Item number	Title/reference *(academic style) name initials (year) title, publisher, volume, pages*	Name of reviewer
21	Rambonnet, L., Vink, S.C., Land-Zandstra, A.M. and Bosker, T., 2019. Making citizen science count: Best practices and challenges of citizen science projects on plastics in aquatic environments. Marine pollution bulletin, 145, pp.271-277.	Tobias Elies, BUPNET

Review of findings / main outcome

This paper focuses on the role of citizen science in studying and managing plastic pollution in aquatic environments. The authors provide an overview of best practices and challenges associated with citizen science projects, highlighting the potential for citizen science to contribute to environmental research and management.

Citizen science involves non-professional scientists participating in scientific research through data collection and analysis. Citizen science projects provide an opportunity to engage local communities in environmental research, foster environmental stewardship, and fill gaps in data collection and analysis. Citizen science has the potential to complement and enhance the work of professional scientists, providing a way to scale up research efforts, collect data over larger areas, and engage a diverse range of stakeholders.

The authors of the article provide several best practices for designing and implementing citizen science projects focused on plastic pollution in aquatic environments. Engaging local communities in project design and implementation is crucial for ensuring project success and sustainability. This involves identifying local needs, interests, and capacities, as well as involving community members in data collection and analysis. Providing training and support for citizen scientists is also essential, as it helps to ensure the quality and consistency of data collection. Standardized protocols for data collection and analysis can also help to ensure the quality and comparability of data across different projects and regions.

The authors also highlight **the importance of effective communication and engagement with stakeholders** in the management of plastic pollution. This includes sharing project results with the public, policymakers, and other stakeholders, as well as involving them in decision-making processes. Effective communication and engagement can help to build trust, enhance understanding of the issues, and promote more effective and sustainable management of plastic pollution.

However, **citizen science projects also face several challenges**. **Data quality is a key issue**, as non-professional scientists may not have the same level of training or experience as professional scientists. To address this, the **authors recommend careful project design**, including **the use of standardized protocols and quality control measures**. Ongoing monitoring and evaluation of data quality is also important, as it helps to identify and address issues as they arise.

Another challenge is the potential for bias or incomplete data collection. Citizen science projects may not capture all relevant data or may over-represent certain types of data, which can affect the accuracy and reliability of results. To address this, the authors recommend involving professional scientists in project design and implementation, as well as ensuring that data collection is comprehensive and inclusive.

The article provides several case studies of citizen science projects focused on plastic pollution in aquatic environments. These case studies demonstrate the potential for citizen science to generate high-quality data and engage local communities in environmental research and management. For

example, the authors describe a project in the Netherlands where citizen scientists monitored plastic pollution in the North Sea. The project engaged a diverse range of stakeholders, including fishermen, beachcombers, and recreational divers, and generated valuable data on the distribution and abundance of plastic pollution in the area.

Overall, the article highlights the potential of citizen science to contribute to the study and management of plastic pollution in aquatic environments. By engaging local communities in research and management efforts, citizen science projects can help to build capacity, foster environmental stewardship, and promote more effective and sustainable solutions to plastic pollution.

However, addressing the challenges associated with citizen science projects, such as data quality and bias, requires careful project design, ongoing monitoring and evaluation, and effective communication and engagement with stakeholders.

Quotes / very useful statements

"Researchers are becoming more aware that citizen science is not only about science but also about society and politics" (Crain et al., 2014; Dickinson et al., 2010)

"Because citizen science projects are not only about science but also about society and politics, including multiple disciplines in a project team is important in order to handle all the aspects of a citizen science project" (McKinley et al., 2017).

Advice 1. Specify the goal of the project: is the emphasis on robust and reliable science, engaging the public or both.

Advice 2. Consider whether one of the outcomes of the project is to inform policymakers, and if so, include experts on governance and legislative issues in the design phase.

Advice 3. Depending on the goal of the project, set-up an interdisciplinary team of collaborators who can give advice on different aspects of the project during the design phase.

