

Citizen Science for Coastal and Marine Conservation

Edited by
John A. Cigliano and
Heidi L. Ballard



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CITIZEN SCIENCE FOR COASTAL AND MARINE CONSERVATION

In recent years, citizen science has emerged as a powerful new approach to enable the general public, students, and volunteers to become involved in scientific research. A prime example is in biodiversity conservation, where data collection and monitoring can be greatly enhanced through citizen participation. This is the first book to provide much needed guidance and case studies from coastal and marine conservation.

The novelty and rapid expansion of the field has created a demand for the discussion of key issues and the development of best practices. This book demonstrates the utility and feasibility, as well as limitations, of using coastal and marine citizen science for conservation, by providing critical considerations (i.e. which questions and systems are best suited for citizen science) and presenting recommendations for best practices for successful coastal and marine citizen science projects.

A range of case studies, for example, on monitoring seabird populations, invasive species, plastics pollution, and the impacts of climate change, from different parts of the world, is included. Also included are discussions on engaging youth, indigenous communities, and divers and snorkelers as citizen scientists, as well as best practices on communication within citizen science, building trust with stakeholders, and informing marine policy as part of this exciting and empowering way of improving coastal and marine conservation.

John A. Cigliano is Professor of Biology and Director of Environmental Conservation in the Department of Biological Sciences, Cedar Crest College, Allentown, Pennsylvania, USA; adjunct faculty at the Schoodic Institute at Acadia National Park, Winter Harbor, Maine, USA; and an Earthwatch Institute Principal Investigator. He collaborates with citizen scientists to study the effects of ocean acidification and warming on temperate rocky-intertidal organisms and communities. John is currently the Past President of the Marine Section, the Vice President of the Participatory and Citizen Science Working Group, both of the Society for Conservation Biology, and a founding member of the Citizen Science Association.

Heidi L. Ballard is Associate Professor of Environmental Science Education and Faculty Director of the Center for Community and Citizen Science at the University of California, Davis, USA. She leads research on what and how adults and youth learn about science, the environment, and their communities through participation in citizen science and community science. She is on the Editorial Board of *Citizen Science: Theory and Practice*, and a member of several professional societies' working groups focused on citizen science. She has collaborated with numerous citizen science and community science projects internationally to help improve design and evaluation of their programs.

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Daniela Honorato is a Marine Biologist with a Diploma in Natural Resources Management. Her main interests focus on the environmental sustainability and rational use of marine/coastal ecosystems, and she has always believed that environmental and scientific education is a critical instrument to achieve this goal. She is currently working in the citizen science program *Científicos de la Basura*, coordinating the Chilean-German project "Following the Pathways of Plastic Litter" in Chile.

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science projects and if this has an influence on their self-efficacy in cases of environmental behavior.

Carrie LeDuc came to the laboratory in the capacity of citizen scientist, contributing to restoration efforts and research on restoration outcomes. In this capacity, she helped to map the extent of eelgrass re-growth over multiple years and conduct research on possible contributors to eelgrass loss. She was trained in marine biology and genetics and has worked as a biologist and manager in related fields ever since. She worked with friends and colleagues to start two biotech companies, and is now working with Hydro-Photon in bringing safe drinking water to everyone. She sees great value in community involvement in science and is an active participant in citizen science at every opportunity.

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Jon Parr is Deputy Director at the Marine Biological Association (MBA) in the UK. Awarded a Royal Charter in 2013, the MBA has been involved in awareness

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April D. Ridlon is a PhD candidate at the University of California, Santa Barbara, USA, with a professional background in marine research, conservation, and education. She has directed citizen scientists in research projects for various non-profit organizations since 2000, including as Team Scientist for Reef Check in the Sapidilla Cayes Marine Reserve, BZ, and as a research assistant for the Earthwatch Institute. April is broadly interested in human impacts to predator-prey dynamics; her current research interests include the indirect effects of recreational divers and spear fishers on marine fish, and the roles of predators in marine invasions.

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Charlie W. Wright is a Citizen Science Data Verification Specialist with COASST. He has a background in avian field biology, is versed in the natural history of Pacific Coast birds, and is interested in shaping and guiding citizen science with rigorous end uses in mind.

