It's Good to Share: Why Environmental Scientists' Ethics Are Out of Date

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Although there have been many recent calls for increased data sharing, the majority of environmental scientists do not make their individual data sets publicly available in online repositories. Current data-sharing conversations are focused on overcoming the technological challenges associated with data sharing and the lack of rewards and incentives for individuals to share data. We argue that the most important conversation has yet to take place: There has not been a strong ethical impetus for sharing data within the current culture, behaviors, and practices of environmental scientists. In this article, we describe a critical shift that is happening in both society and the environmental science community that makes data sharing not just good but ethically obligatory. This is a shift toward the ethical value of promoting inclusivity within and beyond science. An essential element of a truly inclusionary and democratic approach to science is to share data through publicly accessible data sets.

Keywords: policy/ethics, environmental science, history, data sharing, inclusion

Some disciplines, such as meteorology, astronomy, and genomics, have shown an emerging norm of sharing data that has resulted in substantial benefits to those disciplines and to society (Hayes 2012, Ivezic 2012). However, for many of the environmental science disciplines, such as ecology, there has not been a shift in the norms toward sharing data. For example, a recent survey of authors funded by the National Science Foundation's (NSF) Division of Environmental Biology showed that only 8% of authors shared data that were not related to the field of genetics (Hampton et al. 2013). The lack of sharing among environmental scientists is somewhat surprising, given the many recent calls for increased data sharing; the establishment of mandatory and voluntary policies to do so from journals, publishers, and funding agencies; and a growing community of scientists who argue for open science (Parr and Cummings 2005, Zimmerman 2008, Wolkovich et al. 2012).

Most scientists make a nominal nod that data sharing is the "good" thing to do both for methodological reasons (e.g., replication of analyses, data preservation, scientific progress, data integrity) and for societal reasons (e.g., human rights, public trust; Duke and Porter 2013). In fact, Duke and Porter (2013) stated that sharing data "would appear to be among the most basic of scientific ethical principles" (p. 483). However, the limited data-sharing practices by many—if not most—environmental scientists do not seem to match these ethical values. We propose that an additional reason for sharing data has emerged as a result of a recent critical shift in both society and the environmental science community: the ethical value placed on promoting inclusivity within and beyond science (Uriarte et al. 2007). This additional ethical impetus for data sharing may help better align scientists' ethical values of data sharing with the practice of it.

We contend that an essential element of a truly inclusionary—and, indeed, democratic—approach to science is to share data through publicly accessible data sets. (We define *data sharing* as depositing data in a publicly accessible institutional repository at publication or at the end of a project.) We define the promotion of inclusion as supporting early-career scientists and those from underrepresented groups, fostering research at smaller or historically less influential institutions, promoting collaborative research teams, developing stronger partnerships with citizen scientists, facilitating the participation of researchers from the Global South, and including stakeholders and the public in natural resource decisions. However, many of these efforts to promote inclusion in the environmental sciences are seriously hobbled when scientists do not share their data; access to data provides a broader range of people with the opportunity to use, study, and be involved in science. Therefore, if the environmental science community is serious about its increasing commitment to promoting inclusivity, it needs to accept an accompanying ethical shift to share data as the norm.

Many environmental scientists who do not typically share their data say that the reasons for not sharing data outweigh the reasons for sharing data and attribute the costs of data

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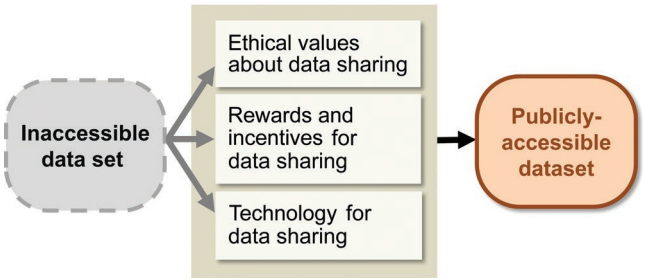

Figure 1. A depiction of the three largest challenges to making an individual data set available in a publicly accessible repository. The data set is one collected from a researcher or her or his research team in the environmental sciences. The three challenges are depicted as separate issues but, in fact, are strongly related. However, the focus to date has been on the challenges related to technology and rewards and incentives. A lack of consideration of all three challenges will result in a failure to shift the norms toward data sharing.

sharing to one of three main categories (figure 1). First are the technological challenges related to how data from individual researchers are discovered, accessed, and used—particularly when the data are heterogeneous and not standardized (e.g., Reichman et al. 2011). Second is the lack of rewards and incentives for individuals to share data—particularly for early-career scientists—and the risk of their future research being "scooped" (Reichman et al. 2011, Wolkovich et al. 2012, Goring et al. 2014). Third, there appears to be no strong ethical impetus for sharing data within the current culture, behaviors, and practices of scientists. The first two reasons are fairly easily fixed; solutions have been proposed or are already in place and include online data repositories, the creation of metadata standards, data publications, journals devoted to publishing and describing data, and new measures of impact and professional credit (Parr and Cummings 2005, Goring et al. 2014; *www.dataone.org*, *www.altmetrics.org*). However, the third reason represents a larger hurdle, and it has not yet been adequately addressed.

