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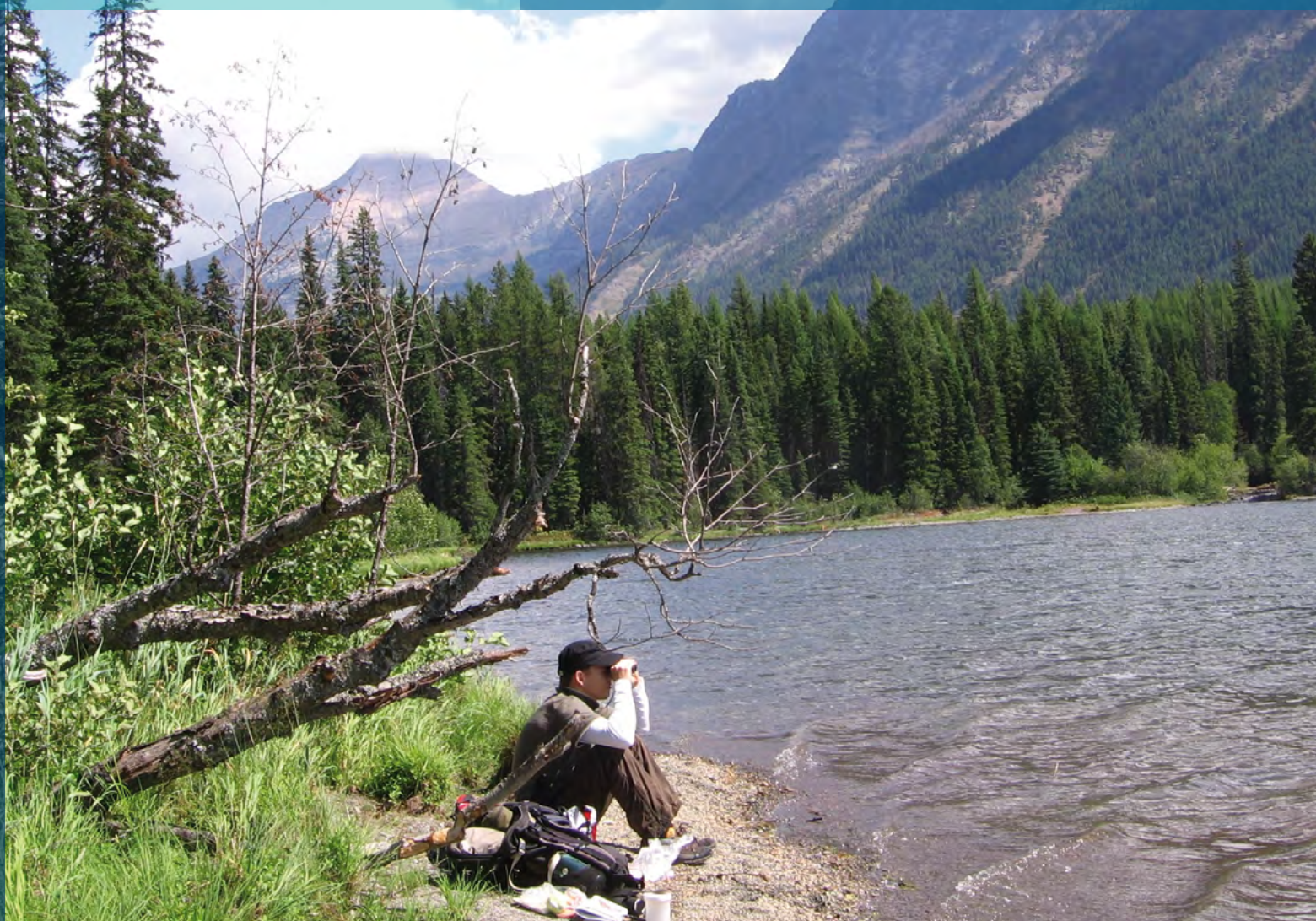
BiodivERsA

CITIZEN SCIENCE TOOLKIT

for biodiversity scientists



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Main contact for this toolkit

l.goudeseune@biodiversity.be

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Thibaut Lochu

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TO CONTACT BIODIVERSA

BiodivERsA Chair & Coordinator

Xavier Le Roux
xavier.leroux@hotmail.fr
Tel: +33 (0)6 31 80 38 20

BiodivERsA Secretariat

biodiversa@fondationbiodiversite.fr

Fondation pour la Recherche sur la Biodiversité
195 rue St Jacques, 75005 Paris, France
www.biodiversa.org

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A ABOUT THIS TOOLKIT

The **objective of this BiodivERsA toolkit** is to inform scientists working in the fields of biodiversity and, more generally, in environmental sciences, about the potential benefits of Citizen Science, and to provide a summary of the rationale to develop Citizen Science, current best practices, and useful resources in the field.

It is aimed at researchers and scientists involved in research projects where Citizen Science could be used for data collection or public/stakeholder engagement (or where existing Citizen Science data could be used). It is expected that this could help scientists to better consider the different dimensions (Figure 1) and potential of Citizen Science as part of their research projects.

Using examples from a variety of projects, including but not restricted to BiodivERsA-funded projects, this toolkit aims to improve the understanding of Citizen Science practices and overcome potential barriers in research projects.

Figure 1: Citizen Science word cloud (created with: WordArt.com)

This toolkit has been developed following the BiodivERsA Citizen Science workshop that took place on the 2nd and 3rd of April 2019 in Brussels, at the Royal Belgian Institute of Natural Sciences. The workshop was part of a larger joint European Citizen Science event, co-organised by BiodivERsA, and including the European Citizen Science Association (ECSA)'s General Assembly and the 'Doing it Together Science' project (DITOs) Final Event. It was followed by a Bioblitz organised at Meise Botanic Garden in the afternoon of the workshop.

We also aim to address issues expressed in a survey conducted among BiodivERsA scientists in 2018 (see Part II Benefits and challenges) which revealed a general positive interest in Citizen Science, but also a lack of knowledge or guidance in this field. This prompted the development of the present toolkit.

B WHAT IS CITIZEN SCIENCE?

Citizen Science has been contributing to various research fields such as astronomy, medicine, art history, and social sciences; but it has proven to be particularly relevant and prevalent in the field of environmental science.

BOX #1

A DEFINITION OF CITIZEN SCIENCE

> **CITIZEN SCIENCE** noun. The process of producing scientific knowledge in which non-scientific or non-professional actors — whether individuals or groups — actively and intentionally participate[1].

Citizen Science can be defined as "*the involvement of the non-academic public in the process of scientific research – whether community-driven research or global investigations.*"[2]

A specific definition in the context of biodiversity and environmental research is: "*Citizen Science, restricted to studies of biodiversity and the environment, is defined as volunteer collection of biodiversity and environmental information which contributes to expanding our knowledge of the natural environment, including biological monitoring and the collection or interpretation of environmental observations.*"[3]

The latter definition highlights the aspect of collection of information but that does not mean that it is limited to that. Indeed, Citizen Science covers a diverse array of approaches and provides both scientific (data collection) and engagement benefits. It is also expected that mobilising citizens should lead to other outcomes like citizens' education, awareness-raising, etc. and has great potential for engagement, education, and action (Haklay et al, 2020; Kelemen-Finan et al, 2018).

There is a wide variety of terms (e.g. *participatory action research*[4], *civic science*[5], *amateur science*[6], *community science*[7], *crowdsourced science*[8]) which are either synonyms for Citizen Science, or have an important overlap with it in terms of meaning. Different fields have developed their own terminology and some terms even have different meanings in different contexts. In addition, there are many related concepts which are not the same as Citizen Science, but closely associated with it (e.g. '*Do-it-yourself' biology*[9], *community-based monitoring*[10], *stakeholders' engagement*[11], etc.). For more information won Citizen Science terminology, see: Eitzel et al, 2017.

To find or discover Citizen Science projects, there are many existing inventories or databases, like the ones listed in Bibliography & resources: e) Inventories and databases.

1. Houllier Merilhou-Goudard, 2016.
2. www.citizenscience.org
3. See the guide published by the UK Environmental Observation Framework: Tweddle et al, 2012.
4. Participatory action research "includes citizens in research work. It was developed in the 1940s in social psychology as an alternative to mission-free science considered alienating to theory and practice." (Pettibone et al, 2016)
5. Civic science is "a science that questions the state of things rather than a science which serves the state" and where "professional scientists as facilitators of tools and information for people" (PublicLab; Peter Levine's blog)
6. Amateur science "describes the scientific activities of citizens who do not earn their living as scientists" (see Finke, 2014; Mahr, 2014 cited in Pettibone et al, 2016).
7. Community science is generally used as synonym for Citizen Science (see websites of the University of Antwerpen and GenR; PPT by Haklay, 2018).
8. Crowdsourced science: "researchers recruiting members of the public to help them collect data" as opposed to "conduct experiments" (for citizen science) (Alan Turing Institute).
9. Do-it-yourself (DIY) biology is "a rather recent phenomenon and can be described as the pursuit of biology outside of scientific institutions by amateurs, students, "hobbyists"". (Landrain et al, 2013)
10. Community-based monitoring (CBM) is a subset of CS in which local SH use their own resources to monitor natural resources to achieve goals that make sense to them' (Chandler et al, 2017)
11. See BiodivERsA's Stakeholder Engagement Handbook.

C THE RISE OF CITIZEN SCIENCE

Although citizens have contributed for centuries to the collection of data and specimens of ecological value (Miller-Rushing et al, 2012), the concept of Citizen Science has received increasing attention and popularity more recently. The numbers of peer-reviewed publications and Citizen Science projects and volunteers have dramatically increased over the last 10 years (see Figures 2a and 2b).

Among the underlying reasons are the recent technological advancements and the accessibility of the general public to new technologies (e.g. internet, smartphones, apps…) and the web 2.0 philosophy of user-generated content, information sharing and participatory culture. These technologies have allowed for better access to and sharing of data. Cheap and reliable environmental sensors are now also more widespread: they facilitate data collection and reduce errors in the geographical and temporal information associated with the records (see Newman et al, 2012; Pimm et al, 2015; Skarlatidou et al, 2019).

The development of website interfaces and platforms over the last decade have enabled easy data collection or data hosting (e.g. iNaturalist), data or image analyses (e.g. Zooniverse), or even recruiting volunteers (e.g. SciStarter). On GBIF, 50% of occurrence records are Citizen Science observations and 6 of the top 10 datasets are citizen science datasets (Waller, 2019).

Historically, biodiversity data collected by volunteers was not well ackowledged in scientific publications (neither the names of the volunteers, nor the use of the term "Citizen Science"). This is now changing (see Figures 2a and 2b) and the improved acceptance of Citizen Science (Fritsch-Kosmider, 2018) contributes to making it more visible (Theobald et al, 2015; Chandler et al, 2017; Pocock et al, 2018a).

Furthermore, Citizen Science is increasingly recognised as a tool to democratise science and promote new forms of collaborations with - and engagement of – citizens. For example, to educate citizens on what research is and, when relevant, to engage citizens in the reseach process; or to take into account their views and expectations as it is the case for other groups of stakeholders (Toomey, 2014; Wittmayer & Janssen, 2019).

