various online channels to convey messages to a broad reach of stakeholders (Riddick et al., 2010). Awareness-raising conveyed in this way often has reach beyond the intended audience and is often distributed following interpretation by others, and so cannot be controlled as well (Lange et al., 2019). An additional benefit to this strategy is the option to specify audiences for awareness-raising materials. For example, tools such as hoot Suite allow you to target your messages to audiences of different ages, gender, interests, professions and more.

### EXAMPLE

The social media platform Twitter has millions of users, representing a broad range of audiences. The platform allows succinct messages to be distributed to a wide audience in a short time-frame, and is, therefore, a low-cost option for raising awareness. Having a Twitter profile is a good way to stay connected with established networks, while also allowing messages and information to be widely shared and discovered by new audiences (Tweddle et al., 2012). The Garden BioBlitz recognises twitter as a critical component in forming a dedicated community of participants and raising awareness not only of the project, but also of the contributions made by other participants, both of which raise awareness and encourage participation (Roy et al., 2012).

Project URL – <https://www.gardenbioblitz.org/>  
Coordinated by – iRecord, UK



## RECOMMENDATION 7: PROVIDE A NEWSLETTER OR BLOG

Newsletters and blogs keep people informed with updates to the project and can be forwarded among networks. Similarly, they can be used to advertise new activities or opportunities for involvement. Both strategies have the capacity to communicate within and beyond existing communities, establishing a central location for information and communication in the project or activity (Richter et al., 2018). Similarly, blogs allow project managers and volunteers to communicate effectively with audiences (Curtis, 2015). Important considerations to make when starting a blog include how regularly you will post, how you will publicise when new blog posts go up, how is the blog linked to from the main project website (if one exists) and will you use particular content or hooks to attract people to read posts, all of which have implications for the success of the blog. Newsletters can detail updates from an organisation, news from citizen science projects and events and opportunities. While newsletters are often targeted at existing members, the opportunity for awareness-raising remains prevalent. Many of the featured projects or events may be new to recipients. Additionally, recipients may choose to forward the newsletter among their networks, accessing a new audience. Newsletters are direct methods of communication that go straight to participants, whereas blogs require a person to proactively go and check it, and so require publicity and promotion of their own, for example via social media. It is important to consider GDPR and ensure correct permissions are gathered when sending newsletters.

### EXAMPLE

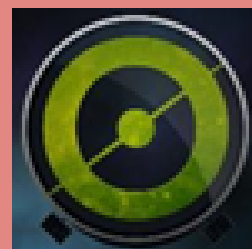
A key component of the launch of the Galaxy Zoo project was an announcement on one of the principle investigators blogs. The publicity raised awareness of the project among a broad audience and resulted in a mass uptake of participants. Following the launch of the project, the project managers launched a blog detailing the research conducted as a result of participants contributions; at the time of publication (2010), this blog received approximately 25,000 unique visitors every month (Raddick et al., 2010).

Project URL - <https://www.zooniverse.org/projects/zookeeper/galaxy-zoo/>

Start date – 2007

Coordinated by – Oxford University, UK

Blog Website - <https://blog.galaxyzoo.org/>



## RECOMMENDATION 8: COLLABORATE WITH KNOWLEDGE-BASED INSTITUTIONS, RESEARCH INSTITUTES, COMPANIES AND/OR ORGANISATIONS

Raising awareness is enhanced by forging relationships and dialogues across disciplines, fostering a multi-faceted and diverse network (Hecker et al., 2018). Collaboration with knowledge-based institutions (institutions whose service is the provision of knowledge, such as universities) can be beneficial to the success of projects and activities, as academic partners can add legitimacy to a project which could convince policymakers of its rigour and importance. Targeted efforts should be made to raise awareness among such institutions surrounding citizen science and establish a partnership and network to work with (Haklay, 2015). Institutions such as universities, private and public research institutions, and corporate/organisational partnerships can help access specific audiences and networks among which to raise awareness.

