

Uptake, explore and champion best practices of Citizen Science (CS) projects

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Abstract—*This paper focuses on knowledge co-production by sharing experiences, major outcomes, and good practices of different citizen science projects. More specifically it takes the inputs from the European Marine Days 2022 - EU4Ocean workshop on citizens Empowerment through Ocean knowledge co-production and explores the gaps and needs between Science, Policy and Citizens.*

Keywords—*citizen science, interoperability, good practices, involvement,*

INTRODUCTION

The goal of the European Maritime Day (EMD) is to offer an engaging event to catch up on the current state of play on a broad range of issues concerning the blue economy and the marine environment and discuss ways of moving forward on maritime affairs and sustainable blue economy. This year, the EMD hosted the EU4Ocean Summit that links together organisations, individuals, young people, schools and teachers to present on their efforts and commitment to the ocean and invite others to join them in their work to enhance ocean literacy throughout Europe. One specific focus of the day was on citizens Empowerment through Ocean knowledge co-production, which explored the gaps and needs between Science, Policy and Citizens. This paper presents on major outcomes and opportunities on co-production by sharing experiences, major outcomes, and good practices of different citizen science projects.

CITIZEN SCIENCE

According a recent survey the first ideas that come to mind when you're asked to think about citizen science are: people, engagement, community, teaching and knowledge.

Although it is in its new hype, citizen science is not a new topic: it is possible to date back the first citizens scientists in early 1800s with Franklin and Darwin [1]. In 2014 the term was added to the Oxford English Dictionary and nowadays we can count thousands of CS projects [1].

The official definition for Citizen Science (CS) is participatory science in which scientific work is done by ordinary people without special qualification, in order to help the work of the scientists.

CS has emerged as a powerful and popular tool to actively involve citizens in environmental monitoring and restoration, collecting extensive data sets for several purposes and European Commission is now asking for 20% of marine data to come from citizen science by 2025.

In this framework, actions to identify good practices of different citizen science projects and to scale up these good practices towards established marine data workflow are crucial, and to this end the EMD session offered the opportunity to work around some key questions to elevate the citizen scientists' activities.

The following paragraph describes some of the adoptable best practices.

CITIZEN SCIENCE PROJECTS

NAUTILOS

NAUTILOS [2] is an H2020 project funded under the Future of Seas and Oceans Flagship Initiative and it is developing a new generation of cost-effective sensors and samplers to democratize the marine environment monitoring to Citizen Science activities. More specifically NAUTILOS is developing (i) low-cost micro-near-infra-red (NIR) scanner for micro plastic classification; (ii) AI and visual based tool for underwater image tagging for classification of the seabed habitat and fauna; (iii) organizing beach/seabed cleaning (and litter tagging) and other field campaigns, together with citizen science awareness activities for students and the general public. Reaching out and setting partnerships with other CS initiatives (e.g. SeaCleaner [3]), NAUTILOS is mobilizing hundreds of citizens to proactively participate in data collection (and environmental restoration) that, thanks to

the NAUFILOS expert network, is going to be validated and hence ingested by key European Marine Data Infrastructure/Integrators (e.g. EMODnet Physics and EMODnet Chemistry, see [4] for a review). In turn the involved citizens are contributing to global coastal ocean monitoring and enriching of e.g. the European Marine Litter Registry.

Outdoor Portofino

The watersports community represents a potential fleet of sea enthusiasts, all ready to collect data for its research and conservation, acting as those multiple eyes and hands that the scientists don't have, all with a limited budget.

These volunteers may act as agents of data collection and/or as research subjects, and usually use innovative technology (e.g., participatory GIS) creating new engagement opportunities with a special focus on the coast, a place that is often excluded from research campaigns, and has a greater complexity in terms of protection. For example, monitoring coastal biodiversity allows to evaluate the state of conservation of a protected area, how non-native and invasive species are spreading and also the state of health of a vulnerable area so as to be sure to act in time.

This cannot be done without talking to coastal area stakeholders and public decision makers and in order to fill the gap and to have an intermediate mediator that can communicate to both communities, Outdoor Portofino branched out OutBe that is a platform to make this dialogue easier and direct.

Surfrider Foundation

The Surfrider Foundation is dedicated to the protection and enjoyment of the world's ocean, waves and beaches, for all people, through a powerful activist network.

Surfrider's programs [5] are: to reduce the impact of plastic in the marine environment, to defend ocean from challenges threatening the viability of the ecosystem, to ensure full and fair each access for all to enjoy, to take on issues that affect beaches and natural shorelines and to protect health and sustainability of our planet water resources.

Projects are developed back to back with education that is also targeted to policy makers who can better understand the outcome of actions up to change laws and regulations.

