Using citizen scientists to mitigate the environmental crisis in the marine ecosystem

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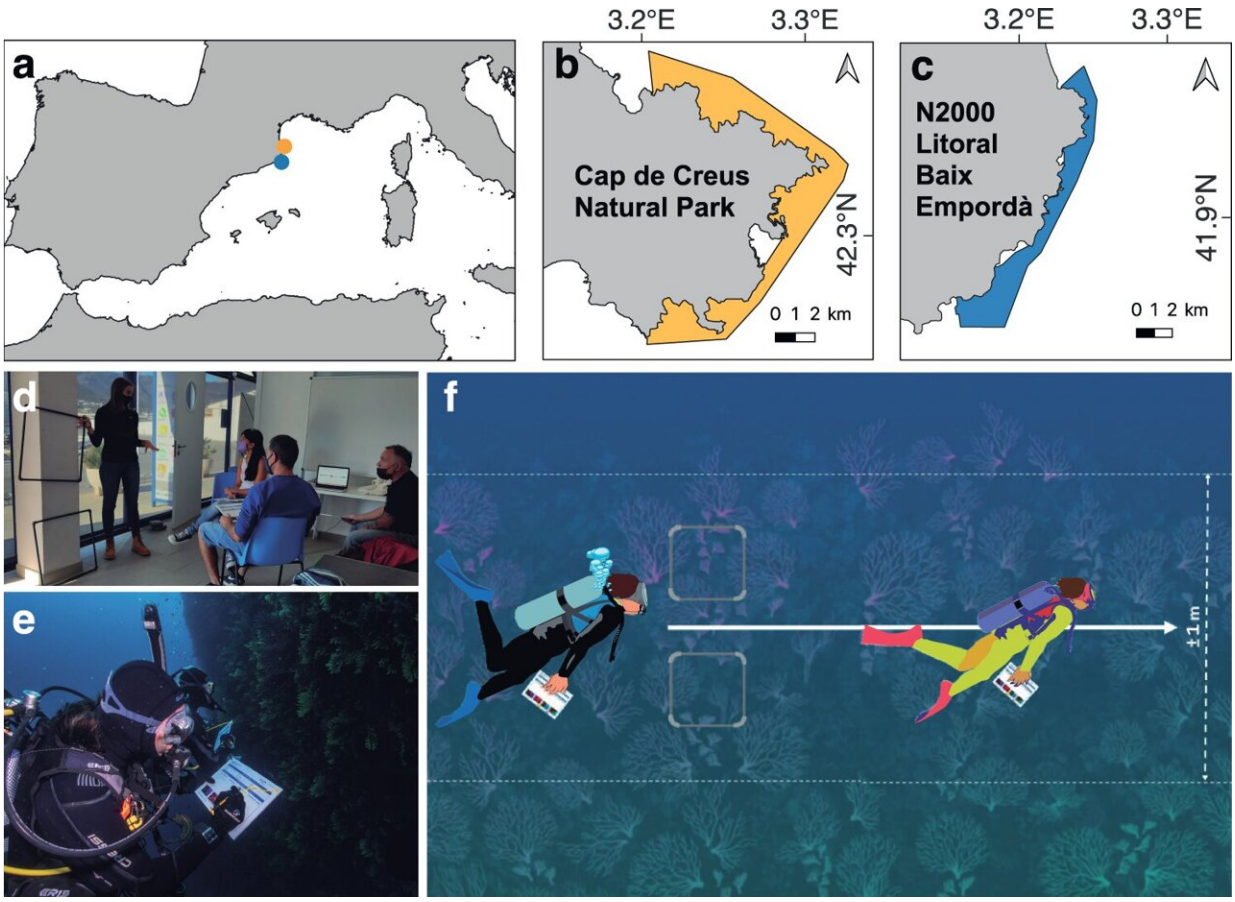

Diagram of citizen science trainings in the northwest Mediterranean (a) and specific location of the Cap de Creus Natural Park (b) and the N2000 Baix Empordà (c). Images represent a summary of the training, from the theoretical approach (d) to protocol application in the field by volunteers (e). Diagram of the sampling protocol validation with volunteers, where two marks (50 × 50 cm square) indicate the beginning of the sampling transect (f). Credit: *Environmental Management* (2023). DOI: 10.1007/s00267-023-01913-x

Citizen science can help to improve conservation and management strategies for Mediterranean marine ecosystems, and to mitigate the impact of the environmental crisis. This is the conclusion of a study by the University of Barcelona and the Institute of Marine Sciences (ICM-CSIC), which highlights the scientific rigor of the work carried out by volunteers in assessing the state of conservation of corals and gorgonians on the Mediterranean coast.

In addition, the results of the citizen science initiative also warn of the increase in the mortality of these species at many points along the Costa Brava (Girona, Spain).