### EXAMPLE

Capturing Our Coast (CoCoast) was a 3-year long Citizen science project. Across the course of the project, CoCoast trained nearly 3,000 citizen scientists to survey rocky shores, gathering data on marine species to create a wider understanding of UK coastal biodiversity. The partners involved were Newcastle University, University of Hull, University of Portsmouth, The Marine Biological Association, Marine Conservation Society, Bangor University, Scottish Association for Marine Science and Earthwatch. Collaboration with knowledge-based institutions accessed a wide network of academics, scientists and students, which proved beneficial in recruiting volunteers and raising awareness of the project. The geographical scope for awareness-raising was broad, as the partners were located across the United Kingdom.

#### **Capturing Our Coast (CoCoast)**

CoCoast is a project that aims to find out more about the species that live in our seas and how we can protect them.

Project URL - <https://www.capturingourcoast.co.uk/>

Start date - 2016

Coordinated by - Newcastle University, UK



## RECOMMENDATION 9: DISCUSS YOUR PROJECT AT EVENTS, CONFERENCES OR GATHERING

Raising awareness directly through conferring with audiences is a critical method of raising awareness and distributing information in a clear and personal way. There are often two benefits to in-person dissemination, the first being awareness raising among potential participants. Speaking to people at events, conferences or gatherings is a traditional but effective method and can be conducted by the research team, volunteers or a dedicated outreach officer. The second benefit of face-to-face awareness raising includes interacting with targeted stakeholders to spread the word of the work you have done. This is particularly useful when attempting to engage policymakers, as you can attend events such as EU Green Week and others where policymakers will already be in attendance. Conferences and events provide great opportunities for dialogue with defined audiences and provide a mutual learning opportunity between citizen science practitioners and stakeholders. Maximising face to face interaction offers a personal component to awareness-raising, which can help to establish working relationships and address expectations early on (Tweddle et al., 2012). Awareness-raising in this setting allows communication of a large volume of information and the opportunity to respond to questions, without relying on third parties to correctly disseminate the information to stakeholders (Lange et al., 2019). The UK Ladybird Survey employed a dedicated officer who was responsible for promoting the survey in a plethora of ways, including hosting talks and workshops at events and attending shows and conferences (Roy et al., 2012).

### EXAMPLE

Events and gatherings are a good way to access a range of audiences. Often, educators or pupils will arrange events at which external parties can have a stand or deliver a presentation. The Association for Science Education hosts a conference each year that attracts people from all over Europe, with a broad range of disciplines, to discover new opportunities for learning and participation. Many citizen science-based projects and organisations run sessions delivering the impact of their research and information about how interested parties can get involved. Similarly, a broad range of stakeholders could be attracted to events, such as the European Researchers Night. This takes place annually, with events hosted in approximately 300 cities across Europe. The event hosts workshops and activities, showcasing science and research to a broad audience.

## RECOMMENDATION 10: EDUCATIONAL OUTREACH AND SCHOOL VISITS

Projects may wish to employ educational outreach, visiting schools or learning groups, delivering workshops or sessions about citizen science, in order to raise awareness and run small scale trials. Educational settings, both formal and informal, are a good resource for generating interest in citizen science projects. Experiencing citizen science activities stimulates interest in the field, establishing an increased awareness of citizen science generally and a motivation to participate (Vitone et al., 2016). Citizen science projects Naturehood and Freshwater Watch are regularly used in schools; in 2019, these projects reached 477 educators and 2923 young people combined. Pupils receive resources to take home to their parents with the website on them, while teachers can pass on the information to their networks. This vastly increased awareness among key audiences, both directly and indirectly. Projects could reach out to their networks to establish contacts at schools, or utilise networks such as teacher unions and CPD organisations to communicate with large groups of educators. It is important to establish your audience criteria when considering which schools to raise awareness with – is there a geographical scope of your project? Do you want to work with schools that have multiple layers of deprivation? Do you want to work with schools who have specific land-requirements, so they can easily conduct research?

