Advancing Public and Industry Participation in Coastal and Marine Sciences

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Edited by

Michael Lück and Brooke A. Porter

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We dedicate this book to the thousands of citizen scientists who freely give their time and passion to support scientific endeavours, and to those scientists who engage with and involve citizen scientists.

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FOREWORD

MARC L. MILLER
SCHOOL OF MARINE & ENVIRONMENTAL AFFAIRS
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The notion of citizen science is tantalizing for the ways it compels us to reconsider roles in society and for its challenge to us to re-imagine how these can be recombined in positive ways. It is exciting that we are encouraged to ponder what new forms science can take and what kinds of people can be central and recruited to the process. Over the last decades, citizen science has effectively brought together diverse and international scientists, governmental researchers and managers, private sector businessmen and businesswomen, and individuals of civil society in addressing a great array of scientific questions and environmental problems/solutions.

In everyday discourse, we simplify life by separating scientists from citizens. The former term is commonly taken to refer to men and women who have formal training in the scientific enterprise and who work with colleagues with complementary scientific credentials. Scientists, then, are exemplified by professionals active in academe, the public sector, and in civil society. In the public mind, science is easily associated with laboratory research, sophisticated instruments of analysis and an amazing array of theoretical and material products. Basic and applied science attuned to coastal and marine systems is designed to (in the short- or long-term) improve relations between humankind and other components of ecosystems.

Citizens, in this way of thinking, are contrasted with scientists in that they do not have an occupational commitment to science. Citizens reside and work in the "real world." Even so, they are (direct or indirect) beneficiaries of science. Citizens vary in the way they are (dis)interested in science. Certainly, citizens recognise that their lives are substantially shaped by science. Citizens, then, use rather than produce the outputs of science.

Citizen science is progressive and bridges the gulf between the world of professional scientists and that of other members of society. Very generally, citizen science implies some sort of cooperation between professional scientists and participating citizens (some of whom may, in fact, be amateur scientists). This interaction entails something more than public input in the

form of oral/written testimony. In the academic literature, aspects of citizen science illustrate the social and cultural dynamics of co-production, public engagement, adaptive management, and (learning-based) collaboration.

Citizen science, like all science, can unfold as a process with research design, data collection, analysis, and write-up phases. However, most typically (but not exclusively) citizens have engaged with scientists in the data collection phase. As is well-known, an impressive international example of citizen science is the Christmas Tree Count which is an annual census of birds in the Northern-hemisphere winter administered by the National Audubon Society. Volunteer birdwatchers abide by a standard protocol in generating population data with conservation implications.

Advancing Public and Industry Participation in Coastal and Marine Sciences is an important and timely contribution to the interdisciplinary field of citizen science. The editors, Michael Lück and Brooke A. Porter, have chosen an exceptional and creative group of researchers to remark on their experiences with citizen science. In the educational and properly provocative chapters to follow, they share their goals, procedures, obstacles encountered, insights, and recommendations. The chapters are especially instructive for the discussions of how tourism and marine recreational activities provide opportunities for data collection, how innovative technologies (social media, new kinds of research platforms, smart phone photography) make this possible, how citizen science can be valid/reliable, how marine industry practices can be modified in light of better understandings of consumer motivations and behaviour, and how citizens find satisfaction in collaborative citizen science.

This volume will be of immediate value to scientists, to citizens who are motivated to make scientific contributions, and to students who are looking for a career (or personal) path that values curiosity, logical inquiry, and responsible environmental policy. The editors and authors are to be congratulated for documenting their ideas about coastal and marine citizen science.

ACKNOWLEDGEMENTS

Completing a book like this is not a lone endeavour – it is a project in which many people are involved, and we would be amiss not acknowledging these. Over the past two years, the global pandemic has had significant impacts on many people around the globe, and many of our contributors are no exception. Despite these disruptions, they have shown enormous patience, support, as well as perseverance, and subsequently written terrific chapters for this volume. We sincerely thank each and every one of them: Claudio Aguayo, Filippo Bargnesi, Carlo Cerrano, Tracy Cooper, Jens Currie, Moira Décima, Andreas Hansen, Serena Lucrezi, Martina Milanese, Mark Orams, Blair Outhwaite, Chantal Pagel, Vikki Schaffer, Stephanie Stack and Karen Stockin. We are especially grateful to Marc Miller, who has provided us with a poignant foreword, suitably setting the scene for this book.

