

Citizen science for environmental citizenship

Finn Arne Jørgensen

Department of Cultural Studies and Languages

University of Stavanger

4036 Stavanger

Norway

Dolly Jørgensen

Department of Cultural Studies and Languages

University of Stavanger

4036 Stavanger

Norway

Corresponding author: Finn Arne Jørgensen finn.a.jorgensen@uis.no

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Conservation-based citizen science projects have the potential to contribute to the formation of environmental citizenship.

Citizen science projects, in which citizens are collectors and sensors generating data, have become a well-established scientific practice (Bonney et al. 2016). Citizen science research within environmental conservation typically focuses on either the usability of citizen-generated data or individual motivation for involvement (Kobori et al. 2016; Ellwood 2017; McKinley et al. 2017). The

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Ten Principles of Citizen Science identify possible benefits to citizen scientists as publications, learning, enjoyment, satisfaction, and policy influence (ECSA 2015). Notably, changes in attitude and values beyond the scientific realm are absent from this list. In short, while the ability of citizen science to transform *scientific practice* is well-known, the potential for citizen science to *transform the citizen* needs further elaboration.

We propose that the social capacity potential of citizen science extends far beyond collecting data. We suggest that involvement in citizen science activities can cultivate environmental citizenship and change attitudes if projects are intentionally designed to do so. This is an opportunity for conservation biologists to engage with citizen scientists on a different level.

Defining Environmental Citizenship

Citizenship is a fundamental principle of participatory democracy (McCowan 2009). Understanding citizenship as only a legal entitlement conferred by nation-states is a limited approach that overlooks that citizens can “participate in, identify as, and belong to our communities” even without legal entitlements (Hayward 2012:3).

Because of ongoing and ever-mounting environmental challenges to society, *environmental citizenship* needs to be an integrated element of democratic citizenship. Environmental citizenship is the “responsible pro-environmental behavior of citizens who act and participate in society as agents of change in the private and public sphere, on a local, national and global scale, through individual and collective actions, in the direction of solving contemporary environmental problems, preventing the creation of new environmental problems, achieving sustainability, as well as developing a

healthy relationship with nature” (ENEC 2018). There are two notable features of this definition. First, environmental citizenship exists on scales other than the nation-state: it encompasses the rights and responsibilities to act at local and global scales. This multi-scalar environmental citizenship is required since many environmental problems and their effects exist at global scales yet require local community responsibility (Valencia Sáiz 2005). Second, environmental citizenship involves an internal motivation of justice, what Hayward (2012:104) calls “embedded ecological justice.” Studies of environmental citizenship highlight ecological concerns and activism as major drivers in citizenship processes (Cheah & Huang 2019; Isin & Nyers 2014), and the importance of intra-generational education and empowerment (Hadjichambis & Paraskeva-Hadjichambi 2020).

More than just recycling or turning off the lights, environmental citizenship requires new ways of thinking and acting. Being an active environmental citizen includes recognizing the value of liveable environments for humans and nature, promoting conservation of resources, and supporting nature protection and biodiversity (Ellis & Waterton 2004). Environmental citizenship entails the right to participate in environmental policymaking, choose sustainable personal actions, obey just environmental law, and promote sustainable arrangements (Bell 2005).

Environmental citizenship emerges as a citizenship class of world citizens who act differently for the sake of the environment. Unlike a legal definition of citizenship, environmental citizenship is non-territorial (Horton 2006). Environmental challenges do not neatly map onto nation-state borders: we live in an age in which humans have modified the Earth on planetary scales. This Anthropocene condition aligns with a notion of environmental citizenship that is global, collective, and positive (Jelin 2010).

Science and citizenship

Citizens play a central role in joining science and democratic politics. Through the integration of people's knowledges, skills, economic interests, and moral values, science and the social order are "mutually constitutive"; the citizen is both consumer and generator of knowledge (Jasanoff 2004:91).

When Alan Irwin launched the term *citizen science* into the public sphere in 1995, he stressed the connection between citizens, science, and environmental challenges. *Citizen science* reconceptualizes the relationship between the three because "a sustainable society needs a sustainable way of handling science and expertise" (Irwin 1995:x). Irwin was not thinking of citizen science as a mode of scientific data collection but as a mode of social engagement in environmental problems (Eitzel et al. 2017).