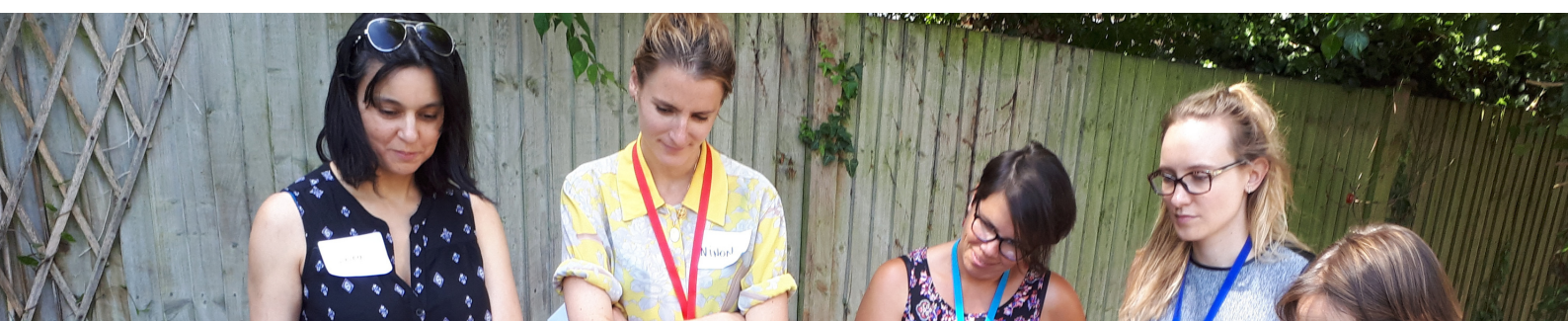
### EXAMPLE

A group of researchers in the USA introduced a citizen science project, investigating the Horseshoe Crab, to a group of pupils aged 11-13. The project was designed and ran by a local biologist, specifically for the purpose of this study. The key aim of this was to determine the effects of citizen science on various social factors, including awareness, willingness to participate and science performance. The result of the study indicated that including citizen science activities within these settings has a positive effect on interest in the project and citizen science generally (Hiller and Kitsantas, 2014). While this study involved long-term participation in the same project, even one workshop or session could drastically increase the awareness of large audiences to citizen science.



## RECOMMENDATION 11: ALIGN PROJECTS WITH ONGOING OR FUTURE POLICY DEBATE

It is suggested that decisions guiding involvement with a project or activity are determined by the purpose and nature of the topic or issue (Hollo et al., 2015). Therefore, considering alignment with ongoing or future policy debates could be an effective method of raising awareness of projects or activities. Awareness-raising that is well-timed and carefully prepared to fit with ongoing or emerging policy debate can raise the profile of a project or activity and attract the attention of politicians. Similarly, aligning with ongoing policy debate means you are likely to select an issue that is of political/societal prominence at that time or of local concern, raising awareness among potential participants. Information gathered from projects or about new and existing projects and activities that is distributed at the right time can feed into policy debate and attract the attention of policymakers and other audiences who have an interest in the issue or debate. Citizen science offers effective ways of connecting policy and communities. So, interest in projects or activities from relevant audiences has the capacity to raise awareness among secondary audiences (e.g. raised awareness among communities on projects surrounding local issues could mobilise individuals to discuss this with local policymakers) (Hecker et al., 2018). It is important to consider that not all topics can feed into policy, and that this recommendation is opportunistic and will not be applicable to all citizen science projects and activities. Similarly, awareness raising among policymakers and decision-makers is difficult, and so it is important to find ample opportunities to communicate and meet with them and target communications to this audience specifically.



