Citizen scientists help assure quality of coastal biodiversity monitoring

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A study conducted in the port city of Santos (Brazil) by researchers at the Federal University of São Paulo shows collaboration between civil society and academia. Credit: Institute of Marine Sciences / UNIFESP

In 2019, history student Rodrigo Gomes found out on social media about a call for volunteers to take part in a scientific project relating to the ocean and conducted by the Federal University of São Paulo's Institute of Marine Sciences (IMAR-UNIFESP) in Santos, on the coast of the state of São Paulo, Brazil. He signed up for the project, took workshops, and trained in the field. "I was very fortunate to have all that contact with professors and learned a great deal about conservation," says Gomes, now a citizen scientist. "It makes a lot of sense to go on with the project and get other people involved."

It is precisely this integration of science with citizen participation that the United Nations aims to bring about in the Decade of Ocean Science for Sustainable Development, launched in April 2021 and due to last until 2030. A practical demonstration of the positive results of the formula is embodied in the study "Participatory Monitoring—A Citizen Science Approach for Coastal Environments," in which Gomes took part.

The study was conducted with FAPESP's support under the aegis of its Public Policy Research Program (PPPP). An article on the study, showing how science and citizenship can go hand in hand, is published in *Frontiers in Marine Science*.

The outcome was the development of a methodology for integrating civil society and academia, including the creation of a protocol for monitoring coastal biodiversity to be applied collaboratively by citizens and scientists.

"In the project, we achieved practical results by monitoring the rocky shore area in Santos, and also created and validated a methodology for use in the area. Citizen science is a growing trend, and there's a lot of discussion about what it means. It's different from volunteering or collaboration by laypeople in the collection of scientific data. It involves

an exchange in which people are given technical training and think more deeply about citizenship," says Ronaldo Christofoletti, a researcher at IMAR-UNIFESP and principal investigator for the study.

The group aims to develop methodologies and promote activities that integrate ocean science and society, such as training for citizen scientists and marine conservation initiatives. The activities conducted to date include a translation into Brazilian Portuguese of the UNESCO handbook "Ocean Literacy for All: A Toolkit" (the Portuguese version is "Cultura Oceânica para Todos"), and "Maré de Ciência" ("Tide of Science"), a program that aims to foster innovative forms of interaction among the scientific community, society, and public policy.

According to biologist Paula Kasten, who was in charge of training during the project, the next step will consist of training new citizen scientists to continue the monitoring exercise on Urubuqueçaba Island and extend it to other parts of the Santos metropolitan area (Baixada Santista), including Guarujá. The island has the area's only natural rocky shore and was the research site chosen by the group. "One of the challenges is keeping the participants engaged," Kasten says.

Gomes also highlighted the difficulties of this engagement. "I realized that commitment is sometimes lacking. People complain about distancing by academia, but they don't always get involved when there are difficulties. It isn't easy to go into the field on a Sunday morning to collect data. But later you feel really fulfilled about having done it," the citizen scientist says.

'Birth' of a methodology

Five workshops were held in 2019 for 51 citizen scientists, 51% of whom were women. Most participants (62%) were 18-33 years old. They included undergraduates, biologists, geographers and professionals in

similar areas, schoolteachers, engineers, and retirees, among others.

To develop the protocol, they partnered with Bangor University's Oceanographic Institute in the United Kingdom via the project "Capturing Our Coast", which trained some 3,000 citizen scientists in 2013-18 to research marine species on rocky shores around Britain to help understand coastal biodiversity.

Support was also provided by the British Council via the UK's Newton Fund, and Brazil's National Council for Scientific and Technological Development (CNPq).

With adaptations to conditions in the Santos area, the workshops contextualized the project, promoted the group's engagement, and discussed the local community's role in participatory monitoring. They also explained theoretical concepts relating to rocky shore ecology and monitoring methods and took the volunteers out into the field to practice applying the protocol.

This entailed defining species habitats and measuring transects (demarcated shore areas for continuous monitoring and sample collection). The main organisms surveyed were mussels, oysters, barnacles and algae.

The results of the survey conducted by the citizen scientists were compared with the data collected by professional researchers. Validation testing showed that the participatory program was a reliable source of scientific data on coastal biodiversity.

The citizen scientists learned to identify species almost as well as specialists, although the researchers stress the need to adjust the protocol so as to train them to perform even more successfully, particularly with regard to identifying more complex coastal organisms.

They also proved capable of recognizing the main threats to marine biodiversity, regardless of occupation and educational background. The vast majority detected problems due to water and air pollution (98.4%); intense farming, deforestation and overfishing (96.7%); disasters caused by humans (91.9%), and climate change (62.9%).

They were interested in learning more about local marine biodiversity and the various types of conservation action available: 72% had already made efforts to protect biodiversity but wanted to do more, and 71% said they were affected by biodiversity loss.

On launching the Decade of Ocean Science for Sustainable Development, the UN urged countries to focus on appropriate management of the oceans, which cover more than 70% of the planet's surface and produce at least 50% of its oxygen.

The researchers stress that biodiversity loss is accelerating in these habitats, especially continental shelves, which provide 90% of fishery production and marine biodiversity, yet 80% of the ocean is unmapped and unexplored, according to the US National Oceanic and Atmospheric Administration (NOAA).

Another global problem is pollution, especially by plastic waste, which is increasing in line with economic and population growth. Plastic accounts for over 80% of the garbage dumped in the ocean. Much of it comes from cosmetics and other manufactured products, but secondary plastic (small pieces derived from the breakdown of larger debris) is a major problem present in all groups of organisms, from plankton up through the entire food chain.

With 8,500 km of coastline and many different ecosystems, Brazil has one of the largest marine territories in the world. Rocky shores are used as models in studies of marine biodiversity to identify ecological patterns

and processes. They are also key environments from the standpoint of monitoring and understanding responses to global warming and other threats to biodiversity.

Next steps

According to Christofoletti, next steps for the researchers include the creation of a Citizen Science Program in partnership with the City of Santos. The proposal is for citizen scientists to monitor biodiversity, climate change, microplastics, and other issues for the city.

Another initiative, to be launched by the end of this year, is training for schoolchildren and teachers to monitor the areas around schools in Santos. "The idea is for students to look for coastal species as well as the impact of climate change, for example," he says.

He is also closely involved with a City of Santos-UNIFESP project to integrate science and public policy for sustainable development (Observatório da Interface entre Ciência e Políticas Públicas para o Desenvolvimento Sustentável).

More information: Paula Kasten et al, Participatory Monitoring—A Citizen Science Approach for Coastal Environments, *Frontiers in Marine Science* (2021). DOI: 10.3389/fmars.2021.681969

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