The study, published in the journal *Environmental Management*, shows the improvement of the scientific quality of the data collected by the volunteers (regarding precision and accuracy).

"With only one training session, they reached values equal to those obtained by scientists," says Professor Cristina Linares, ICREA Academia professor from the UB's Faculty of Biology and the Biodiversity Research Institute of the UB (IRBio), who coordinated the research, published together with Joaquim Garrabou, from ICM-CSIC, both members of the MedRecover research group.

These results are part of Laura Figuerola-Ferrando's doctoral thesis (UB-IRBio). The article is also authored by Yanis Zentner (UB-IRBio) and Paula López-Sendino (ICM-CSIC).

Citizen science in defense of marine ecosystems

The Mediterranean coral reef, formed by the accumulation of calcareous organisms, is home to more than 1,600 marine species that have been

affected by the rise of water temperatures over the last years. This study was carried out as part of the Atenció Coralls! project, promoted by the citizen science platform Observadors del Mar, to train volunteers in the study of the distribution and ecological status of populations of octocorals and hexacorals affected by human disturbances (largely by the temperature rise).

The team compared the data obtained in the Costa Brava by the volunteers with different training levels in the application of the sampling protocol, to observe whether there as an improvement between the first and the second sampling after training.

"The data on the assessment of the state of conservation, obtained from the percentage of affected colonies, collected by volunteers who trained for two days, are comparable to the data obtained by the scientists. After only one day of training, the volunteers obtained quite remarkable results from the first sampling," notes Cristina Linares, from the UB's Department of Biology, Ecology and Environmental Sciences.

Key factors in the study are the previous training the volunteers receive and the expert validation of the data before their transfer and analysis. "The validation process by the experts is essential to guarantee the assessment of the conservation state to be consistent and reliable," says Laura Figuerola, predoctoral researcher at MedRecover.

Once the effectiveness and rigor of the volunteers' work had been validated, the researchers analyzed all the data obtained. In different areas of the north-western Mediterranean, coral and gorgonian populations are, according to the authors of the study, "getting worse and worse," as the percentage of affected colonies is going from mostly unimpacted or lightly impacted populations in the 2012/14 period, to moderately and severely impacted populations in the 2015/2019 and 2020/2022 periods.

"These results are similar to those reported in scientific articles, but in areas that had not been studied before, giving an enrichment of knowledge about the conservation status of these species in areas that had not been studied until now," says ICM researcher Joaquim Garrabou.

Coralligenous Weekends: Citizen science sessions

The data of this study were obtained in 2022, but the trips to assess the state of other species continued in 2023, expanding the sampling spots. Thus, last year, the UB and Observadors del Mar organized the Coralligenous Weekends, which received the participation of seventy volunteers and seven diving centers of Costa Brava that followed the Atenció Coralls! protocols to assess the impact of heat waves on more than 10,000 gorgonians—95 censuses in sixteen towns—in Cap de Creus and in Espai Natura 2000 Baix Empordà.

Elisenda Franco, from the Club Nàutic Port de la Selva, is one of the people who took part in the conference. "It was a very positive experience. Citizen science is great, because it allows us to mix citizens who are enthusiastic about the sea with scientists, taking advantage of the experience of each one, in my case, as a diver," she points out. For Robert López, a biologist who also participated in the activity, it is an opportunity "to help obtain data that can be disseminated or published in a scientific article."

About the training, the volunteer recalls that it is "very visual and understandable. It gives you a different view of the sea: now you can see how the gorgonians are and you can see that many of them are damaged," she explains. In the same vein, Robert López, a member of the Biology Immersion Club of the UB's Faculty of Biology, adds, "It makes you aware of the impact on the gorgonians and the changes that are taking place under the water due to the warming of the sea."

Finally, both volunteers agree that it is a way of "raising awareness" about the reality of climate change and ensuring that this knowledge reaches the public. "The fact that they told us about it so well, that it was such a motivating experience, makes you try to transfer it to your environment. In a way, it is a step that remains, it is a kind of chain to educate, raise awareness and disseminate what we have learned," stresses Elisenda Franco.

Mortality due to high temperatures

The first results revealed that, in all the populations that suffered mortality due to the high temperatures over the last years, "the white gorgonian was the most affected one, with 80% of the populations being severely affected, while in the case of the red gorgonian, 50% of the populations were severely affected," note the researchers.

The effects also vary according to depth. "In the first 20 meters, severe damage predominates, between 20 and 30 meters, moderate damage predominates—corresponding to 30%–60% of the gorgonians being affected—and it is not until we go beyond 30 meters that we find populations with low damage, i.e., with less than 30% of the gorgonians affected," the experts conclude.

More information: Laura Figuerola-Ferrando et al, Marine Citizen Science and the Conservation of Mediterranean Corals: The Relevance of Training, Expert Validation, and Robust Sampling Protocols, *Environmental Management* (2023). DOI: 10.1007/s00267-023-01913-x

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