## RECOMMENDATION 11: ALIGN PROJECTS WITH ONGOING OR FUTURE POLICY DEBATE

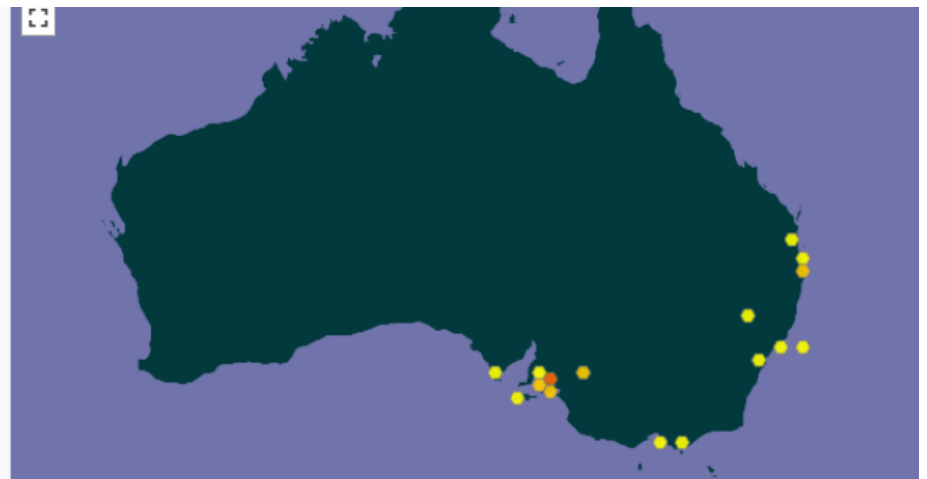
### EXAMPLE

Populations of Koala bears vary across Australia; while some districts fear for the survival of the species, other areas, such as Kangaroo Island, see them as a pest, wreaking havoc on the landscape (Masters et al., 2004). This has caused widespread discussion about how best to manage populations of the species. In the early '90s, culling populations led to a huge public outcry. Lack of comprehensive information on population distribution presents an inimitable challenge for policymakers, confusing efforts to formulate a suitable management plan and framework that applies nationally (Flower et al., 2016). This highlights an area of potential for citizen science to influence policy. Long-term data monitoring has provided a significant contribution to management schemes, offering substantial and clear information on population and distribution (Flower et al., 2016). The Great Koala Count is a citizen science project, aimed at formulating a comprehensive idea of koala populations across Australia. The project is repeated annually, offering a long-term perspective of changes to population, particularly following natural disaster (Research Data Australia, 2019). This project, and its respective data, has been widely utilised in the management planning for the species, contributing to the development of a South Australian Government koala management and conservation policy (Hollow et al., 2015).

Project URL - <https://researchdata.ands.org.au/national-parks-association-koala-count/671425>

Coordinated by - National Parks Association of NSW, Australia

Start date - 2012



## RECOMMENDATION 12: LINK STUDIES, PUBLICATIONS AND REPORTS BACK TO THE CITIZEN SCIENCE PROJECT

Linking studies back to the research project is effective in raising awareness – sometimes, research that is reported on is not linked back to the project or activity from which data was gathered. It is important to link blogs, reports and publications utilising results from citizen science back to the initial study and to raise awareness of the successes of citizen science.

### EXAMPLE

Plastic pollution studies often make national news, yet many are unaware that the results were gathered from a citizen science project. The 'Break Free from Plastic' project encompasses the work of multiple environmental organisations, working towards the goal of tackling plastic pollution. The project coordinates clean-ups and is most famous for its brand audit. Sampling more than 180,000 pieces of plastic across 42 countries, the project aims to highlight the corporations that were the top 'offenders' for plastic pollution. The results are widely publicised and awareness of the project increased exponentially as a result of mention in the media (Break Free from Plastic, 2019).

Project URL - <https://www.breakfreefromplastic.org/>

News - <https://www.euronews.com/living/2019/11/16/who-are-the-world-s-top-ten-marine-plastic-polluters>