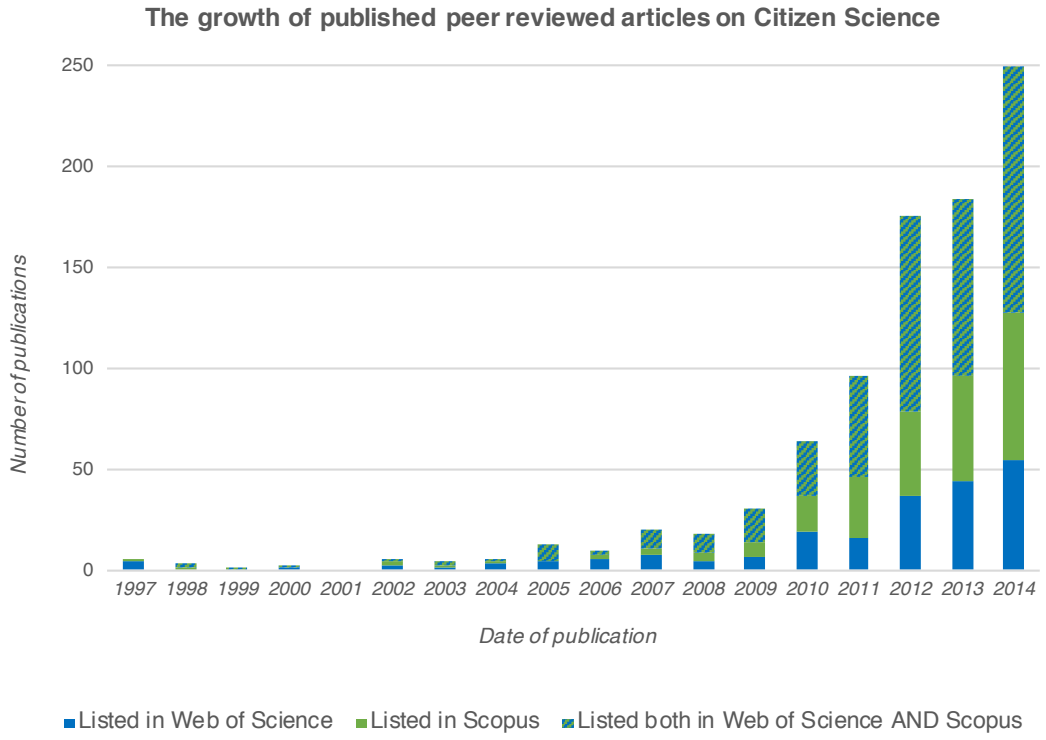


Figure 2a: Increase in the number of published peer-reviewed articles on citizen science (adapted from: Follet & Strezov, 2015).

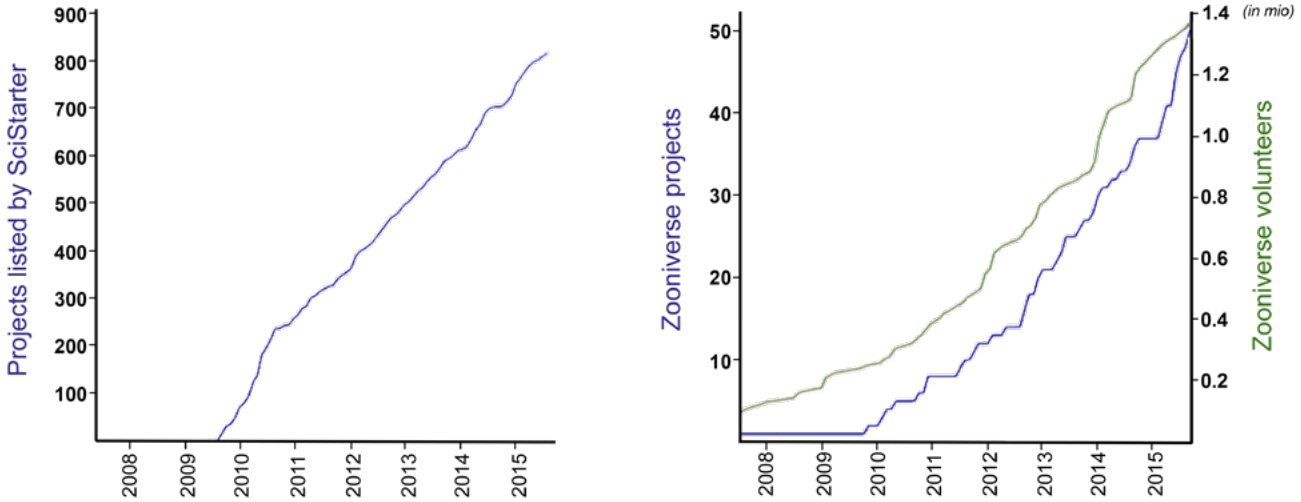


Figure 2b: (left) number of projects listed in SciStarter (adapted from Kosmala et al, 2016); and (right) number of projects created by Zooniverse (blue) and corresponding number of volunteers (grey) (adapted from Kosmala et al, 2016).

D DIFFERENT TYPES OF CITIZEN SCIENCE PROJECTS

Citizen Science activities or approaches have been classified using different categories or typologies.

These existing typologies and the scope of Citizen Science can be determined through different perspectives or aspects, such as:

- ***Who are the volunteers?*** They range from mass public to expert naturalists or retired professionnals, from stakeholders (e.g. farmers) to school children.
- ***What are their roles and tasks?*** They can record observations, collect samples on the field, implement simple experiments, contribute to analysing data, providing ideas and input in setting up the research questions, etc.
- ***When do the volunteers contribute?*** Citizen Science can include volunteers at different stages of the research process, from study design and development of research questions, to the validation of research results.
- ***How do scientists and citizens collaborate?*** Many options of collaborations are possible, from scientist-led projects where citizens operate under their coordination, to community-driven projects where citizens are taking the lead and partner with research institutions.

Bonney et al, 2009 considers the level of participation or engagement of the volunteers in the research process to distinguish three main types of projects:

- ***Contributory projects***, which are generally designed by scientists and for which members of the public primarily contribute data;
- ***Collaborative projects***, which are generally designed by scientists and for which members of the public contribute data but also help to refine project design, analyse data, or disseminate findings;
- ***Co-created projects***, which are co-designed by scientists and members of the public. At least some of the public participants are actively involved in most or all steps of the scientific process.

Another classification adds to these types the concept of "Extreme Citizen Science" which requires the scientists not only to act as experts, but also as facilitators. (Figure 3).

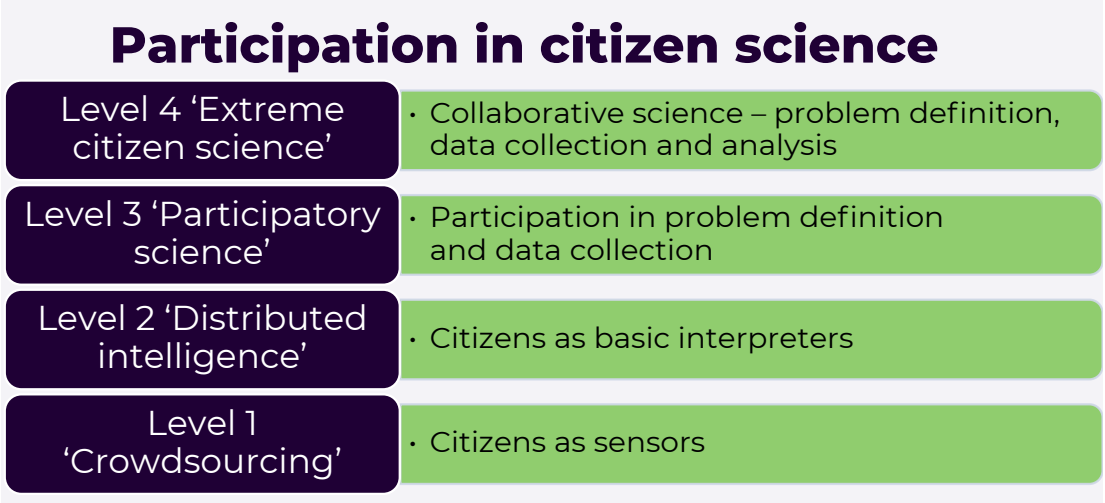


Figure 3: Levels of participation in Citizen Science projects (after Haklay, 2013)

An more detailed overview of these models of Citizen Science projects and how both experts and volunteers are involved at several stages of the projects has been illustrated in Pocock et al, 2015a.

Van Noordwijk et al. (2020) identifies four Citizen Science approaches that present particularly strong opportunities for environmental impact:

- place-based community action projects - for local communities;
- educational/captive research learning projects - for schools, employees, museums, etc.;
- interest-group investigation projects - for citizens with prior knowledge/expertise/interest in the topic;
- mass-participation census projects - for the general public.

This demonstrates that different types of projects tend to attract different audiences, and are suitable in different contexts.

E COMMON CITIZEN SCIENCE APPROACHES OR ACTIVITIES

In the field of environmental sciences (biodiversity and ecosystems), examples of common methods include:

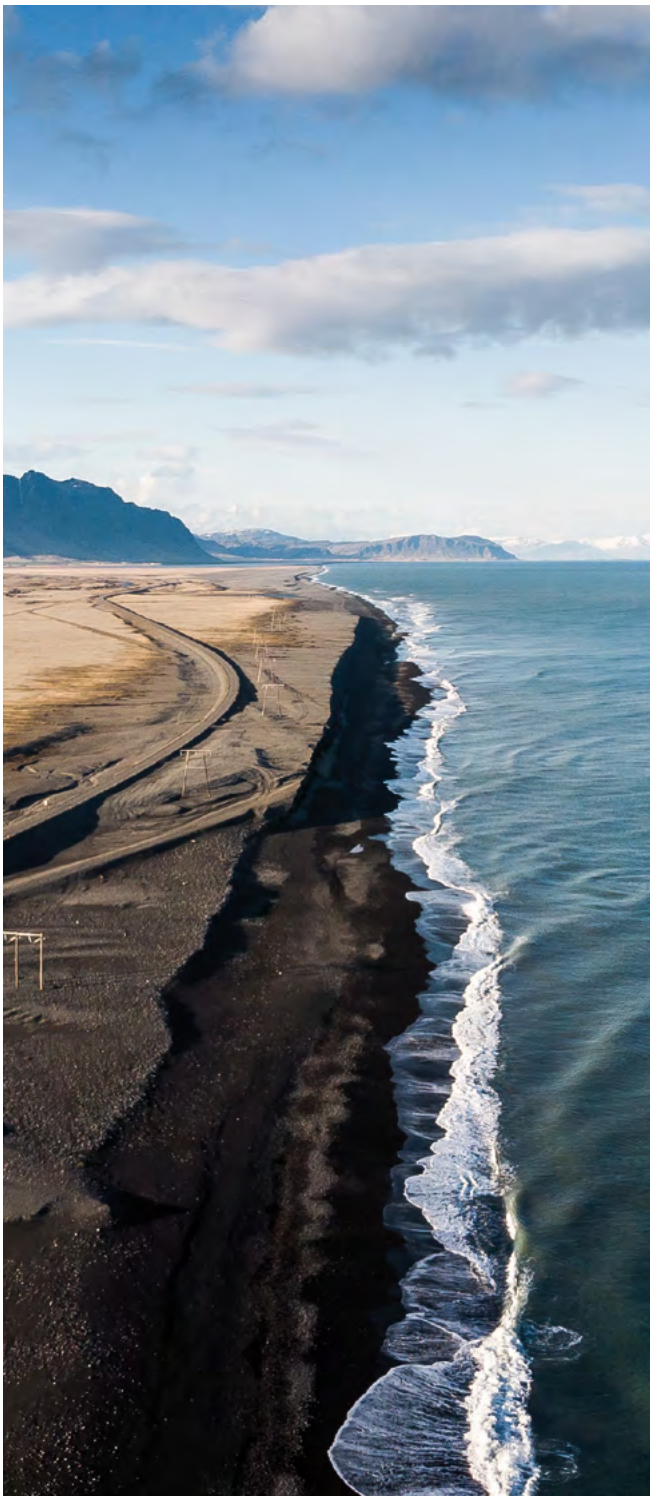
BIOLOGICAL OBSERVATIONS AND RECORDINGS

A popular task citizens can do to contribute to science projects is to record their observations (e.g. of species occurrence) in the wild, with no specific objective or indication, and upload them on platforms such as iNaturalist. After validation, the data are made accessible through infrastructures like the Global Biodiversity Information Facility (GBIF) in particular for researchers who can benefit from large datasets and coverage.