We would also like to sincerely thank Adam Rummens, Helen Edwards and Amanda Millar at Cambridge Scholars Publishing, who were extremely patient, and provided support throughout this project, from the first proposal to the final production.

Stillwater, New Zealand and Amelia, Italy
Michael Lück and Brooke A. Porter

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Dr Chantal Denise Pagel is a graduate of Auckland University of Technology (AUT), New Zealand. While becoming a conservation biologist, Chantal has worked with sustainable marine wildlife tourism since 2010, including the exploration of the global whale watching phenomenon and baseline research on swim encounters with Norwegian killer whales. As part of her doctoral thesis, Chantal investigated perceptions of tour participants towards social media content featuring human-wildlife encounters (e.g., wildlife selfies) in three different commercial swim-with-wildlife experiences in the South Pacific. She is further providing advice and guidance on managing commercial swim-with programmes as a founding member of the responsible whale watching certification programme initiated by the World Cetacean Alliance.

Dr Brooke A. Porter works as instructional designer developing accessible content for various sectors related to development. She holds a B.Sc. in marine biology, an M.Ed. in curriculum development and Ph.D. in tourism and fisheries livelihoods. She has worked in various capacities with NGOs, international aid agencies and educational institutions in Maui, New Zealand, Italy, the Philippines and in Eastern Africa. She has also worked in the tourism industry as a naturalist aboard whale watching tours across the Pacific. Brooke has published in a number of international journals and has recently published two edited volumes on gender biases in fieldwork (Channel View).

Dr Vikki Schaffer is senior lecturer within the School of Business and Creative Industries at the University of the Sunshine Coast (UniSC), Australia. Employing innovative approaches including immersive technologies, Vikki, a passionate citizen scientist, engages in transdisciplinary research focusing on sustainable marine wildlife tourism and cognitive

appraisal of immersive visitor experiences and the influence of awe on pro-environmental outcomes. Vikki's citizen science research focuses on evaluating the participant experience for diversity and inclusivity such as people with physical disabilities, dark sky tourism, tourist scientists and volunteer engagement in turtle research programmes and clean up events.

Stephanie Stack is the international lead for research at Pacific Whale Foundation where she directs research projects in Australia, Japan, Ecuador and Chile. She has a background in environmental science and over 15 years' experience participating in cetacean and pinniped field studies. Her recent focus has been on using innovative technologies to understand and mitigate threats to cetacean populations. Stephanie is an invited member to the Scientific Committee of the International Whaling Commission and advises the Canadian and Australian governments on anthropogenic impacts to cetaceans.

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CHAPTER 1

ADVANCING PUBLIC AND INDUSTRY PARTICIPATION IN COASTAL AND MARINE SCIENCES: TAKING THE PLUNGE

MICHAEL LÜCK, BROOKE A. PORTER

The aim of this book is to explore ways in which the public and industry may participate in coastal and marine sciences. Previous research supports a general willingness to participate in the sciences and has shown that 'citizen scientists' are able to adequately fill in for trained scientists who often face temporal and monetary constraints (Cohn 2008). The concept of citizen science (CS) is well established; however, its validity as a method is sometimes questioned. In addition, there is a need to expand on unconventional ways in which the public and industry can meaningfully participate and engage with the sciences. For example, there are numerous social media groups dedicated to spotting wildlife, such as eBird (https://ebird.org/home) and HappyWhale (https://happywhale.com/home). Such groups can serve as real-time and valuable data bases for researchers. Likewise, some researchers call for contributions for specific projects by individuals spotting wildlife in a specific area. For example, in 2009 a researcher called for help from visitors to the Kruger National Park in South Africa. She studied the movements and mortality of wild dogs in the park. However, the park is of such a large size that she alone would never be able to cover all corners on her own (or with the help of research assistants and/or park rangers). She thus distributed flyers throughout the park, asking visitors who spotted wild dogs to send her an email with photos and the exact location where the dogs were spotted. When sending in photos of sightings and location, hoping that it would be helpful, the researcher replied "This is great, I needed right hand shots for these dogs. Look at the map, they travelled all over the place. There were 5 adults & 7 puppies in