Advice 4. Include a communication expert and data expert in the team. Regardless, make sure to have a well-developed communication and data plan.

Advice 5. Develop a sampling protocol which meets the goals of the project and the background of the volunteers and test these protocols in a pilot study.

Advice 6. Keep attention spans of volunteers in mind when determining sampling duration.

Advice 7. Use digital tools for recording and submitting data to increase efficiency and value of datasets.

Advice 8. Include quality assurance and quality control in protocols.

Advice 9. If comparing and combining with other (citizen science) data sets is important, make sure to collect data and metadata according to existing protocols.

Advice 10. When one of the goals of the project is to impact policy or society, make sure communication about project outcomes is geared towards different stakeholders, such as the general public and policymakers. Volunteers can play an important role in dissemination towards these stakeholders.

Advice 11. Engaging with and acknowledging volunteers helps to keep them motivated and retain them.

Advice 12. Scientists are often motivated to citizen science because they want to make a change in the world. However, realistic expectations need to be set in the project. For example, data collection can take considerable amounts of time, and project management can be a time sink.

Other useful points

Table 1
Details of the citizen science projects included in the current project, including plastic type, project name, abbreviation used in remainder of paper, sampling approach and start date.

Plastic type	Project name (location)	Abbrev.	Range[a]	Approach	Start date
Micro	A Rocha (UK)	AR	International	Beach sediment sampling	2017
	Adventure Scientists (USA)	AS	International	Water grab sampling	2013
	Florida Microplastic Awareness Project (USA)	FMAP	Regional	Coastal water sampling and filtering	2015
	Ucluelet Aquarium (Canada)	UA	Regional	Beach sediment sampling	2017
	5 Gyres (USA)	5G	International	Filtering plastics using trawls	2014
Macro	Cientificos de la Basura (Chile)	CB	National	Standardized beach litter sampling	2007
	Makroplastik Nordsee (Germany)[b]	MN	International	Wooden drifters	2016
	The Plastic Tide (UK)[c]	PT	International	Tagging litter from photos	2017
	Beachwatch & Great British Beach Clean (UK)	MCS	National	Beach clean-ups	1994
	Schone Rivieren (Netherlands)	SR	National	River bank clean-ups and monitoring	2016

[a] The range indicates the geographical range where citizen science can participate.
[b] Official project title is Macroplastics Pollution in the Southern North Sea - Sources, Pathways, and Abatement Strategies.
[c] The Plastic Tide ended in 2019 and their work continues in Ellipsis Environmental.

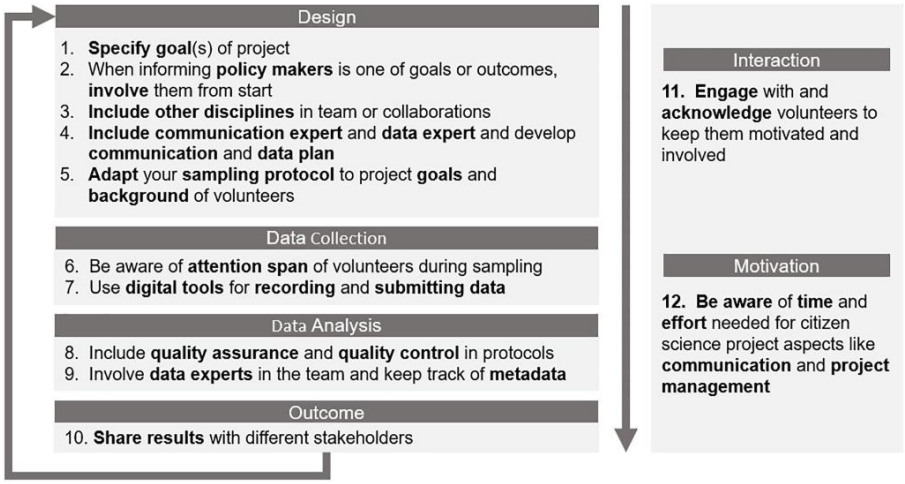

Fig. 1. Framework with recommendations for improving or developing a citizen science project.