# REFERENCES

- Bachner-Melman, R., Gritsenko, I., Nemanov, L., Zohar, A., Dina, C. and Ebstein, R (2005). Dopaminergic polymorphisms associated with self-report measures of human altruism: a fresh phenotype for the dopamine D4 receptor. *Molecular Psychiatry*, 10(4), pp.333-335.
- Bernstein, M., Bright, M., Cutrell, E., Dow, S., Gerber, E., Jain, A. and Kulkarni, A. (2013). Micro-volunteering: helping the helpers in development. In: CSCW '13: Proceedings of the 2013 conference on Computer supported cooperative work companion. pp.85-88.
- Bonney, R., Cooper, C., Dickinson, J., Kelling, S., Phillips, T., Rosenberg, K. and Shirk, J. (2009). Citizen Science: A Developing Tool for Expanding Science Knowledge and Scientific Literacy. *BioScience*, 59(11), pp.977-984.
- Bonney, R., Shirk, J., Phillips, T., Wiggins, A., Ballard, H., Miller-Rushing, A. and Parrish, J. (2014). Next Steps for Citizen Science. *Science*, 343(6178), pp.1436-1437.
- Bosson, J.A., Mudway, I.S. and Sandström, T. (2019). Traffic-related Air Pollution, Health, and Allergy: The Role of Nitrogen Dioxide. *American Journal of Respiratory and Critical Care Medicine*, 200(5), pp.523-524.
- Break Free from Plastic (2019). Break Free From Plastic Movement | #breakfreefromplastic. [online] Break Free From Plastic. Available at: <https://www.breakfreefromplastic.org/> [Accessed 9 Dec. 2019].
- British Ecological Society. (2013). Is there a role for the citizen scientist in policy making? - British Ecological Society. [online] Available at: <https://www.britishecologicalsociety.org/is-there-a-role-for-the-citizen-scientist-in-policy-making/>.
- British Trust of Ornithology (2019). Volunteer for BTO surveys | BTO - British Trust for Ornithology. [online] Bto.org. Available at: <https://www.bto.org/how-you-can-help/take-part-project/volunteering> [Accessed 17 Oct. 2019].
- Burgess, H., DeBey, L., Froehlich, H., Schmidt, N., Theobald, E., Ettinger, A., HilleRisLambers, J., Tewksbury, J. and Parrish, J. (2017). The science of citizen science: Exploring barriers to use as a primary research tool. *Biological Conservation*, 208, pp.113-120.
- Cambridge (2019). AWARENESS | meaning in the Cambridge English Dictionary. [online] Dictionary.cambridge.org. Available at: <https://dictionary.cambridge.org/dictionary/english/awareness> [Accessed 3 Oct. 2019].
- Ceccaroni, L., Bibby, J., Roger, E., Flemons, P., Michael, K., Fagan, L. and Oliver, J. (2019). Opportunities and Risks for Citizen Science in the Age of Artificial Intelligence. *Citizen Science: Theory and Practice*, 4(1).
- Ceccaroni, L., Bowser, A., Piera, J. (2017). Instant Gratification Citizen Science. In: 2017 Citizen Science Association Conference.
- Chivite, I. Using Survey123 for Citizen Science and Crowdsourcing Initiatives. In: 2017 Education GIS Conference Proceedings.
- Collins Dictionary (2019). Aware definition and meaning | Collins English Dictionary. [online] Collinsdictionary.com. Available at: <https://www.collinsdictionary.com/dictionary/english/aware> [Accessed 3 Oct. 2019].