Volunteers can support scientists to record observations within a specific scheme, e.g. related to specific species, locations or timeframes (e.g. Reef Life Survey[12] in which trained SCUBA divers undertake underwater surveys of reef biodiversity; The Big Butterfly Count[13], one of the world's largest butterfly surveys).

Another option is to request already existing sources or data to support the research, e.g. for the Landscape Change[14] project, people were asked to retrieve old pictures of landscapes from their region and take new pictures of the current landscapes, in order to observe and monitor changes.

Depending on the complexity and the framing of the task, biological observations and recordings can be set up as mass participation censuses or long-term interest group monitoring schemes.



BIOBLITZ

A BioBlitz is an intense period of biological surveying in an attempt to record all the living species within a designated area. The aim is to discover as many species of plants, animals and fungi as possible, within a set location and over a defined time period. A BioBlitz usually comprises a mixture of wildlife experts and the wider public and is considered Citizen Science if the collected data are shared for use by scientists (Robinson et al, 2013).

Many institutions, museums, botanic gardens, etc. organise BioBlitzes each year[15] with the aim of engaging the general public in scientific activities.

12. https://reeflifesurvey.com/
13. https://www.bigbutterflycount.org/about
14. Pettibone et al, 2016
15. https://www.nhm.ac.uk/take-part/citizen-science/bioblitz.html

ONLINE CROWDSOURCING

The Oxford Dictionary indicates it "*consists in obtaining information or input into a task or project by enlisting the services of a large number of people, typically via the Internet*"[16]. Online crowdsourcing projects use the time, abilities and energies of a distributed community of volunteers.

An example of this type of Citizen Science is the Snapshot Serengeti project[17] hosted by Zooniverse, which uses citizens' time and skills to identify wildlife species from pictures taken from automatic camera traps in the Serengeti National Park.

COLLECTING SAMPLES

Scientists can also request the help of volunteers to directly collect specimens or samples on the field, whether in terrestrial or aquatic ecosystems.

Two examples are: a Canadian Citizen Science project monitoring plastic pollution in freshwater ecosystems (Forrest et al, 2019) where citizens would filter water samples possibly containing microplastics, and the Bay Area Ant Survey[18], where volunteers would collect ants and send them back to the research centre they were working with. Projects can go a step further by providing participants with testing kits, allowing them to analyse samples in the field and uploading data, rather than sending sampels off to a lab. This is for example the case in the global FreshWater Watch[19] programme.

CITIZEN EXPERIMENTS

Citizen experiments are small, controlled experiments set up by the volunteers and reported centrally. Unlike for observational studies, the volunteer must set up the experiment, look after it and report on the results. Some or all of the materials may be supplied centrally, but often the equipment needed is minimal. Some Citizen Science projects specifically ask volunteers to set up experiments, e.g. in their own gardens.

Examples include the Garden Organic 2019 Members Experiments[20], the Teabag Index project[21], or the Big Bumblebee Discovery Project[22], the BIOVEINS project (see Box #3).

16. https://www.lexico.com/en/definition/crowdsourcing
17. https://www.zooniverse.org/projects/zooniverse/snapshot-serengeti
18. https://scistarter.org/bay-area-ant-survey
19. https://freshwaterwatch.thewaterhub.org/
20. https://www.gardenorganic.org.uk/2019experiments
21. http://www.teatime4science.org/
22. Roy et al, 2016

PART II:
BENEFITS AND CHALLENGES

» A. The benefits of Citizen Science in research projects

» B. Potential challenges associated with Citizen Science

A THE BENEFITS OF CITIZEN SCIENCE IN RESEARCH PROJECTS

Citizen Science can be beneficial to both scientists and citizens, and to society at large (Hecker et al, 2019). In addition, numerous studies have shown that Citizen Science can contribute positively to biodiversity research (e.g. Amano et al, 2016; Chandler et al, 2017; McKinley et al, 2017, etc.).

We asked researchers involved in BiodivERsA-funded projects about their appreciation of Citizen Science through a survey in 2018: 51 people from 35 different projects responded in the online questionnaire (on a total of 73 projects). A vast majority of respondents positively valued Citizen Science, whether or not they had already used it in their project (see Figure 4). A presentation of the detailed results of the survey is available online[23].

The added-value and positive aspects of Citizen Science for research and researchers were also discussed during the BiodivERsA Citizen Science workshop on the 3rd of April 2019. The results of the group discussions and the answers to the survey (complemented by some readings and experts' contributions) on the perceived advantages of Citizen Science by scientists have been merged into the list below.

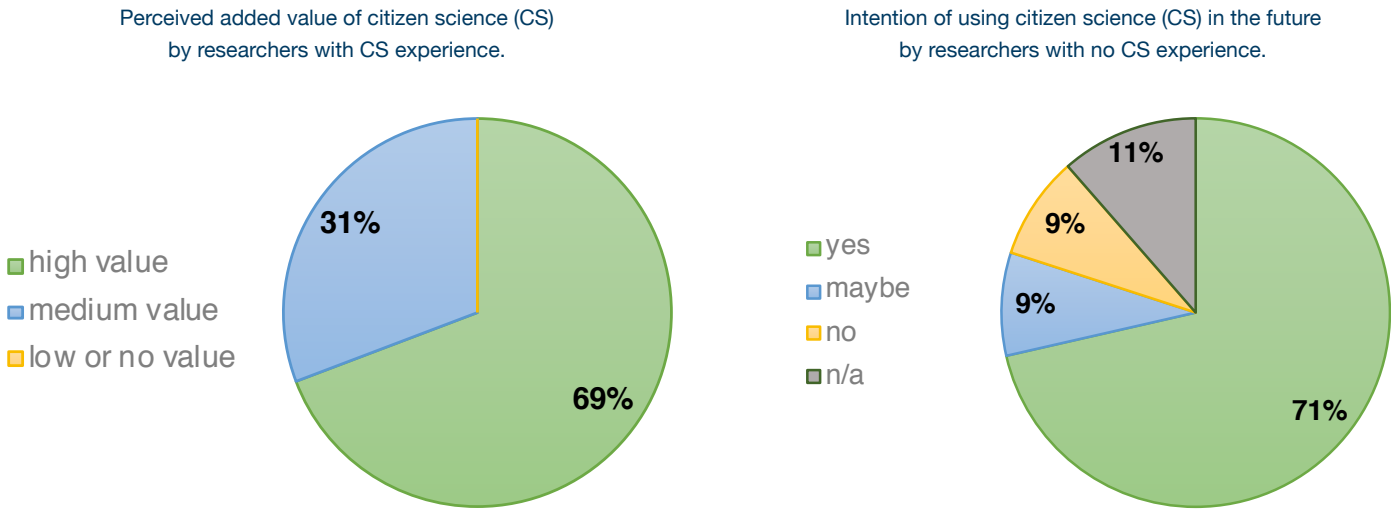


Figure 4: Pie charts showing the perceived added value of Citizen Science (CS) by researchers with CS experience (left) and the intentions of using CS in the future (right) by researchers with no CS experience. Result from a BiodivERsA survey in 2018.

23. See: http://www.biodiversa.org/1738/download

Citizen Science can…

- ***Increase and/or improve research data*** in terms of amount and spatial/temporal coverage, data richness… It allows for large scale research & large/diverse datasets otherwise unavailable and data collection in locations that are not normally accesible to researchers (e.g. private gardens).

- Enable the set-up of ***regular long-term monitoring programmes***, which are particularly relevant to study species/ecosystems dynamics and to document impact of environmental changes (which in turn, are very important for putting in place policy measures).

- ***Save time and money***: the work done by volunteers has not to be performed by the researchers themselves, hence saving projects costs (and consequently, public funds). E.g. researchers have calculated that the work done by volunteers on Zooniverse has been worth ~37 years of researcher's time (Cox et al, 2015). Within the FreshWater Watch programme, the return on investment for the lead scientists was more than 9 hours of sampling time for each hour of training (Thornhill et al, 2016).

- ***Help research to account for citizen's needs***: citizens can help formulate research questions which are based on their knowledge and needs. As such, research can become more societally relevant.

- Give access to ***new methods and distributed knowledge***, spread within the local area and shared by the community. It thus expands the scope of the researchers who can learn new techniques and methodologies, and enhances capacity-building.

- ***Bridge the gap between scientists and citizens***: with citizens involved, their trust in science is increased and a better mutual understanding between citizens and scientists is possible. This breaks down the barrier between researchers and society and increases public acceptance of research results.

- Be a powerful means for ***awareness-raising and education on environmental issues***. Engaging citizens in environmental/biodiversity research projects leads to a greater awareness on the current state of the natural world. It is a way of educating people of all ages on these issues and explaining how they can change habits to reduce their impact on nature. It also helps to reconnect people with nature, which might result in better protection of biodiversity (as "*No one will protect what they don't care about; and no one will care about what they have never experienced*" by David Attenborough[24]).

- ***Involve a variety of stakeholders***: multiple external actors can be consulted and involved in the research process, giving insight into different perspectives and, in some cases, to more balanced points of view.

- Support/reinforce the ***uptake of research by practicioners and policy-makers***: research can be more impactful when using Citizen Science. Practitioners and policy-makers can take more care of research results when society is involved in science approaches, because the message is then conveyed not only by scientists but also by citizens. This creates a general increase in legitimacy, credibility and visibility of science by society.

- ***Contribute to personal development***: Citizen Science also helps researchers to open up to new types of interactions.

Not all Citizen Science projects will generate all of these benefits and projects should be designed with the target audience and desired impacts in mind to maximize their success.

