Citizen Science: Public Participation in Environmental Research

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I look forward with hope to a successful outcome for the efforts documented here.—Mark Tasker, *Joint Nature Conservation Committee, Inverdee House, Baxter Street, Aberdeen, AB11 9QA, United Kingdom. E-mail: mark.tasker@jncc.gov.uk*

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Citizen Science: Public Participation in Environmental Research.—Janis L. Dickinson and Rick Bonney, Eds. 2012. Cornell University Press, Ithaca, New York. 240 pp., 32 figures, 4 tables. ISBN 9780801449116. Cloth, $49.95.—This book provides a current view of citizen science in the context of modern communication and engagement through the Internet. The Cornell Lab of Ornithology (CLO) has led the way in this domain within the New World, and the authorship of this edited volume reflects this leadership: 21 of 45 authors are from the CLO, with others coming from U.S. academic and conservation institutions, and one chapter presenting the U.K. experience. This treatment of citizen science is both broad and deep—necessitating, in places, the exploration of complex concepts and detailed explanations. Although a diversity of audiences will benefit from dipping into accounts as wide-ranging as Bioinformatics and Children and Nature, the purpose of this book is to inform serious engagement with citizen science as we continue to develop the capability of people to collect scientifically useful data that can benefit environmental conservation.

The book has three main parts. The first deals with the practice of citizen science, referring to case studies over the past quarter century and moving on to the Internet's impact on how we capture, analyze, and manage data, grow the volunteer base, and evaluate the outcomes of citizen science. The second part covers the various ways we can use the data for conservation, and the third broadens the book's interest into areas of educational and social policy.

Richard Louv's foreword sets the scene nicely, stating that "Citizen scientists collect more than data. They gather meaning." This expresses the heart of the book, which goes on to describe the whole end-to-end process for nurturing the partnership between professional and citizen scientists and turning data into meaningful information that can make a difference. Richard's hope is that citizen science can reverse the trend of young people becoming disconnected from the natural world. The introductory chapter explains why birds are at the center of the growing citizen science movement. The CLO and the British Trust for Ornithology (BTO) curate and use huge volumes of historical and recent bird monitoring data, collected by people who are excited by the birds around them. The Internet era allows the loop between data collector and professional institution to be completed and then used to nurture the relationship through feedback, the citizen's interaction with their own data and those of others, and for volunteers to really feel part of the conversion of observations into scientific conservation outputs. The case studies of FeederWatch, Monitoring Monarchs, Neighborhood Nestwatch, and Project BudBurst enable lessons to be learned.

For many readers, Steve Kelling's chapter on bioinformatics will be the key element underpinning future developments in citizen science. Readers will need a strong interest in computer science, and a good understanding of data modeling and visualization, to embrace the full potential of these fast-developing techniques. Progress relies on information tools for global networks of volunteers, rewards for participation, data exchange through a cyber-infrastructure, and successful analysis and visualizations that explain the data findings to relevant sectors. Visions for the future include crowd-sourcing of solutions from environmental data. In the following chapter, Miyoko Chu, the CLO's director of communications, and others tackle the challenge of recruiting hundreds of thousands of people to participate in citizen science projects, an engagement job still to be done. Here, again, the Internet has changed the game. Creating projects that people will be interested in requires a knowledge of the motivations and rewards of participation. Understanding different audiences and how best to communicate with them leads to participant-centered approaches. Case studies on eBird and the Great Backyard Bird Count demonstrate how participant-based rewards—tools for birders in the case of eBird—and publicity have fueled data collection. The future challenges are well described, of embracing social networking and enabling the citizen science community to build itself.

How much is the CLO case-study approach, adopted throughout most of this book, the whole story? This approach relies on a very large community of participants collecting big data by a simple method. It is the scale of the data set that allows the fast-developing computer-science concepts of analysis, modeling, and visualizations to tell a story about bird movements, abundance, and changing patterns. There are other approaches, as described in the chapter on the U.K. experience: BTO, again with citizen scientists, collects more stratified data in a range of bespoke projects that look at all the different stages of birds' life histories. This provides an opportunity for integrated population monitoring, whereby the cause of population change can be more readily identified, a feature historically successful in the U.K. conservation policy landscape. This U.K. experience sits slightly aside from the Cornell approach, and generally there could have been a better integration of different models for citizen science threaded throughout the book.

The BTO account comes at the end of Part II, where four other chapters are devoted to the impacts of citizen science on conservation research. Increasingly the methods are used in landscape-scale ecology, such as testing hypotheses on habitat loss and fragmentation. In Fink and Hochachka's chapter on data mining to explore patterns in citizen science data, the visualizations from eBird of the migration movements of birds at a continental scale really come into their own. They treat the analytical challenges openly and recognize the potential biases and how to deal with them. Developing a conservation research program, as described by Hames, Lowe, and Rosenberg in the next chapter, takes these analytical approaches a step further in thinking about how to use them in addressing the impacts of environmental change. Birds in Forested Landscapes, in which volunteers undertake field experiments alongside traditional survey data gathering, is the described model.

The final part of the book examines the relationship between the scientists and the citizens, exploring education, behavior, and social aspects of participation. Once again, the prevalence of the Internet in the ways we all engage with day-to-day life has modified the way scientists approach the challenges of involving a broader section of society, using techniques to engender scientific understanding alongside participation, and to enable communities to build their own scientific effort. The final chapter looks at how citizen science can play an important role in disaster recovery, written without reference to the *Deepwater Horizon* oil spill in the Gulf of Mexico, a most poignant example referred to in John Fitzpatrick's afterword as the book went to press. He ends on an optimistic note. Our ability to use huge computing power and the Internet to return knowledge to the citizen scientists deepens their experience. He hopes that our ability to monitor changes to our planet in real time, through the increasing power of the citizen scientist, will improve science literacy in society.

The cited literature is broad and up-to-date, adding considerably to the book's authoritative appeal. This overall work is a must-have item for academic institutions, libraries, governments, and non-governmental organizations that work with volunteers. Its deep examination of the whole citizen-science process means that it deals with complex concepts, some of which require specialist knowledge to appreciate fully. However, the writing style and the breadth of material offer something for all readers engaged with citizen science.—Andy Clements, *British Trust for Ornithology, The Nunnery, Thetford, Norfolk IP24 2PU, United Kingdom. E-mail: andy.clements@bto.org*