# REFERENCES

- Cox, J., Oh, E.Y., Simmons, B., Lintott, C., Masters, K., Greenhill, A., Graham, G., Holmes, K. (2015) Defining and Measuring Success in Online Citizen Science: A Case Study of Zooniverse Projects. *Computing in Science & Engineering*, 17 (4). pp. 28–41.
- Curtis, V. (2015). Motivation to Participate in an Online Citizen Science Game. *Science Communication*, 37(6), pp.723–746.
- European Commission Digital Earth Lab (2019). Implications of Citizen Science for EU policy-making | Digital Earth. [online] [Digitalearthlab.jrc.ec.europa.eu](http://digitalearthlab.jrc.ec.europa.eu). Available at: <http://digitalearthlab.jrc.ec.europa.eu/implications-citizen-science-eu-policy-making/57707> [Accessed 9 Oct. 2019].
- Farley, P. (2013). Using the Computer Game “FoldIt” to Entice Students to Explore External Representations of Protein Structure in a Biochemistry Course for Nonmajors. *Biochemistry and Molecular Biology Education*, 41(1), pp.56–57.
- Figueiredo Nascimento, S., Cuccillato, E., Schade, S. and Guimarães Pereira, A. (2016). Citizen Engagement in Science and Policy-Making: Reflections and recommendations across the European Commission. European Commission.
- Flower, E., Jones, D. and Bernede, L. (2016). Can Citizen Science Assist in Determining Koala (*Phascolarctos cinereus*) Presence in a Declining Population? *Animals*, 6(7), pp.42.
- Gittleman, M., Jordan, K. and Brelsford, E. (2012). Using Citizen Science to Quantify Community Garden Crop Yields. *Cities and the Environment*, 5(1), pp.1–14.
- Hecker, S., Bonney, R., Haklay, M., Hölker, F., Hofer, H., Goebel, C., Gold, M., Makuch, Z., Ponti, M., Richter, A., Robinson, L., Iglesias, J., Owen, R., Peltola, T., Sforzi, A., Shirk, J., Vogel, J., Vohland, K., Witt, T. and Bonn, A. (2018). Innovation in Citizen Science – Perspectives on Science-Policy Advances. *Citizen Science: Theory and Practice*, 3(1).
- Hiller, S. and Kitsantas, A. (2014). The Effect of a Horseshoe Crab Citizen Science Program on Middle School Student Science Performance and STEM Career Motivation. *School Science and Mathematics*, 114(6), pp.302–311.
- Hollow, B., Roetman, P., Walter, M. and Daniels, C. (2015). Citizen science for policy development: The case of koala management in South Australia. *Environmental Science & Policy*, 47, pp.126–136.
- Jennett, C., Kloetzer, L., Schneider, D., Iacovides, I., Cox, A., Gold, M., Fuchs, B., Eveleigh, A., Mathieu, K., Ajani, Z. and Talsi, Y. (2016). Motivations, learning and creativity in online citizen science. *Journal of Science Communication*, 15(03).
- JNCC (2019). UK Biodiversity Indicators 2019 | JNCC – Adviser to Government on Nature Conservation. [online] Available at: <https://jncc.gov.uk/our-work/uk-biodiversity-indicators-2019/> [Accessed 4 Dec. 2019].
- Lamoureux, Z. and Fast, V. (2019). The tools of citizen science: An evaluation of map-based crowdsourcing platforms. *Spatial Knowledge and Information Canada*, 7(4), pp.1.
- Lee, T.K., Crowston, K., Østerlund, C. and Miller, G. (2017). Recruiting messages matter: Message strategies to attract citizen scientists. In: *ACM Conference CSCW proceedings. ACM Conference on Computer Supported Cooperative Work and Social Computing*.



# REFERENCES

- Maistrello, L., Dioli, P., Bariselli, M., Mazzoli, G.L. and Giacalone-Forini, I. (2016). Citizen science and early detection of invasive species: phenology of first occurrences of *Halyomorpha halys* in Southern Europe. *Biological Invasions*, 18(11), pp.3109–3116.
- Maccani G., Goossensen M., Righi V., Creus J. and Balestrini M., Scaling up Citizen Science - What are the factors associated with increased reach and how to lever them to achieve impact, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-25157-6, doi:10.2760/00926, JRC122219.
- Mapping for Change. (2016). Citizen Science Used to Map Community Air Quality - Mapping for Change. [online] Available at: <https://mappingforchange.org.uk/projects/citizen-science-used-to-map-community-air-quality/> [Accessed 20 Jan. 2020].
- Maslach, C., Schaufeli, W. and Leiter, M.P. (2001). Job Burnout. *Annual Review of Psychology*, 52, pp.397–422.
- Masters, P., Duka, T., Berris, S. and Moss, G. (2004). Koalas on Kangaroo Island: from introduction to pest status in less than a century. *Wildlife Research*, 31(3), pp.267.
- Martin, V. (2017). Citizen Science as a Means for Increasing Public Engagement in Science: Presumption or Possibility? *Science Communication*, 39(2), pp.142–168.
- McKinley, D., Miller-Rushing, A., Ballard, H., Bonney, R., Brown, H., Cook-Patton, S., Evans, D., French, R., Parrish, J., Phillips, T., Ryan, S., Shanley, L., Shirk, J., Stepenuck, K., Weltzin, J., Wiggins, A., Boyle, O., Briggs, R., Chapin, S., Hewitt, D., Preuss, P. and Soukup, M. (2017). Citizen science can improve conservation science, natural resource management, and environmental protection. *Biological Conservation*, 208, pp.15–28.
- Natural England (2011). Volunteering in Nature. [online] Available at: <http://publications.naturalengland.org.uk/#> [Accessed 20 Jan. 2020].
- Newman, G., Wiggins, A., Crall, A., Graham, E., Newman, S. and Crowston, K. (2012). The future of citizen science: emerging technologies and shifting paradigms. *Frontiers in Ecology and the Environment*, 10(6), pp.298–304.
- NHS (2016). Blood donors texted when their blood goes to hospitals to save lives. [online] NHS Blood Donation. Available at: <https://www.blood.co.uk/news-and-campaigns/news-and-statements/blood-donors-texted-when-their-blood-goes-to-hospitals-to-save-lives/> [Accessed 17 Dec. 2019].
- Parker, S.S., Pauly, G.B., Moore, J., Fraga, N.S., Knapp, J.J., Principe, Z., Brown, B.V., Randall, J.M., Cohen, B.S. and Wake, T.A. (2018). Adapting the bioblitz to meet conservation needs. *Conservation Biology*, 32(5), pp.1007–1019.
- Pocock, M., Chapman, D., Sheppard, L. and Roy, H. (2014). Choosing and Using Citizen Science: a guide to when and how to use citizen science to monitor biodiversity and the environment. Centre for Ecology & Hydrology.
- Raddick, M., Bracey, G., Gay, P., Lintott, C., Murray, P., Schawinski, K., Szalay, A. and Vandenberg, J. (2010). Galaxy Zoo: Exploring the Motivations of Citizen Science Volunteers. *Astronomy Education Review*, 9(1).