Two examples retrieved from BiodivERsA-funded projects demonstrate that outcomes of Citizen Science projects can be multifold (Boxes #2 & 3).

24. https://www.goodreads.com/quotes/3243300-no-one-will-protect-what-they-don-t-care-about-and

BOX #2

CITIZEN SCIENCE TO GENERATE DATA, BUT ALSO PROMOTE AWARENESS, SENSE OF BELONGING, AND CITIZENSHIP

Highlights from a BiodivERsA project

The **UrbanGaia project** (2017-2020) capitalised on the untapped knowledge of the many existing Green-Blue Infrastructures (GBIs) in urban context. The project aimed to develop realistic indicators to evaluate, manage, and develop performant GBIs in cities (i.e. Vilnius, Leipzig, Ghent, Coimbra) and in intensively managed landscapes.

Citizen Science aspect and activities implemented:

The **MapNat** (MAPping NATure's services) **smartphone app** was developed for users (both citizens and scientific researchers) to map nature's services provided by green infrastructures, in particular:

- mapping of biking, hiking, bird watching, and picnicking spots, in urban areas and the countryside
- reporting environmental issues such as bad water quality, pests, and plants causing allergies or hay fever

Records are sent from the phones of all users to a server that collects and processes the records which are then made accessible to all users. This aims at developing strategies based on the participatory involvement of all citizens expressing their opinions with advanced IT and communication technology (preferences on the planning and management of the green and blue infrastructure). This contributes to increased knowledge on environmental services, which may influence policy and planning processes aiming at more sustainable cities. It is expected to increase participation, citizenship through self-awareness and commitment, the sense of belonging, and ultimately reinforce democracy.

Best practices: what went well?

To ensure commitment/motivation:

- Citizens need to have full access to information
- Citizens' contributions need to be considered and used
- Feedback needs to be provided
- Access to the final results by the citizens who were involved

What was challenging and which solutions were found?

A major challenge was the involvement of the "non-converted" citizens. It was not easy to reach the entire population, i.e. not only the 'activists' or the ones that regularly use urban GBIs' environmental services for their individual activities.

The aim was also to increase awareness and commitment. To this end, the young students' population, above 10 years old - namely the basic and secondary students - was focused because there are cities without universities and because researchers aimed at targeting all the urban areas.

Links:

- Contact: Antonio Dinis Fereira, CERNAS-ESAC-IPC Portugal, aferreira@esac.pt
- Project website: http://urbangaia.eu
- MapNat app: https://www.ufz.de/index.php?en=40618
- Presentation: http://www.biodiversa.org/1732/download

BOX #3

CITIZEN SCIENCE TO EDUCATE CITIZENS TO RESEARCH

Highlights from a BiodivERsA project

The main objective of the **project BIOVEINS** (2017-2020) was to provide, together with local stakeholders, the knowledge to identify the critical features of green and blue infrastructure (GBI), to guide the establishment, management and restoration of GBI, and to mitigate the effects of major urban global challenges, like habitat fragmentation, air pollution, and urban heat islands.

Citizen Science aspect and activities implemented:

Building on the lessons learned from an existing Belgian project (AIRbezen), BIOVEINS has put in place citizen science projects in 6 cities across Europe (Tartu, Poznan, Zurich, Antwerp, Paris and Lisbon). The campaign was called strawbAIRies Europe - Air quality and pollination success of plants in European cities.

The objective was to estimate the spatial distribution of (mainly traffic-related) pollution in the city by means of strawberry plants placed and treated by citizens, to collect simultaneously data on air quality and pollination. Citizens had to:

- Place pots outside a windowsill at their house, school…
- Care for the plants for 2 months (May-June 2019)
- Follow-up berry and pod production
- Collect and deliver samples (end June 2019)

Bringing citizens in contact with science was the primary objective, data collection was secondary.

Best practices: what went well?

- Win-win situation for citizens and scientists demonstrated
- Proposed method easy to understand, simple to do, not requiring too much work
- Open and frequent communication (website, Facebook, e-mail, media, info moments...), but avoiding too much communication
- If sensitive data: communication with all stakeholders (beforehand)
- Take care of communication with the press
- Foresee enough time to answer questions, personal feedback is expected

What was challenging and which solutions were found?

- Language barriers
- Attract potential collaborators
- Solution: use students

Links:

- Contact: Roeland Samson, University of Antwerp, roeland.samson@uantwerpen.be
- Project website: http://www.bioveins.eu/
- Blog: http://www.bioveins.eu/blog/strawbairies
- Presentation: http://www.biodiversa.org/1733/download

B POTENTIAL CHALLENGES ASSOCIATED WITH CITIZEN SCIENCE

Although there are many recognised advantages of using Citizen Science, there are still some barriers that prevent it from becoming a widespread and inclusive practice among the biodiversity research community (Figure 5; Table 1).

Figure 5: Citizen Science approaches have great potential but also raise many questions that need to be properly considered (credit: Designed by rawpixel.com / Freepik).

Table 1: List of potential challenges (FOR engaging with citizens or WHEN engaging with them) from the scientists' perspectives, as well as some pathways to overcome them. These have been identified through the discussions during the BiodivERsA Citizen Science workshop's roundtables and from answers to the survey conducted by BiodivERsA, complemented by a selection of relevant readings (Geoghegan et al, 2016; UKEOF, 2017, Pocock et al, 2018b).

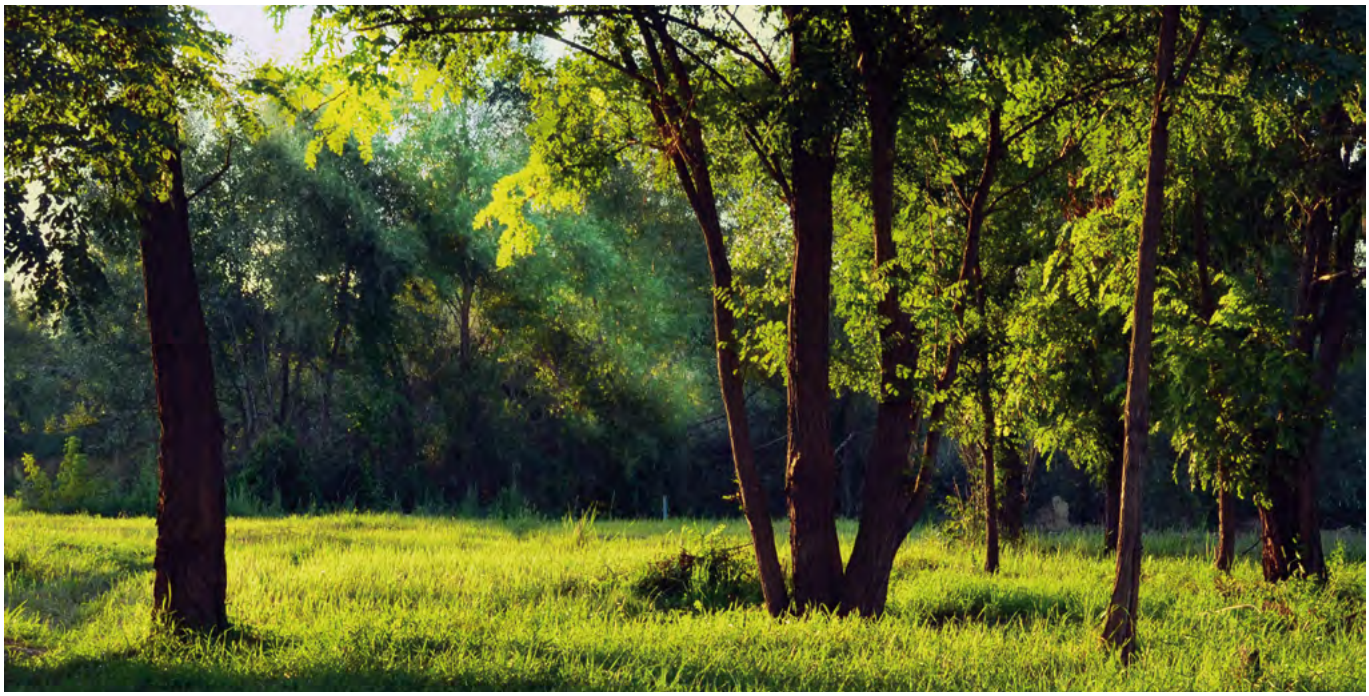
POTENTIAL CHALLENGES	WAYS TO OVERCOME THEM
1. Citizen Science approaches are not always relevant nor useful for the research • not all projects require Citizen Science methods or data (e.g. project based on modelling) • not always fit for specific taxonomic groups, research questions or scopes	• Citizen Science is not compulsory in biodiversity research projects… • …but investigate if Citizen Science could be an added-value to the project (e.g. using data of observations by citizens to complement the data produced by the researchers)
2. Citizen Science can lead to poor data quality/ reliability & scientific bias • distrust regarding data collected or generated by non-professionals • scientific bias and sampling issues related to sample size, sample coverage, lack of randomness, sampling intensity, under- or overestimation of species abundance, more observations in human-managed areas,… • for interviews: difficulty to synthetize results, to judge the reliability of the information provided,… • risk of ending up with inconsistent data • problems related to data format and availability	• use methods and protocols for data validation • ensure protocols are suitable and easy to use for the target audience, test and adjust protocols before roling out the project • run data quality control/verifications by professionals • consider mixed approaches where volunteers collect certain data, complemented with other data sources See Kosmala et al (2016) on assessing Citizen Science data quality; Aceves-Bueno et al (2017) on assessing data accuracy; Jacobs (2016) for examples.