We argue that data sharing is a prima facie ethical obligation for all environmental scientists; in other words, the obligation holds, all else being equal, as long as there are no overriding considerations or responsibilities. However, there may be higher risks associated with sharing data for specific populations of scientists, such as those that are in their early career, those in countries in which science is funded at very low levels, or those from the Global South or tribal communities (Sankoh and Ijsselmuiden 2011, Harding et al. 2012, Mathae and Uhlir 2012). Therefore, more discussion and research should be performed to explore whether special considerations are needed in order to protect these scientists. Nevertheless, environmental scientists should be reassured by stories of other disciplines' successful experiences moving to open data (Mathae and Uhlir 2012, Kenall et al. 2014).

Before it will become common practice for individual environmental scientists to share their data, there must be a fundamental shift in the established spoken and unspoken ethical norms. These norms must align with the community's growing emphasis on inclusion in all facets of research, including research teams, networks, professional societies, institutions, and scientists' interactions with the public and environmental policy.

Within the inner circle: Research teams, networks, and professional societies

Environmental science is moving away from hierarchically structured research teams dominated by single or a few investigators within a single discipline. Instead, many environmental science teams are large, interdisciplinary, and often diverse across a variety of characteristics (e.g., career stage, discipline, demographic characteristics, personality, viewpoints; Uriarte et al. 2007, Cheruvelil et al. 2014). In fact, such diversity has been shown to increase scientific outcomes in terms of both quality and quantity (McLeod et al. 1996, Guimera et al. 2005, Campbell et al. 2013). Such teams often employ a distributed leadership style that promotes members' making collective decisions and working together to achieve mutual goals and outcomes. Equity among team members—particularly related to data and other research product access—is necessary for this type of team to operate efficiently and effectively. Recent publications about coauthorship and data sharing (e.g., Weltzin et al. 2006, Duke and Porter 2013) demonstrate how collaborative research and data sharing within these diverse teams have become common practice. However, it is less often standard practice for teams to have policies or practices for sharing their data with outside researchers or teams.

The increasing number of environmental research teams that are also part of larger national and international networks is beginning to shift the norm of sharing data not only from within individual teams but also to sharing across teams within a network and sometimes beyond. Building on long-time networks such as the US Long Term Ecological Research Network, scientists are participating in a wider range of network types that include grassroots efforts (e.g., eBird, the Global Lake Ecological Observatory Network, the Nutrient Network, the Phenocam Network), top-down efforts of governments and funding agencies (e.g., Ameriflux, the National Ecological Observatory Network), and efforts coming from both directions (e.g., the European Long-Term Ecosystem Research Network, the NSF's Research Coordination Networks). However, the level of commitment to data sharing varies among environmental networks. Policies and practices regarding data sharing are often left to the individual teams within the networks to decide, and many networks do not yet appear to share their data beyond the network. Nevertheless, these environmental research networks can and are facilitating the inclusion of scientists from smaller or historically less influential institutions, as well as those from the Global South, which supports a more diverse science

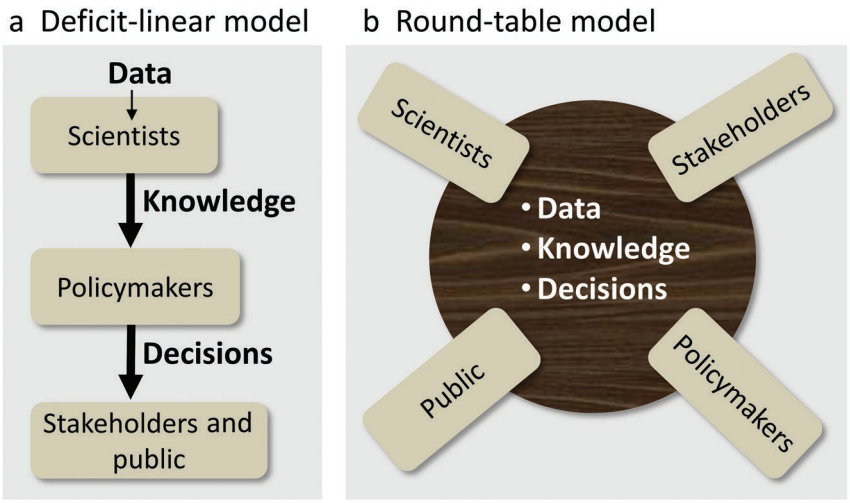

Figure 2. Two models that describe environmental science–policy interactions among scientists, policymakers, stakeholders, and the public and their relationships to data, knowledge, and decisions. (a) The deficit–linear model has been more common historically, whereas (b) the roundtable model is becoming more common today.

community. Therefore, although the trend toward egalitarian teams and distributed networks appears to be creating a more inclusionary discipline, the potential of this shift for providing publicly available, open-access data beyond the teams and networks has not yet been fully realized.