# REFERENCES

- Raddick, J. M., Bracey, G., Gay, P., Lintott, C., Cardamone, C., Murray, P., Schawinski, K., Szalay, A. and Vandenberg, J. (2013). Galaxy Zoo: Motivations of Citizen Scientists. *Astronomy Education Review*, 12(1).
- Research Data Australia. (2019). National Parks Association of NSW Great Koala Count. [online] Available at: <https://researchdata.ands.org.au/national-parks-association-koala-count/671425> [Accessed 19 Jan. 2020].
- Richter, A., Hauck, J., Feldmann, R., Kühn, E., Harpke, A., Hirneisen, N., Mahla, A., Settele, J. and Bonn, A. (2018). The social fabric of citizen science—drivers for long-term engagement in the German butterfly monitoring scheme. *Journal of Insect Conservation*, 22(5-6), pp.731-743
- Riverfly Partnership (2019). Anglers' Riverfly Monitoring Initiative | riverflies.org. [online] Riverflies.org. Available at: <http://www.riverflies.org/rp-riverfly-monitoring-initiative> [Accessed 2 Dec. 2019].
- Robinson, L., Cawthray, J., West, S., Bonn, A. and Ansine, J. (2018). Ten principles of citizen science. In: S. Hecker, M. Hacklay, A. Bowser, Z. Makuch, J. Vogel and A. Bonn, ed., *Citizen Science: Innovation in Open Science, Society and Policy*, 1st ed. London, pp.27-40.
- Rotman, D., Hammock, J., Preece, J., Hansen, D., Boston, C., Bowser, A. and He, Y. (2014). Motivations Affecting Initial and Long-Term Participation in Citizen Science Projects in Three Countries. [online] iConference Proceedings, pp.110-124. Available at: <http://doi:10.9776/14054> [Accessed 7 Dec. 2019].
- Rotman, D., Preece, J., Hammock, J., Procita, K., Hanen, D., Parr, C., Lewis, D. and Jacobs, D. (2012). Dynamic Changes in Motivation in Collaborative Citizen-Science Projects. In: *Proceedings of the ACM Conference on Computer Supported Cooperative Work*. [online] pp.217-226. Available at: <http://10.1145/2145204.2145238>. [Accessed 17 Dec. 2019].
- Roy, H., Pocock, M., Preston, C., Roy, D., Savage, J., Tweddle, J. and Robinson, L. (2012). *Understanding Citizen Science & Environmental Monitoring*. UK-EOF. NERC Centre for Ecology & Hydrology and Natural History Museum.
- Schade, S., Manzoni, M., Tsinaraki, C., Kotsev, A., Fullerton, K., Sgnaolin, R., Spinelli, F. and Mitton, I. (2017). Using new data sources for policymaking. JRC Technical Reports. Luxembourg: Publications Office of the European Union.
- Sea Watch Foundation (2020) Sea Watch Foundation: Achievements [online] Available at: <https://www.seawatchfoundation.org.uk/achievements/> [Accessed 23 Nov. 2020]
- Shirk, J. L., H. L. Ballard, C. C. Wilderman, T. Phillips, A. Wiggins, R. Jordan, E. McCallie, M. Minarchek, B. V. Lewenstein, M. E. Krasny, and R. Bonney. 2012. Public participation in scientific research: a framework for deliberate design. *Ecology and Society* 17(2): 29.
- Steven, R., Barnes, M., Garnett, S., Garrard, G., O'Connor, J., Oliver, J., Robinson, C., Tulloch, A. and Fuller, R. (2019). Aligning citizen science with best practice: Threatened species conservation in Australia. *Conservation Science and Practice*, 1(10).