POTENTIAL CHALLENGES	WAYS TO OVERCOME THEM
3. The skills or training of the volunteers might be insufficient • difficulty to find citizens with specific skills (e.g. divers able to dive at a certain depth of relevance to the research) • citizens may not be suited for tasks which are highly specialised and require strong scientific background • some volunteers have limited technical knowledge (e.g. correct access/use of webportal or app) • lack of time to recruit and train the volunteers	• look for volunteers through specialised associations, institutions, networks (e.g. divers' club, etc.). • Example: The Riverfly Partnership. • recruit among students • facilitate access/use of technical tools by adapting them to citizens • make time for proper training for citizens
4. It can be difficult to find volunteers • difficulty to attract potential collaborators, to make them interested in the project, and to engage them • some citizens are already occupied with other tasks • too few participants in meetings, too few respondents to questionnaires/interviews	• search for specific associations or organisations (e.g. Earthwatch) • use help of students • ask some representatives (e.g. mayors) to organise meetings and advertise local populations • repeat contacts (phone, email,…) when reaching out to potential volunteers
5. It is difficult to sustain volunteers in the long-term • continuity of the engagement (and sustainability of the project) is not always guaranteed • need to manage expectations of citizens • not easy to keep long-term motivation of volunteers	• engage amateurs or students who have an initial interest in the research topic or objective • communicate well in advance and understand volunteer's expectations • provide opportunities for progression and collaboration across the volunteer community • take care of acknowledgement, recognition, and feedback (see point 7)
6. Resources, money, time, and skills (for Citizen Science) are often lacking in research projects • Citizen Science practices require time and money investment by research, e.g. coordination of the work, communicating with citizens, training, engagement, reporting,… • need to develop and maintain websites, portals, apps,… • Citizen Science approaches require skills (e.g. mediation, facilitation, etc.) or methods (e.g. how to design interviews) that many scientists do not have • research projects do not last long enough to build a 'brand' or reputation among the volunteers (unlike projects like iNaturalist or eBird who have gained the trust of their users over time)	• be realistic about the costs of good quality Citizen Science and prepare an adequate funding plan • foresee time/resources dedicated to Citizen Science upstream, at research proposal stage • show that where money and time are spent, it is regained elsewhere in the project • mobilise skilled scientists within the research consortium and/or ensure proper training of scientists • find supplemental funding

POTENTIAL CHALLENGES	WAYS TO OVERCOME THEM
7. Citizen Science is not always acknowledged as good science • it is still not largely accepted by the scientists (e.g. it is not always considered as 'proper science') • it is not properly valued in scientific careers • belief that publications based on Citizen Science data are unreliable, less relevant, or even unpublishable • some peer reviewers might be more reserved during the peer review process • institutions and funders might be more sceptical and less inclined to support projects using Citizen Science	• support better acceptance by the scientific community, e.g. by communicating on successful projects, on the reliability of data derived from Citizen Science, etc. • funders like BiodivERsA partners are increasingly clear that Citizen Science projects are welcomed in their calls for research proposals (On the positive impact of CS in terms of scientific publications: Mallapaty, 2018; Van Vliet et al, 2014)
8. Problems of tools or language can act as barriers • language barriers (access of scientific langage to citizens; and linguistic barriers when working in different countries) • lack of a ready-to-use but reasonably customizable web-based platform to collect data from citizens • assumption that citizens have access to internet/ mobile phone and are comfortable with technology	• organise meetings and Q/A sessions between scientists and citizens, including regarding scientific terminology • allow processes to take time and drawing on additional expertise • have multiple alternative strategies for working towards the same goal • be flexible with technical aspects (e.g. accept contributions by email) • listen to volunteers and understand their needs, co-create the project where possible, involve them throughout the process
9. The Citizen Science landscape is too fragmented • the field of Citizen Science is very fragmented • no championing of Citizen Science at high level • this fragmentation can even make some scientists unaware that the datasets they use are Citizen Science data	• institutions, funders, projects, scientists, etc., should communicate on exemplary projects (this toolkit is an example!) • each project should identify a champion to communicate on the project • use the structures and networks already available (i.e. ECSA, the EU citizen science community,…)
10. Funders are having different expectations towards Citizen Science projects • because more work can be performed through Citizen Science, more outputs and results are expected from the project • funders might not be ready to provide the same funding amount if volunteers are involved in the project (as they will be expected to do part of the work for free) • funding rules may restrict capacity to fund Citizen Science organisations the researchers would like to work with • because more work can be performed through Citizen Science, more outputs/results are expected from the project	• describe clearly - at project proposal stage - how much resources are needed to include Citizen Science and how much outputs are expected to be produced (e.g. Citizen Science is not about producing the same amount of data for cheaper, but also about producing more or different knowledge with the same budget) • funders should consider the capacity to support relevant organisations • build on the growinmg body of scientific literature on the effectiveness and impact of Citizen Science

POTENTIAL CHALLENGES	WAYS TO OVERCOME THEM
11. Conflicts might arise between groups of citizens • conflicts might arise between different groups of citizens participating to the project but having different interests • citizens can be partial in reporting the data to reflect their own views or political objectives (Nature, 2015)	• use mediation/conflict resolution skills • question and understand volunteers' motives and interests • cooperating with representatives of local associations or NGOs to coordinate and mediate among the citizens
12. The outcomes of Citizen Science beyond production of data/information should be given increased recognition • some scientists and some funders may forget that the added value of Citizen Science goes beyond the production of data/information: raising awareness, educating citizens to science, developing the sense of a place, etc. is a very important aspect	• discuss in advance in the research consortium about the manifold expected outcomes of the planned Citizen Science approaches; explicit them in the research proposal • funders should recognise the multiple outcomes of Citizen Science (this is the case in, e.g., the evaluation criteria used in BiodivERsA calls)
13. There might be concerns about data privacy and safety • Issues linked with data privacy and safety may be particularly critical in Citizen Science projects	• Consider legal frameworks (e.g. GDPR regulation) and data ownership. (see Bowser et al, 2014; Eleta et al, 2019; Groom et al, 2016)

Some practical examples taken from BiodivERsA-funded projects illustrate well some of the potential challenges identified above and ways to tackle them (see Boxes #4-6).



BOX #4

THE POTENTIAL AND LIMITS OF DATA COLLECTION THROUGH CITIZEN SCIENCE RATHER THAN BY RESEARCHERS ONLY

Highlights from a BiodivERsA project

The **GreenFutureForest project's** (2016-2019) overall objective was to identify national forestry and conservation strategies that produce wood in a sustainable way. The strategies accounted for the future global demand for wood and the supply of wood in EU countries during the coming 100 years assuming different scenarios of socio-economic development.

Citizen Science aspect and activities implemented:

The project considered using Citizen Science data (from the website www.Artportalen.se where citizens upload sightings of species; also from GBIF.org) for statistical modelling and future projection of the distribution and dynamics of species instead using systematically collected data. The activities included:

- Citizen Science data download, cleaning, and preparation; systematic collection of field data in parallel
- Fit species distribution models using Citizen Science data; fit models using systematically collected data
- Formulate scenarios of future forestry and conservation
- Compare temporal projections using models based on Citizen Science data vs. models based on systematically collected data.

Best practices: what went well?

- Small differences in projected species occurrence between models based on Citizen Science data and models based on collected data
- Citizen Science data seem a suitable source of data for projecting future species occurrence

What was challenging and which solutions were found?

Citizen Science generates data with quality not always guaranteed.

Reporting frequency varies (non-randomly) through time, across space, between habitats. Reports of species presences, but hard to confirm species absences.

Solution: For specific taxa, contact professional reporters and ask for verifying that not reported species can be interpreted as absence of these species.

Links:

- Contact: Tord Snäll, Swedish University of Agricultural Sciences, tord.snall@slu.se
- Project webpage: http://www.popecol.org/research/greenfutureforest/
- Presentation: http://www.biodiversa.org/1731/download

BOX #5

CITIZEN ENGAGEMENT IN RESEARCH : THE NEED TO SPEAK A COMMON LANGAGE

Highlights from a BiodivERsA project

The **project ENABLE** (2016-2019) aimed to advance knowledge of how to design and implement green and blue infrastructure (GBI) to maximize its potential to deliver numerous social and environmental benefits, such as social inclusion, health and human wellbeing, storm water retention and habitat functions. This was achieved by developing and testing multi-method assessment frameworks, analytical tools and approaches for evaluating GBI performance.

Citizen Science aspect and activities implemented:

ENABLE heavily relied on participatory research. Two main approaches were used, i.e. interviews with citizens and workshop-based exercises (i.e. in Barcelona, Spain). This allowed public engagement, iterative study design, research question definition, knowledge integration, along with evaluation, validation, and co-development of policy options. In particular, the objectives were:

- determining priority areas for green infrastructure
- determining demands for ecosystem services
- determining spatial ecosystem services deficiencies

Best practices: what went well?

Two primary tracks with regards to citizen science were followed:

- knowledge co-creation, starting with the problem definition
- knowledge translation (to make sure knowledge is actionable and packaged to fit with the intended target process/discourse)

What was challenging and which solutions were found?

It was particularly challenging to find a common language (and other tools) for constructively taking discussions forward.

Solution: allow the processes to take time, draw on additional expertise, have multiple alternative strategies for working towards the same goal...

Links:

- Contact: Erik Andersson, Stockholm Resilience Centre, erik.andersson@su.se & Johannes Langemeyer, UAB, Johannes.Langemeyer@uab.cat
- Project website: https://www.researchgate.net/project/ENABLE
- Presentation: http://www.biodiversa.org/1734/download

BOX #6

THE POTENTIAL AND DIFFICULTIES OF MOBILIZING TARGETED GROUPS OF CITIZENS

Highlights from a BiodivERsA project

The MARFOR project (2017-2019) aimed to understand past and predict future consequences of global change for biodiversity of marine forests, by the geographical distribution of functional traits, genetic biodiversity and connectivity, and their consequences for stakeholders linked to blue-green ecosystem infrastructures formed by marine forests along European coastlines.

Citizen Science aspect and activities implemented:

The project had a dedicated task on Citizen Science to contribute to the building of a database of distribution records (over space and time) of seaweed, seagrass, corals, sponges and other forest-forming species, initiating continuous monitoring of the distribution of NE Atlantic marine forests. The citizens here were volunteer divers able to go as deep as 50-60m. Citizen Science activities included:

- recordings of spatial and temporal data on NE Atlantic marine forests
- localisation of deep populations of macroalgae species (Laminaria digitata)

These recordings could be provided through different sources: pictures taken during dives, references in literature, specimens from herbariums, etc.

The main outcome is a worldwide database and worldwide maps with distribution records.

Best practices: what went well?