May – hope the pups did not get killed", and attached a map of previous sightings of the same pack of wild dogs (Figure 1-1).

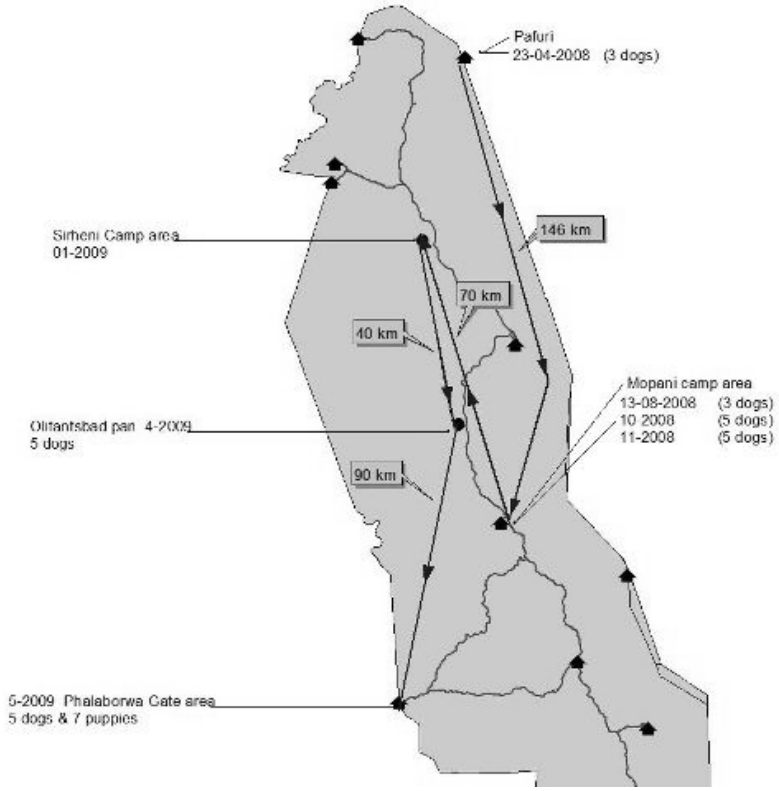

Figure 1-1. Map showing sightings of a pack of wild dogs in Kruger National Park, South Africa

This example not only demonstrates that the general public, especially tourists, can be of great help in establishing the range and longevity of a species, but also that the response of the researcher is providing information, education and awareness to the citizen scientists.

Lastly, nature-based tour operators often collect sighting data or can provide beneficial and low-cost research platforms for scientists. In some cases, such as New Zealand, sighting logs are a requirement as part of a tour operator's permit (Department of Conversation 2022).

The use of social media has been growing significantly over the past years, and with it comes the unique opportunity to utilise social media as a source for scientific data. This can be done actively, through the involvement of social media groups (see for example Chapter 2), or by using general posts (including photographs and videos) on social media as data (see Chapter 4).

From an industry perspective, participating in the sciences may seek to both advance an organisation's mission and vision, and provide a value-added benefit to the customer. For example, the Pacific Whale Foundation (PWF) is one of the largest not-for-profit whale watching operators, but has also an extensive research division in various locations. PWF funds a lot of their research through the operation of commercial whale watch tours, and at the same time is in engaged with the general public through high quality interpretation and education on board and on shore, as well as organising and attending numerous events, such as the annual whale counts and participation in academic conferences, and workshops of the International Whaling Commission (IWC). PWF's mission and vision (Figure 1-2) are clearly showing their desire to a) provide scientific research, and b) involve and educate the general public.