PREFACE

This book came about as a natural outgrowth of the global and explosive expansion of citizen science and other forms of public participation in scientific research. While scientists and non-scientists have been collaborating to better understand coastal and marine environments for many years, we've recently seen a perfect storm of available technologies, open source hardware and software, cultural and social awakening, social justice and community-based movements, and government need and interest resulting in what we see now as a firmly established field of citizen science. While many people associate this field with bird watching and stargazing, the fact is that one of the most crucial contexts in need of broad spatial and temporal data sets for environmental and conservation science is coastal and marine systems; and marine scientists and members of the public have responded with hundreds of citizen science projects around the world. Therefore, when the 2014 International Marine Conservation Congress in Glasgow, Scotland, called for symposia, several of us knew a citizen science-focused symposium could help to push this under-discussed field forward. That original symposium included scientists and citizen science project leaders from a wide range of project areas: Tina Phillips, Ann Wasser, Ryan Meyer, Jake Levenson, Amy Freitag, Jason Holmberg, and the two of us, many of whom have authored chapters in this book.

We particularly appreciate that at that conference Tim Hardwick at Earthscan suggested this might make a good focus for a book. Since then we have discovered dozens and dozens of projects around the world working on nearly every coastal and marine ecosystem, at varying stages of development and maturity as programs. This book represents a small fraction of the coastal and marine citizen science projects that exist and continue to emerge, and we selected those that seemed to offer representative cases for the variety of technologies, contexts, audiences, and conservation goals that have been up and running long enough to offer lessons for the fields of citizen science and conservation more broadly. We regret that many

exemplary projects with amazing successes and/or thoughtfully designed programmatic structures could not be included in the book, but we tried to ensure that each author discussed many of those programs to provide the broader context for their work.

Heidi would like to thank her team of amazing graduate students and collaborators at UC Davis and beyond who have discussed big-picture thinking about coastal and marine citizen science. At UC Davis, that's been Ryan Meyer and Jen Metes in particular, and Emily Harris, Colin Dixon, Erin Bird, Sinead Brien, Lina Yamashita, Sally Neas, and Karen Bush. Alison Young and Rebecca Johnson at the California Academy of Sciences have pushed my thinking about what coastal citizen science can do (Snapshot Cal Coast!), and Julia Parrish at the University of Washington and COASST have pushed my thinking about what it can do well and how. My THAW colleagues who have provided support and guidance in both scholarly and work-life balance conundrums: Gail Patricelli, Kari Cooper, Amber Boydston, and Magali Billen. Finally, I want to thank my family for supporting me unwaveringly in all my work with warmth and constructive criticism: Jill, Gary, Matt, Jeff and Marny.

John would like to thank all the citizen scientists who have collaborated with him on his citizen science projects for their enthusiasm, hard work, and inspiration. Earthwatch Institute not only provided funding for my projects but also invaluable guidance and support over the years that turned an interest into a passion. A special thanks goes to Mark Chandler. I would also like to thank colleagues that helped me think deeply and broadly not only about the process of citizen science but also about the nature of citizen science, especially Abe Miller-Rushing at the National Park Service, Hannah Webber at Schoodic Institute, and Tina Phillips at Cornell University. And to Rich Kliman for his good cheer and hard work. No one could ask for a better collaborator. A very, very special thanks, of course, goes to my family, Karen, Marisa, Olivia, and Darwin, whose unconditional and unwavering support over the years has allowed me to pursue my passion for coastal and marine citizen science.

We particularly want to acknowledge all the hard work of the authors of chapters in this book, and their thousands of volunteers and participants in the projects they write about. Without the passion, expertise, experience, enthusiasm, time, and energy of the people who make up these citizen science projects around the world, we would already be far behind in our understanding and application of coastal and marine conservation, and in our understanding of the ways the human communities and individuals can positively impact our ecosystems as stewards and scientists. If anything, the expansion of citizen science for coastal and marine conservation has provided a whole new arena for people to enact their conservation values, and we are so honored to be able to highlight some of the ways that can be effectively, rigorously, ethically done by scientists and members of the public alike.