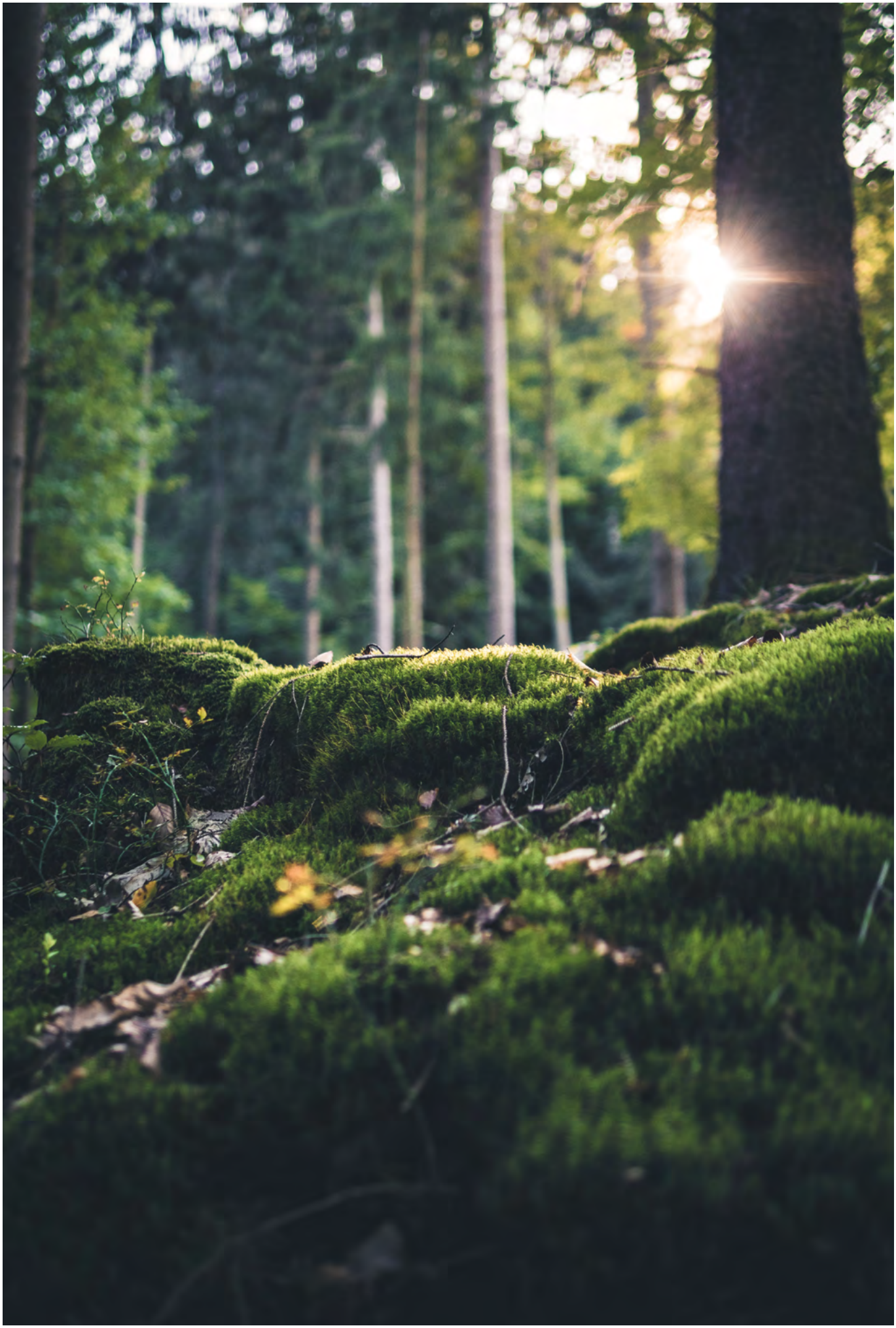
- As of 9 July 2019, there were 6,060 records (with pictures) of 629 species by 287 volunteers
- Errors and bias: less were found in Citizen Science data than in scientific data
- Records were obtained in areas where nothing was known
- Allowed awareness-raising & interest of volunteers for the research project

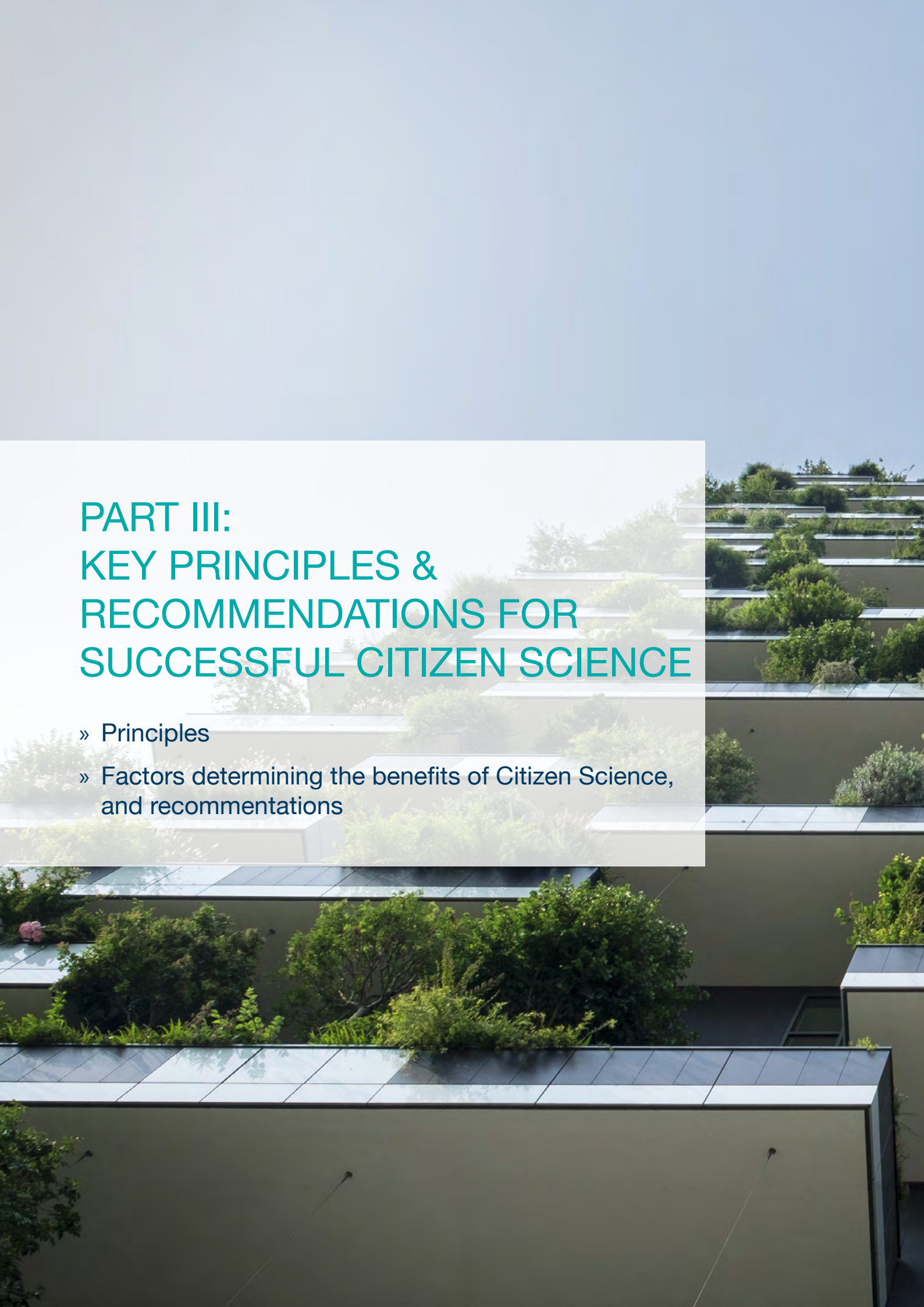
What was challenging and which solutions were found?

- Access to the site (some people did not like to have to get a login and password)
- Solution: accept contributions by e-mail
- Finding people able to dive to 50-60 m depth
- Solution: contact diving clubs or - much better - directly known divers

Links:

- Contact: Ester Serrao, CCMAR, Portugal, eserrao@ualg.pt
- Project websites: marfor.eu and www.marineforests.com
- Presentation: http://www.biodiversa.org/1730/download





PART III: KEY PRINCIPLES & RECOMMENDATIONS FOR SUCCESSFUL CITIZEN SCIENCE

» Principles

» Factors determining the benefits of Citizen Science, and recommentations

A PRINCIPLES

The European Citizen Science Association, ECSA, has established ten key principles of Citizen Science (ECSA, 2015a) that underlie good practice in Citizen Science (see Box #7) which have been widely recognised and taken up by many organisations and professionals. Applying these might help to overcome some of the potential challenges identified above (see Part II Benefits and Challenges).

BOX #7

PRINCIPLES FOR SUCCESSFUL CITIZEN SCIENCE

ECSA's Ten key Principles:

1. Citizen science projects actively involve citizens in scientific endeavour that generates new knowledge or understanding.
2. Citizen science projects have a genuine science outcome.
3. Both the professional scientists and the citizen scientists benefit from taking part.
4. Citizen scientists may, if they wish, participate in multiple stages of the scientific process.
5. Citizen scientists receive feedback from the project.
6. Citizen science is considered a research approach like any other, with limitations and biases that should be considered and controlled for.
7. Citizen science project data and meta-data are made publicly available and where possible, results are published in an open access format.
8. Citizen scientists are acknowledged in project results and publications.
9. Citizen science programmes are evaluated for their scientific output, data quality, participant experience and wider societal or policy impact.
10. The leaders of citizen science projects take into consideration legal and ethical issues surrounding co-pyright, intellectual property, data sharing agreements, confidentiality, attribution, and the environmental impact of any activities.

Other relevant key principles summarised from existing publications include:

1. Consider the Citizen Science aspect at **project inception**: consider IF and WHICH citizen science approach could fit (Citizen Science is not always possible or relevant).
   - For a checklist of questions to consider from beginning to end of project, see Pettibone et al, 2016.
2. To ensure the success of a Citizen Science project, volunteers should be **well trained** and clear **methods and protocols** should be developed.
   - Quality of datasets produced by volunteers can be very high, provided adapted methods and protocols are used (Kosmala et al, 2016).
3. **Data management** is central to Citizen Science, especially if dealing with open data practices.
   - See DataONE's Data Management Guide (Wiggins et al, 2013)
   - For data analysis examples, see Hill et al, 2011; van Strien et al, 2013
   - On the openness of Citizen Science data, see Groom et al, 2016
4. **Communications** with volunteers and **feedback** on the project are essential.

For a list of questions to ask regarding communications & ideas on how to promote good feedback/acknowledge citizens' work, see Pettibone et al, 2016.

5. **Ethical and legal aspects** should be considered when working with citizens and Citizen Science data.
   - For a detailed exploration of these questions, see Resnik, 2019.

B FACTORS DETERMINING THE BENEFITS OF CITIZEN SCIENCE, AND RECOMMENDATIONS

Although there are many potential benefits of using Citizen Science, whether they are realised depends on a number of factors related to the study design and its execution. Below we provide an overview of the key factors that should be considered when planning for Citizen Science approaches.

DEFINE AND UNDERSTAND THE VOLUNTEERS/CITIZENS

- Who are they?
- Why would they want to get involved?
- How will you reach, recruit, and retain them?
- Does the task you want them to undertake fit their motivations?

DATA QUALITY

- What quality is needed?
- What knowledge and training will participants need? Does this fit the volunteer profile you are aiming for?
- Building data checks into the system

PRACTICAL CONSIDERATIONS

- Is the time commitment needed to set-up a Citizen Science system, recruit and train volunteers etc. worth the return you are likely to get?
- Do you have the resources for marketing, communication and volunteer support needed to run a succesful project?
- Partner with experienced Citizen Science organisations
- What are the ethical implications?

In addition, the guide of the Natural History Museum of London (Tweddle et al, 2012) proposes a flowchart of different steps to follow when setting up a Citizen Science project (see Figure 6).