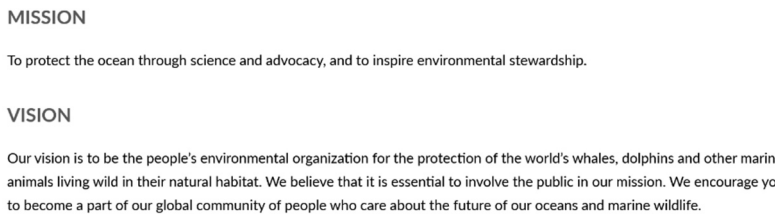

Figure 1-2. The mission and vision statements of the Pacific Whale Foundation (PWF 2022)

Public and industry participation in the sciences provides an opportunity to connect with nature that can provide additional benefits to researchers that may otherwise be difficult to obtain. Through a collective case study of transglobal and transdisciplinary applications of public and industry participation in science research, this book seeks to improve the validity of public and industry participation by providing explicit examples of both direct and indirect public modes of participation in coastal and marine environments. The underlying methods of such participation are explained using existing theoretical frameworks. The book covers a wide range of

topics such as reliability, methodologies, and potential areas of biases. Given the attention to theoretical frameworks, the cases presented in this volume will have transferable applications.

In Chapter 2, Outhwaite and Stockin used citizen science in the form of social media as a methodology to collect habitat use data for coastal delphinid species in the Hauraki Gulf, New Zealand. Sightings data were collected via two dedicated Facebook groups, and cross referenced against sightings made from research vessel and platform of opportunity. Over 16 months, 36 independent reports of killer whales (*Orcinus orca*) and 42 sightings of bottlenose dolphins (*Tursiops truncatus*) were recorded by citizen scientists. Notably, citizen science was able to detect additional delphinid sightings to those from the research vessel and platform of opportunity alone, reporting seasonal variation in habitat use for both species. However, species identification was identified as a limitation within the citizen science dataset, with bottlenose dolphins easily confused with other similar sized delphinids. Nonetheless, while social media has a place in citizen science and conservation, this study revealed it was not without limitation.

In Chapter 3, Stack and Currie note that the majority of the ocean environment is utilised by vessels not dedicated to specific research studies. They contend that these platforms of opportunity (PoP) represent cost-effective means of data collection providing wide coverage over a protracted period and have the potential to be an important resource for scientific data collection. Vessels such as whale watching boats, cruise ships, and ferries have been used as low-cost platforms for scientific data collection ranging from simple species inventories to the collection of biopsy samples and health assessment. Data collections from PoPs present some biases, but have been shown to be an important part of advancing our scientific knowledge in various fields of research. PoPs represent an underutilised resource that could play a crucial role in an era of limited funding and the need for large-scale continuous monitoring. Stack and Currie explore how PoPs have been successfully used for scientific data collection and discuss implications, limitations, and future directions.

In Chapter 4, Pagel explores the issue of wildlife harassment by the example of human-shark interactions and a small-sample analysis of qualitative data derived from Instagram to further discuss potential risks involved for wildlife and the digital audience of such content. The contemporary visual culture is significantly shaped by social media landscapes and particularly by platforms such as Instagram that utilise imagery, paired with captions, hashtags and comments to reach a broad digital audience. The way content featuring human-wildlife interactions is

displayed on visual social media platforms may influence users' perceptions of nature and wildlife. Topical accounts with several thousands of followers frequently post images and videos that picture harassment of wildlife, yet this is not always cognisable to those who give their virtual "likes". Research using Instagram as a data source has been limited, yet it has the potential to understand platform-specific behaviour as well as secondary phenomena.