The growing value placed on issues of inclusion in the environmental science community has also begun to reshape professional societies and institutions. Many professional societies have formed caucuses or programs focused on women and underrepresented groups, such as the Ecological Society of America's Strategies for Ecology Education, Diversity, and Sustainability Program, the "Women in wetlands" section of the Society of Wetland Scientists, and the "Ethnic and gender diversity" working group of The Wildlife Society. Likewise, many US universities have received grants from the NSF's Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers program in an effort to increase the representation of women in the science, technology, engineering, and mathematics fields by transforming institutions. We contend that the same concerns that motivated these professional society and institutional changes must also propel individual scientists, teams, and networks to align their data-sharing norms, both within the academy and beyond, with these inclusionary values.

Expanding the inner circle: Public access and citizen science

By definition, data sharing increases access to information, not only for researchers but also for the public. There are growing grassroots movements, led by scientists and the public alike, toward greater public participation in environmental science and policy. Concurrently, there are growing expectations from funding agencies such as the NSF and the European Commission's Directorate-General for Research for scientists to share their data from publicly funded research projects. Citizen scientists and local experts, as well as the data that they collect and create, are increasingly being included in environmental research (Silvertown 2009, Miller-Rushing et al. 2012). Understood in this context, it is clear that data sharing is not solely connected to practical concerns such as technology and professional incentives. Instead, the issue of data sharing holds the potential for environmental scientists to align their practice with the discipline's growing interest in issues of social consciousness, the democratization of science, inclusion, and scientific literacy. This is particularly true in the realm of environmental policymaking, which, we argue, demands an inclusionary approach and, therefore, data sharing. This combination of public sponsorship of research, participation in research, and connection with policy creates a set of circumstances that push environmental scientists—and particularly those who seek to broaden participation in science—toward data sharing as an ethical obligation.

The democratization of environmental science at the interface with policy

Over the past 25 years, the dominant paradigms for environmental science–policy interactions have moved decisively toward more inclusive approaches, and it is easy to see how these changes have altered the ethical landscape surrounding data sharing (figure 2). In the past, two related models described science–policy interactions (Wynne 1992, Pielke 2007, Calow 2014). According to the deficit model, most social disputes about science were caused by a lack of scientific understanding on the part of the public. Therefore, the best approach for resolving disputes was for the scientific community to educate policymakers and the public about the relevant science. According to the linear model, scientific information fed into technological development and policy decisions in a relatively straightforward way, in a single direction. Taken together, under the deficit–linear model, the scientific community worked in a fairly isolated manner to generate knowledge from data, which was passed to the policymakers, who applied the knowledge to make decisions, which were passed on to the stakeholders and the public (figure 2a).

In response to criticisms related to inclusion, public acceptance, and scientific quality, alternatives to this model have been proposed in a variety of forms, which we refer to collectively as the roundtable model (figure 2b; Dickinson et al. 2012, Newman et al. 2012, Shirk et al. 2012). This

model is based on public participation, broad-based deliberation, and scientists sitting around a metaphorical and sometimes, an actual, table with multiple stakeholders (NRC 1996, Couvet et al. 2008). For this inclusive model of science–policy interactions to work, however, scientists need to make their data publicly available so that even stakeholders not at the table can access the information. Under the deficit–linear model, it might have been appropriate for scientists to keep their data to themselves, to decide how to interpret the results, and to pass the conclusions on to managers and policymakers; this strategy is not appropriate under the roundtable model.

There are compelling arguments in support of the roundtable model for environmental science–policy interactions, many of them strongly tied to inclusion. First, the public has demanded that they be more involved in interpreting research for policy purposes, particularly in high-stakes situations and when the scientific information is complex and uncertain (Jasanoff 2005, Shrader-Frechette 2007, Ottinger and Cohen 2011). Second, stakeholders and the public are much more likely to accept scientific findings and policy decisions when they know that the results have been vetted through a transparent, open process (Dietz and Stern 2008, Röckmann et al 2012). Third, science-policy analysts argue that research can be made more robust and policy more relevant by developing collaborations between scientists and people without formal scientific training (Irwin 1995, Kleinman 2000, Walley 2004). For example, citizen science and community-based monitoring efforts are on the rise around the world in response to environmental concerns (Whitelaw et al. 2003, Silvertown 2009, Conrad and Hilchey 2011), and there are examples of direct applications of those efforts for conservation and policy (Crabbe 2012). In summary, to facilitate this new model of inclusive science–policy interactions, researchers need to provide their data to those who sit around the table with them, as well as to those who do not. To do otherwise would cripple the ability of stakeholders to participate as serious decision partners at the environmental science–policy interface.

The ethical case for data sharing

The increasingly well established ethical commitment of the environmental sciences to promote inclusion—through diverse, interdisciplinary teams and networks, through public access and citizen science, and through public participation in environmental policymaking—requires an accompanying change in the norms related to data sharing. In this article, we have called for a shift in the conversation concerning data sharing from a focus on technological and institutional challenges to the ethical values underlying the practice of data sharing. If environmental science is to be truly inclusive, including diverse groups of people at the tables of research, decisionmaking, policy, and public debate, it is not only necessary to share, it is ethically obligatory.

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