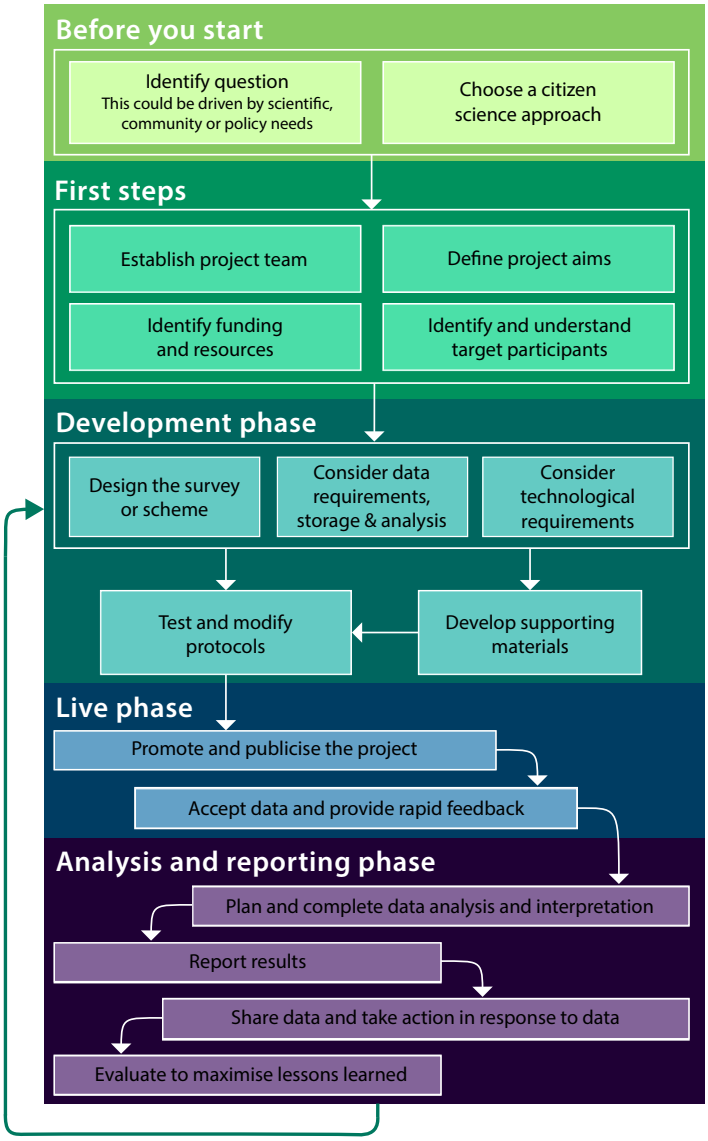
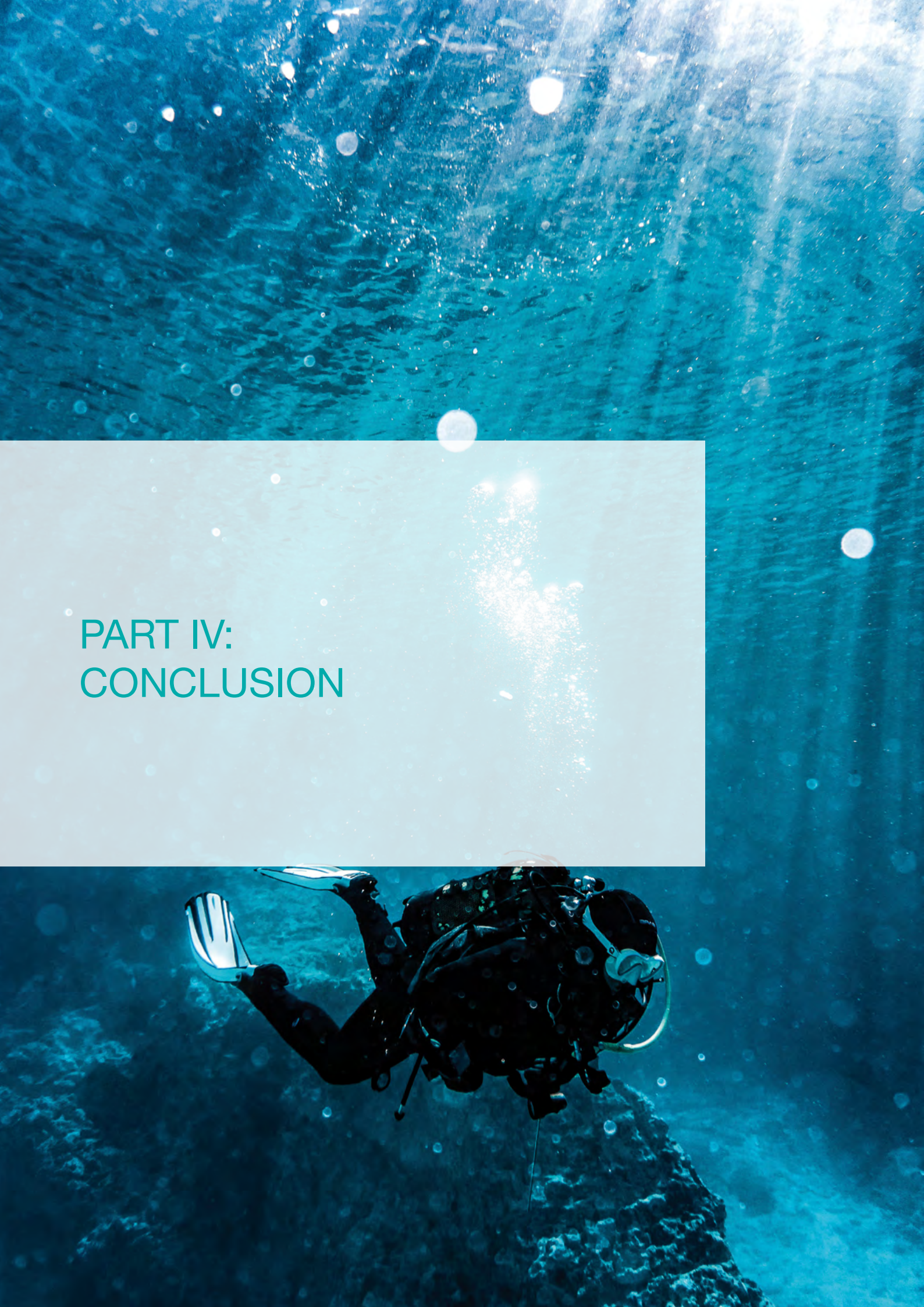


Figure 6: Proposed method for developing, implementing and evaluating a citizen science project (after: figure by the UK Centre for Ecology & Hydrology, see Tweddle et al, 2012).

Finally, Van Noordwijk et al. (2020) analyses the link between different forms of Citizen Science (see typology under I.d What are the different types of Citizen Science projects?), their environmental impact, and how the projects should look like to be successful, and proposes six pathways to achieve maximum environmental impact.



PART IV: CONCLUSION

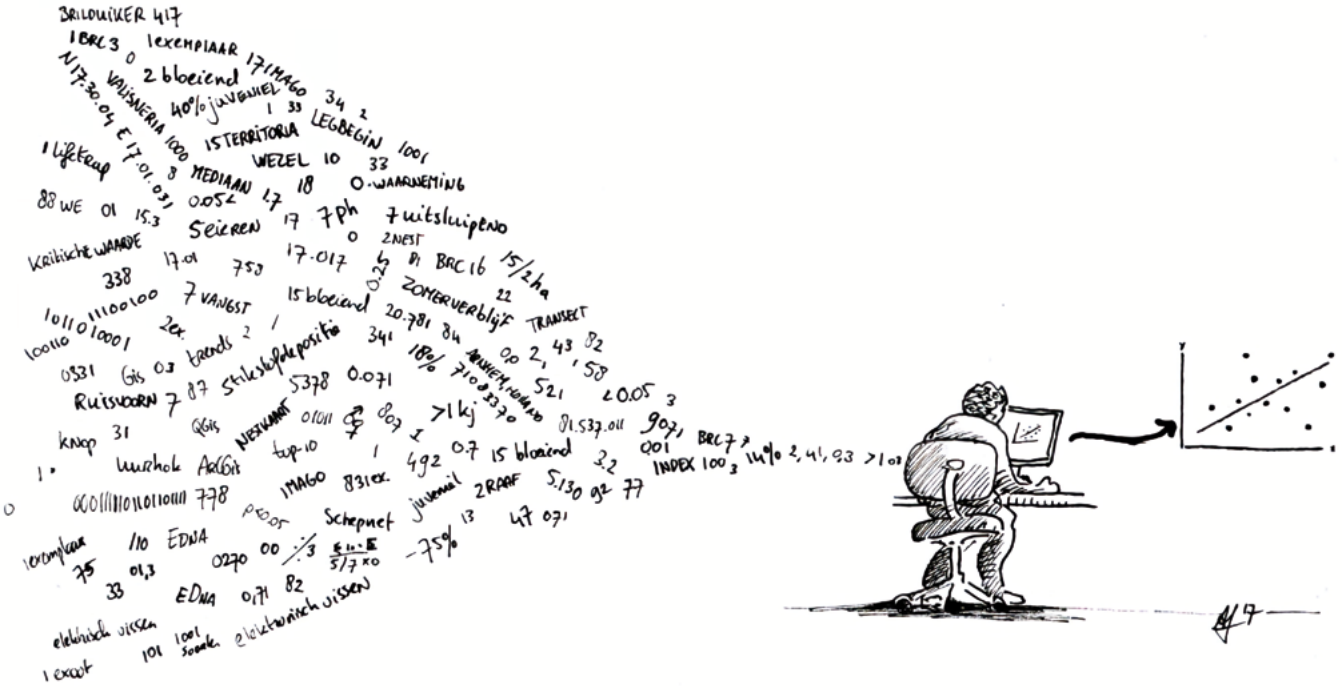
Citizen Science has increased and developed rapidly in the last decades and its range of activities and approaches have largely expanded beyond data collection. Citizen Science does not refer to a single method or concept, but covers an array of different possibilities and opportunities.

Citizen Science should be considered as a tool, which may be the main tool to use in some projects or one tool amongst others, either for data collection or analysis, but also for the engagement of citizens as stakeholders.

To make sure that the Citizen Science activities and the collaboration with citizens are sucessful, the selection and development of the format and type of approaches should match the project's objectives and design.

As shown throughout this toolkit, the number of available resources to develop and implement a Citizen Science project is very high, but research projects can build on existing insights and, where possible, **partner with experienced practitioners, to avoid some of the common pitfalls**.

Now, we wish you good luck for your Citizen Science projects and collaborations !



Credit: Albert De Jong

BIBLIOGRAPHY & RESOURCES

ABOUT THIS CHAPTER

This list contains only a selection of the resources: a bibliography for the publications cited in the text and a selection of essential resources and tools.

For a full list of references and resources, see: http://www.biodiversa.org/1770.

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B INFORMATION HUBS & NETWORK ORGANISATIONS

Websites that contain a wide array of information (publications, tools, resources, news, events,…) on Citizen Science and that allows for connecting and networking with the right people.