In Chapter 5, Bargnesi and colleagues assessed scuba divers' willingness to see sharks, to pay to see them and to act for shark conservation, as well as actual shark conservation efforts, using qualitative research with a focus on CS. They conducted face-to-face interviews at two famous shark diving locations in southern Africa: Ponta Do Ouro (southern Mozambique) and Aliwal Shoal, south of Durban (South Africa). In parallel, an online survey was conducted. Sharks are not only one of the most endangered but also one of the most sought-after groups of animals in marine-based nature tourism, especially scuba diving. Shark diving is an integral part of the scuba diving market, with a large number of people travelling every year to have an underwater encounter with this charismatic species. Southern Africa offers ample opportunities to meet several shark species in the wild and is home to some of the most famous shark diving spots in the world. Shark diving could be a trigger to develop local, sustainable economies and support shark conservation. Participatory research – citizen science – is an excellent means for professional scientists to collect data on rare and endangered species. CS programmes could help to increase the ocean literacy of ocean users, such as scuba divers, while also raising awareness of the global conservation status of elasmobranchs (sharks, rays and skates). Furthermore, CS programmes can provide diving centres with new marketing strategies, giving a higher value to the shark diving experience. Scuba divers tended to travel and spend money to see sharks; they were aware of the global conservation status of sharks and the threats they face; and they were interested in becoming involved in CS and conservation programmes. However, real participation in a CS shark-related programme at the time of the study was low. Fundamental aspects suggested by divers to increase their participation were coordination with diving centres and an easy, fun and smart way to share data via social media, apps and web platforms. Using professionals who can link divers with scientists and introduce and guide them through educational and conservation-oriented experiences merits consideration by the diving industry. Findings suggest that CS experiences have the potential to add value to shark diving and promote sustainable growth in this sector for the benefit of local economies while collecting valid data to support shark research and conservation.

In Chapter 6, Schaffer and Orams introduce a case study providing insights into the opportunities and challenges of citizen and tourist scientist engagement in coastal research. Globally, governments, institutions and non-scientific organisations are increasingly utilising, investigating and supporting citizen science-based activities. CS offers avenues for co-created research on a wide range of issues in a variety of physical settings, including settings that are challenging to access. Logistical challenges such as accessibility, equipment, safety, seasickness, and limitations due to inconsistent weather, make research in coastal and marine settings highly complex. However, the potential "benefits of marine citizen science outweigh the challenges" (Earp & Liconti 2020, p. 19). This chapter provides a case study of CoastsnapQLD, focused on the citizen scientist aspects of the project. Coastsnap seeks to enlist citizens to take photographic images of specific Australian beaches, including the Sunshine Coast, Queensland, Australia. Photos taken by citizens are uploaded to social media sites and used to create a community beach monitoring database to assess beach erosion and recovery cycles over time. Analysis of the temporal data provides insights that help the local community and management agencies better understand and manage dynamic coastal areas.

In Chapter 7, Hansen introduces different citizen science uses in visitor management, with examples drawn from Nordic coastal and marine contexts. Examples include established methods such as Visitor Employed Photography (VEP) and Public Participation GIS (PPGIS) as well as more explorative methods such as the use of smart phone apps and data drawn from online media services. Visitor management has grown to become one of the most important management activities today, especially in popular recreational and touristic areas, such as national parks and nature reserves, marine as well as terrestrial. Traditionally, visitor management includes activities such as visitor information, education and zoning. Another important aspect is visitor monitoring, which concerns monitoring of visitor numbers, flows and activities. Visitor monitoring activities are usually undertaken by management staff or researchers without much involvement of the visitors themselves, (e.g. counters, remote sensing and various standardised visitor surveys). However, growing acknowledgement of the importance of gaining a more qualified understanding of the visitor, particularly their attitudes, opinions and experiences, has spawned an interest in alternative and more engaging monitoring approaches, including citizen science, which allows managers to work from the point of view of the visitors. New technological advances that allow tailored and effective citizen science methods to be applied further spark this development.