# REFERENCES

- Steven, R., Barnes, M., Garnett, S., Garrard, G., O'Connor, J., Oliver, J., Robinson, C., Tulloch, A. and Fuller, R. (2019). Aligning citizen science with best practice: Threatened species conservation in Australia. *Conservation Science and Practice*, 1(10).
- The Conservation Volunteers (2014). Citizen Science in your Community: A guide to getting involved. [online] The Conservation Volunteers. Available at: [https://www.tcv.org.uk/wp-content/uploads/2014/11/community\\_citizen\\_science\\_guidance\\_updated\\_final\\_0.pdf](https://www.tcv.org.uk/wp-content/uploads/2014/11/community_citizen_science_guidance_updated_final_0.pdf) [Accessed 4 Oct. 2019].
- Thornhill, I., Loisele, S., Lind, K. and Ophof, D. (2016). The Citizen Science Opportunity for Researchers and Agencies. *BioScience*, 66(9), pp.720–721.
- Topham, G., Clarke, S., Levett, C., Scruton, P. and Fidler, M. (2015). The Volkswagen emissions scandal explained. [online] The Guardian. Available at: <https://www.theguardian.com/business/ng-interactive/2015/sep/23/volkswagen-emissions-scandal-explained-diesel-cars>.
- Tweddle, J., Robinson, L., Pocock, M. and Roy, H. (2019). Guide to citizen science: developing, implementing and evaluating citizen science to study biodiversity and the environment in the UK. [online] Natural History Museum and NERC Centre for Ecology & Hydrology for UK-EOF. Available at: <http://www.ukEOF.org.uk> [Accessed 17 Nov. 2019].
- Vann-Sander, S., Clifton, J. and Harvey, E. (2016). Can citizen science work? Perceptions of the role and utility of citizen science in a marine policy and management context. *Marine Policy*, 72, pp.82–93.
- Varner, J. (2014). Scientific Outreach: Toward Effective Public Engagement with Biological Science. *BioScience*, 64(4), pp.333–340.
- Verbrugge, L.N.H., Ganzevoort, W., Fliervoet, J.M., Panten, K. and van den Born, R.J.G. (2017). Implementing participatory monitoring in river management: The role of stakeholders' perspectives and incentives. *Journal of Environmental Management*, 195, pp.62–69.
- Vitone, T., Stofer, K., Steininger, M.S., Hulcr, J., Dunn, R. and Lucky, A. (2016). School of Ants goes to college: integrating citizen science into the general education classroom increases engagement with science. *Journal of Science Communication*, 15(01).
- Werbach, K. and Hunter, D. (2012). *For the win*. Philadelphia: Wharton Digital Press.
- West, S.E. (2015) Understanding participant and practitioner outcomes of environmental education, *Environmental Education Research*, 21:1, 45–60, DOI: 10.1080/13504622.2013.879695
- West, S. and Pateman, R. (2016). Recruiting and Retaining Participants in Citizen Science: What Can Be Learned from the Volunteering Literature? *Citizen Science: Theory and Practice*, 1(2).
- Wold (2018). The Survey123 App: Enhancing the Citizen Science Experience (U.S. National Park Service). [online] Available at: <https://www.nps.gov/articles/survey123.htm> [Accessed 20 Jan. 2020].