The **Austrian Center for Citizen Science** serves as a service and information centre to, among others, supports scientists and practitioners in the development and implementation of Citizen Science projects. https://www.zentrumfuercitizenscience.at/

The **Doing It Together Science** - DITOs - project (ended in 2019) organised many innovative events across Europe focusing on the active involvement of citizens in Citizen Science. http://togetherscience.eu

The **Citizen Science Association** (USA) aims to bring together the expertise of practitioners working in this field, in order to share the breadth of resources and best practices across different Citizen Science project types. https://www.citizenscience.org

EarthWatch Europe is an independent research organisation and leader in Citizen Science. It has developed a range of citizen science methods, platforms and tools including on freshwater quality, biodiversity monitoring, soil health, and ecosystem services provided by trees. Earthwatch continues to advance the science of citizen science and engages diverse audiences, including schools, teachers and the business community, in environmental research. https://earthwatch.org.uk/

EU-Citizen.Science is an online platform for sharing knowledge, tools, training and resources for Citizen Science. On the platform, you will find resources, projects, a training section, an events' calendar, and community forums. https://eu-citizen.science

The **European Citizen Science Association** - ECSA - is a non-profit association set up to encourage the growth of the Citizen Science movement in Europe, by initiating Citizen Science projects and performing research on Citizen Science. https://ecsa.citizen-science.net/

The **GEWISS - Bürger schaffen Wissen** online platform gathers information on Citizen Science (in German). https://www.buergerschaffenwissen.de/en

The **MICS project** (coordinated by EarthWatch Europe) has the objective to develop an integrated platform of metrics and instruments to measure the costs and benefits of citizen science by considering its impacts on society, governance, the economy, the environment, and science. https://www.mics.tools

The **National Biodiversity Network** (UK) provides a list of tools, resources and publications for Citizen Science. https://nbn.org.uk/tools-and-resources/

Science ensemble is a webportal from the Sorbonne University and the French Museum of Natural History. Its objective is to communicate on Citizen Science research projects and to encourage the general public to contribute to it. https://www.science-ensemble.org

The **Sciences Citoyennes** (France) association works on democratic and civil appropriation of science in order to put it at the service of the common good. https://sciencescitoyennes.org/

The **UK Environmental Observation Framework** - UK-EOF - has a Citizen Science Working Group as well as a list of Citizen Science resources. http://www.ukeof.org.uk

C TOOLS FOR SETTING UP AND MANAGING CITIZEN SCIENCE PROJECTS

Online tools and platforms to support the technical development of Citizen Science projects.

BioCollect is a free tool developed by the Atlas of Living Australia (ALA) to support the needs of researchers and citizen scientists by providing form-based structured data collection for surveys and projects. https://www.ala.org.au/biocollect/

The **Citizen Science Alliance** is a collaboration of scientists, software developers and educators who develop and manage internet-based citizen science projects in order to further science and to involve the public in academic research. https://www.citizenscienceralliance.org

CitSci.org supports research projects by providing tools and resources allowing to customize the entire research process from creating new projects, and analyzing collected data, to gathering participants' feedback. https://www.citsci.org

CyberTracker is a tool to create smartphone apps for field data collection and data visualisation, free of charge. It is being used worldwide by indigenous communities, in protected areas, scientific research, citizen science, etc. http://www.cybertracker.org

Free online course «Introduction to Citizen Science & Scientific Crowdsourcing» conducted by researchers from the Extreme Citizen Science Group (ExCiteS) at University College London. https://extendstore.ucl.ac.uk/product?catalog=UCLXICSSCJan17

The **Mobile Collective** enables and supports the collaborative development of innovative technology-based solutions by bringing the mobile developer & designer communities together with professional scientists and educators in ThinkCamp events. It is a payable service. https://mobilecollective.wordpress.com/

Natural Apptitude specialise in making bespoke, user-focused data collection apps & websites for environmental and socially focused projects. It is a payable service. http://naturelocator.org/

NBN Record Cleaner is a free software tool to help people improve the quality of their wildlife records and databases. (only works on Microsoft). Download + user's guide: https://nbn.org.uk/tools-and-resources/nbn-toolbox/nbn-record-cleaner/

Pybossa is a freely accessible crowdsourcing framework for the development of platforms and data collection of online projects in which volunteers can take part. https://pybossa.com/

SciStarter is an online tool to promote and manage citizen science projects and find and engage participants (all fields). https://scistarter.com

Scratchpads are websites for uploading taxonomic information and species distribution maps, and setting up blogs and forums. They are perfect for making online atlases for recording schemes or citizen science projects, building a bibliographic database, or creating a reference collection of images and observations. http://scratchpads.eu/

SENSR is a web-based visual environment where people who want to collect and explore small set of data can build an iPhone application as a data collection tool. Free of charge. http://www.sensr.org/

SPOTTERON provides fully customizable apps for documenting localised and specific sightings in the context of citizen science, environmental protection and volunteer monitoring projects. It is a payable service. https://www.spotteron.net

Wildlife Sightings is a platform for the creation of Citizen Science projects (involving novices & experts) in the field of wild animal watching. http://www.wildlife-sightings.net/

Zooniverse is a citizen science web platform owned and operated by the Citizen Science Alliance. Professional researchers can build their citizen science projects online and request the help of hundreds of thousands of volunteers across the world to analyse and interpret large datasets (e.g study/identify faraway galaxies, historical records and diaries, or videos of animals in their natural habitats,…). https://www.zooniverse.org/

D PLATFORMS & DATA REPOSITORIES

Online platforms for hosting, managing, and sharing observations & repositories of datasets.

Artportalen (the Swedish Species Observation System) is a website for reporting and retrieving information on observations of Sweden's plants, animals and fungi. Datasets are published on GBIF. https://www.artportalen.se

The **DoeDat**-platform, managed by the Meise Botanical Garden, gives the opportunity to volunteers to help deciphering and unlocking information about their collections. https://www.doedat.be/institution/index/7405

eBird: managed by the Cornell Lab of Ornithology, this biodiversity-related citizen science project/database receives more than 100 million bird sightings each year. eBird data document bird distribution, abundance, habitat use, and trends through checklist data collected within a simple, scientific framework. Datasets are uploaded on GBIF. https://ebird.org/

FreshWater Watch is a global platform for water quality monitoring. It uses a well established methodology and easy to use app to generate reliable and robust measurements of phosphate and nitrate concentrations, turbidity and other water quality parameters. Parameters can be easily adjusted to the research quation at hand. https://freshwaterwatch.thewaterhub.org/

GBIF - the Global Biodiversity Information Facility - is an international network and research infrastructure aimed at making scientific data on biodiversity available to anyone, and accessible and searchable through a single portal. The datasets are provided by many institutions from around the world, including from Citizen Science projects (e.g. iNaturalist, eBird, Artportalen,…). www.gbif.org

iNaturalist: probably the most popular mobile app and website interface (750,000 users) to record and share observations of fauna, flora, and fungi all over the world. Research-grade observations, which are validated by the community, are being uploaded on a regular basis to GBIF. iNaturalist is a joint initiative by the California Academy of Sciences and the National Geographic Society. https://www.inaturalist.org/

iRecord is a UK website for managing and sharing wildlife observations. It was created to make it easier for wildlife sightings to be collated, checked by experts and made available to support research and decision-making at local and national levels. https://www.brc.ac.uk/irecord/

iSpot is a Citizen Science platform run by The Open University to help anyone learn about and engage with nature. It has grown into a database of over 1.5 million photos with hundreds of thousands observations of species from a wide range of taxonomic groups. https://www.ispotnature.org

Project Noah is a global Citizen Science platform to discover, share, and identify wildlife (+827,000 wildlife sightings as of July 2019). https://www.projectnoah.org

Reef Life Survey is a non-profit Citizen Science program in which trained SCUBA divers undertake standardised underwater visual surveys of reef biodiversity on rocky and coral reefs around the world. https://reeflifesurvey.com/

The **Registry of Research Data Repositories** is a global registry of research data repositories that covers research data repositories from different academic disciplines. https://www.re3data.org

E INVENTORIES AND DATABASES

Searchable inventories and databases to find and discover Citizen Science projects or programmes.

Australian Citizen Science Project Finder, developed in partnership with the Atlas of Living Australia (ALA), which includes mostly Citizen Science projects in Australia. https://biocollect.ala.org.au/acsa

CitSci-X - Citizen Science Project Explorer: inventory of citizen science projects (~ 500 projects) relevant for environmental policy, developed by the European Commission. It is planned to be updated regularly. https://ec-jrc.github.io/citsci-explorer/

The **EuMon database** of biodiversity monitoring programmes (approx. 649 schemes) involving volunteers. http://eumon.ckff.si/monitoring/index.php?sort_field=time_id&sort_dir=desc

The **Federal Crowdsourcing and Citizen Science Catalog** (~ 440 projects) is a US government-wide listing of citizen science and crowdsourcing projects by agency. https://www.citizenscience.gov/catalog/#

A **Global Citizen Science Database** was built for the purpose of a research study in 2017 (Chandler et al, 2017: SPM table A2). It claimed to be (at the time) the largest and most comprehensive database of its kind (~ 420 programmes representing ~ 3600 projects)

SciStarter's searchable list of 1,500+ citizen science projects: https://scistarter.com/finder

A **Web-based Biodiversity Citizen Science Database** (~ 390 projects) was developed by (see Theobald et al, 2015: SPM1).

RESULTS OF THE 2018 CITIZEN SCIENCE SURVEY

To access the detailed results of the 2018 Citizen Science survey to BiodivERsA scientists, please visit: http://www.biodiversa.org/1738/download

The BiodivERsA Partners

French Foundation for Research on Biodiversity, FRANCE (coordinator)

Austrian Science Fund, AUSTRIA

Belgian Science Policy Office, BELGIUM

The Fund for Scientific Research – Wallonia, BELGIUM

The Research Foundation - Flanders, BELGIUM

National Science Fund Bulgaria, BULGARIA

Ministry of the Environment, CZECH REPUBLIC

Innovation Fund, DENMARK,

Ministry of Environment and Food, DENMARK,

Estonian Research Council, ESTONIA

Academy of Finland, FINLAND

French National Research Agency, FRANCE

French ministry of Ecological and Solidarity Transition, FRANCE

French Ministry for Higher Education, Research and Innovation, FRANCE

New Caledonian Economic Development Agency, FRANCE

Guadeloupe Region, FRANCE

French Guyana Region, FRANCE

Reunion Region, FRANCE

Project Management Agency of the German Aerospace Center, on behalf of the German Federal Ministry of Education and Research, GERMANY

German Research Foundation, GERMANY

Ministry of Agriculture, HUNGARY

The Irish Environmental Protection Agency, IRELAND

Ministry of Environmental Protection, ISRAEL

Latvian Ministry of Environmental Protection and Regional Development, LATVIA

Research Council of Lithuania, LITHUANIA

Research Council of Norway, NORWAY

National Science Centre, POLAND

Portuguese national funding agency for science, research and technology, PORTUGAL

Regional Fund for Science and Technology, Azores, PORTUGAL

The Executive Agency for Higher Education, Research, Development and Innovation Funding, ROMANIA

Slovak Academy of Sciences, SLOVAKIA

Spanish State Research Agency, SPAIN

Regional Government of the Canary Islands, SPAIN

Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning, SWEDEN

Swedish Environmental Protection Agency, SWEDEN

Swiss National Science Foundation, SWITZERLAND

The Netherlands Organisation for Scientific Research, NETHERLANDS

Ministry of Food, Agriculture and Livestock, TURKEY

Joint Nature Conservation Committee, UNITED KINGDOM

Reading this guide you will…

Get a better overview and understanding of what Citizen Science is.

Figure out all the benefits of adopting Citizen Science approaches.

Have access to a list of the most relevant publications and most useful tools for Citzen Science.

Find out how to overcome the most common perceived challenges.

Discover many examples of Citizen Science projects and testimonies from researchers.

…and much more!

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