Divers United for the Environment

Divers United for the Environment (DUEproject) is a monitoring program based on the observations of recreational divers [6] to protect the fragile Mediterranean Sea life. DUEproject designed a citizen based system to monitor the sea when official channels are lacking of funds and manpower.

DUEproject results suggest that by implementing a widespread use of CS and environmental education programs in resorts and in travel destinations that are popular because of their natural appeal, tourists could learn about the environment in an informal way, while developing awareness toward environmental issues and retaining it in the following years. Tourism could thus become more sustainable by creating long lasting awareness, which could enhance a societal behavioral change. Furthermore, with a larger

dataset, such outcomes can be of interest to tourism stakeholders which could increase their commitment and efforts towards environmental education programs.

Fig. 1 shows how these campaigns can be used as a quality performance indicator.

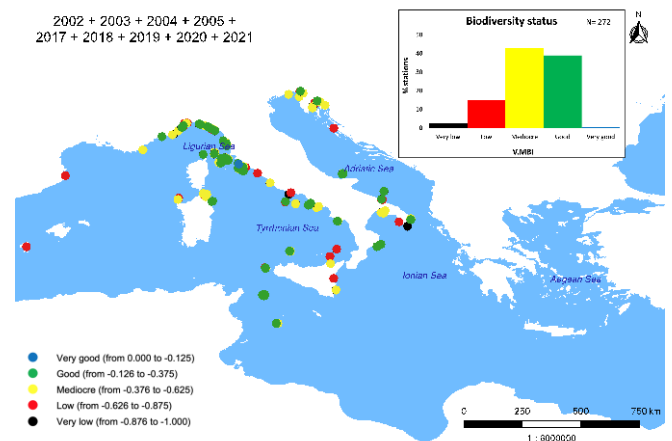


Fig. 1 DUEproject results

Lega Navale

With more than 50.000 subscribers, Lega Navale represents a further key community of volunteers ready to collect data and facilitate ocean environment restoration (litter recovery, *Posidonia oceanica* seeding etc.).

DISCUSSION

The EMD session was organized to present on some running citizen science activities and to discuss about how to elevate this massive potential to its next step and some key questions were addressed:

- why most CS datasets are not shared with marine data repositories?
- which are the scientific concerns that limiting the use of CS data?
- how to keep the momentum and participation high?
- which are the rewards and expectations of the CS on their data?
- how can we use more CS data?

The outcomes from the roundtable interaction indicated that we are reaching the tradeoff to overcome researchers' skepticism on the value of the citizen science data. Many researchers are now also active promoters and ambassadors of citizen science projects and they are contributing to elevate the quality of the produced data by having defined clear and sustainable data assessment workflows. Moreover, having intermediate aggregators that can speak to both researchers and citizens (e.g. OutBe, Surfrider Found.), having marine data platforms that are getting ready to receive these CS data (e.g. EMODnet Ingestion), the tradeoff to see a wider adoption and consumption of CS data is lowering fast. And the easier the data are aggregated (e.g. ocean physics collected by a sensors), the lower the threshold becomes.

In turn, it starts being even more crucial to keep high the momentum and the participation of the citizens in such activities. The presented experiences showed that this is a key element. Citizens have to be informed and awarded for

their active participation. They are key actors and it's important to receive report on how their data have been used, which products have been made available, to which decision-making process they contributed, which scientific results they enabled.

Events, workshops, social media are channels to be used by integrators and projects to give feedback and show the value (and cost saving) that active participation has.

PERSPECTIVE

Many Citizen Science initiatives have already imagined methods to collect marine and freshwater observations covering vast spatio-temporal scales next to and wider than conventional data collection [1] [7-8]. CS projects can be used in education, citizen environmental awareness, scientific research, and even as a call-to-action towards policy makers and the public, it happened that many Citizen Science initiatives failed to reach the success of integration, sustainability, and end-users outside their own community.

In this paper we collected some good practices that overcome these difficulties and enable the citizen science projects to start interoperating with marine data initiatives and repositories (e.g. EMODnet) and being aware of the influence of the sea on our lives, as well as the influence of our living habits on the sea.

The more abundant the data, the more accurate the environmental policies will be, especially in times of climate change and biological invasions. The more abundant the oceanographic data are, the more reliable the meteorological models will be upon which the programming of open-air activities like sports and touristic leisure activities are based (but also other activities linked to the blue economy, like fishing and transport).

CS data are produced on a voluntary base, they are open and should be freely and unrestrictedly accessible to anyone. Open data access, no restricted access to data [9] based on the FAIRness principles, enables the possibility to develop new knowledge and new CS projects that consume CS data.

But citizen science in the marine environment is not just a tool for collecting data. The active involvement of people in research and marine conservation, also supports a progressive ocean literacy, education and ambassadorship.

And the more one knows about the sea, the more public support will be invested for environmental policies and actions that protect the marine environment, often limited in their success by misinformation.

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