Building upon Irwin's call for linking science-citizen-sustainability, we argue that citizens can generate and consume scientific knowledge about the environment, actively shape their own practices, and produce politically-relevant environmental action through citizen science. While many citizen science projects understand citizens as generators of knowledge, they do not go far enough with the socially transformative potential of citizen science.

Connecting citizen science to environmental citizenship

Conservation-based citizen science activities can become a critical node in promoting environmental citizenship. Citizen scientists working on environmental projects do so at the junction of scientific practices, norms for good environmental citizen behavior, and ideas about nature (Figure 1). Citizen scientists involved in biodiversity monitoring and other nature-related activities tend to have higher connectedness to nature than the average citizen (Evans et al. 2005; Ballard et al. 2016; Lynch et al. 2018; Ganzevoort & Born 2019). How might feeling connected to nature through citizen science activities contribute to environmental citizenship development?

[Figure 1 here]

Citizen science projects can contribute positively to the formation of environmental citizens by modifying attitudes. Dobson (2007) argued that changing attitudes is fundamental to cultivating environmental citizenship and that active involvement with environmental projects is an effective way to change attitudes. Although we cannot take for granted that changed attitudes lead to changes in behavior (Krasny 2020), first-hand experience and observation anchor knowledge into people's everyday lives, thereby transforming knowledge into a tool for environmental action. Fostering environmental citizenship provides individuals and communities a toolbox they can draw upon to change attitudes and behaviors.

We propose three strategies to address environmental citizenship during the citizen science project design process: recognizing the collective nature of citizenship (collectiveness), cultivating situated

citizenship (situatedness), and connecting local data to larger environmental problems (connectedness). Each of these need fuller scholarly elaboration to identify best practices, but we offer them here as a starting point for incorporating environmental citizenship into project designs.

First, collectiveness: a key component of citizenship is participation in the collective. Activities from bird watching to beach combing build a sense of collaboration and communal responsibility for the environment, with individuals working collectively toward a common good, which is a vital aspect of environmental citizenship (Schild 2016). Learning about the local environment and being connected to nature are primary motivations for citizens to become involved in ecological-based citizen science projects (Ganzevoort et al. 2017). Collaboration reinforces existing feelings of responsibility and care for nature and the willingness to act. Citizen science projects should cultivate public environmental activism and community building, rather than focus on private sphere environmentalism and individual behavior to build environmental citizenship (Hadjichambis et al. 2020). Working together is thus more important than working alone for the cultivation of citizenship thinking.

Second, situatedness: citizen science initiatives need to cultivate situated citizenship (Szerszynski 2006). Learning should be embedded in the lived experience of participants as part of social practice and physical environment (Lave & Wenger 1991). When environmental citizen science projects require outdoor activities, the projects offer an opportunity for place-based situated learning (Schild 2016). Even digital projects can promote connections, attachment, and care about a specific environment or species even though physically distant from the participant (Jørgensen 2014).

Third, connectedness: citizen science projects should help their participants make connections between the data they collect and larger environmental problems. Environmental citizenship calls

citizens to address the structural roots of environmental challenges, particularly the uneven distribution of environmental burdens (Ballard 1993) and the lack of inclusion of minorities in environmentalist organizations (Taylor 2016). Moving individuals to think about the big picture is one pathway for connecting local citizen science to global environmental citizenship.

Conservation-based citizen science has the potential to create social innovation by cultivating environmental citizenship, which includes individuals' awareness, attitudes, and behaviors to live sustainably. When citizens generate and consume scientific knowledge about the environment, they have the opportunity to transform their own relationship with nature. We offer three characteristics that a project centering environmental citizenship would have: collectiveness, situatedness, and connectedness. By intentionally designing projects with environmental citizenship as an outcome, scientific data is not the only result of citizen science initiatives. Citizen science of the future should take the *citizen* part as seriously as the *science* part to foster environmentally engaged citizens.

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Figure 1. Model for development of environmental citizenship through environmental citizen science projects