In Chapter 8, Lucrezi and colleagues consider recreational divers as an essential resource for citizen science, especially in the marine and environmental sciences. The skills of divers and their disposition to preserve underwater habitats make them particularly suitable for participation in CS activities. As CS makes headway in the world of recreational diving, this process is expected to lead to the growth of robust niche tourism which is called scientific diving tourism (SDT). However, CS faces design challenges as adequate business models to involve divers and become integrated into the world of recreational diving are currently lacking. The study presented in this chapter used a mixed methods approach to collect data from recreational divers and members of the diving industry, also linked to CS. Data were evaluated to better understand the potential of SDT and the problems related to its sustainable development. SDT is recognised as niche tourism with a solid foundation in CS with potential economic value. Such value, however, can only materialise thanks to the implementation of a development plan based on scientific legitimacy supported by adequate interactions, practices and contributions from various actors.

In Chapter 9, Aguayo and Décima argue that much of the focus of citizen science initiatives has been put on the general public serving researchers by contributing to observations, data collection, and/or the provision of local knowledge to complement research projects. Yet less often reports on citizen science initiatives focusing first on the educational benefits that participating in citizen science projects may have can be found in the literature. This education focus calls for a clear juxtaposition of gains from scientific research versus learning outcomes and social empowerment possible to be achieved through citizen science initiatives. Such an approach becomes critical when it comes to the need of achieving social understanding and adaptation to climate change, from the generation of scientific knowledge itself. Based on an underwater STEAM citizen science case study, Aguayo and Décima engage with the type of educational considerations that can be implemented when engaging primary students and their local community in the monitoring of salps (marine invertebrates), in the context of the Goat Island Marine Reserve in New Zealand. They argue that not only citizen science initiatives should have a stronger focus on educational considerations and outcomes for participants, but also on how such an approach can benefit the generation of scientific knowledge.

In Chapter 10, Cooper provides an operator perspective on contributions to citizen science. Kaikōura is a small town on the east coast of the South Island, Aotearoa New Zealand (NZ), which has become a marine wildlife tourism hotspot in the country. Off Kaikōura's coast, a deep submarine canyon system, the Kaikōura Canyon supports a variety of marine life and

is world renowned for its diversity of marine mammals and pelagic birds. Several tourism operators offer experiences to see marine mammals by boat, kayak, plane or helicopter taking advantage of the wealth of opportunities centred around the increasing demand to see wildlife in their natural surroundings. Cooper outlines how a local marine wildlife tour operator, *Encounter Kaikōura*, contributes significantly to science as part of both their dolphin and pelagic bird watching tours. She concludes that using platforms of opportunity to collect quantitative data is an inexpensive way of sourcing data. Further, the data can be utilised to fill knowledge gaps and provide a valuable tool for quantifying marine mammal and seabird distributions in the Kaikōura area and contribute towards the knowledge of highly mobile species. She also highlights the necessity to incorporate citizen science data to support management and conservation strategies.

Throughout this volume, the authors discuss pertinent advantages and disadvantages of employing various forms of coastal and marine CS, underpinned with case studies from around the globe. When reading these contributions, it becomes clear that CS is not without flaws, but can and must play an important role in the advancement of our understanding of the coastal and marine environments. This is true not only for marine wildlife (as illustrated in most chapters), but also for the management of the coastal and marine environments, such as visitor monitoring efforts and beach management. We feel that we are only at the beginning of CS efforts. Equipment, such as cameras, drones, and vessels are becoming more affordable, and are increasingly used by the general public. Such equipment is also continuously improving in quality, making photographs and video footage from a distance (i.e. non-invasive) suitable for scientific research. It is important that researchers making use of citizen and operator data reward their contributors. This can be in form of simple “thank you” notes or the provision of reports and data pertaining to the project. That way, there is an important educational component added, as well as potentially the feeling of accomplishment, pride and even eudaemonia.

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CHAPTER 2

APPLICATION OF CITIZEN SCIENCE VIA SOCIAL MEDIA: A CASE STUDY ON BOTTLENOSE DOLPHINS (*TURSIOPS TRUNCATUS*) IN THE HAURAKI GULF, NEW ZEALAND

BLAIR R. OUTHWAITE & KAREN A. STOCKIN

A bottlenose dolphin viewed by members of the public following a citizen science report