Author: Valerie Racine
Creation date: February 6, 2017
URL: www.onlineethics.org/40548.aspx
The author wishes to acknowledge the contributions of Karin Ellison, OEC - Life and Environmental Sciences Editor, and Joseph Herkert, OEC Engineering co-Editor. They provided valuable input in selecting topics and crafting the resources.

Big Data Case Study: Big Data & Conservation Biology[1]

Andrei Rublev, a retired art history professor living in New England, enjoys spending his afternoons exploring the New England wilderness and bird watching. Last year, he discovered eBird, a website designed to bring both amateur and professional birders together by gathering information from their observations and providing access to big data resources on bird sightings, locations, and species distribution across the world.

The Cornell Lab of Ornithology and the National Audubon Society, a non-profit environmental organization dedicated to conservation, launched eBird in 2002. Its stated goal is to "maximize the utility and accessibility of the vast numbers of bird observations made each year by recreational and professional bird watchers" and then to share "these observations with a global network of educators, land managers, ornithologists, and conservation biologists" (ebird.org). In doing so, the project also hopes to aid conservation biologists to "better coordinate national and international conservation efforts with the aid of citizen science data" (Wood *et al.* 2011). Since its inception, there have been numerous scientific publications that have made used of eBird's databanks.

As a conservationist, Andrei was eager to participate in this citizen science project. Last year, he began to record his observations of his bird sightings, including his sightings of the Short-eared Owl (Asio flammeus), which is listed as an endangered species in the state of Massachusetts. He decided to submit those observations to the eBird project late last year.

Andrei owns an extensive plot of land that neighbors a state park as well as another private property of almost 100 acres. He observed these birds on his own property, but quite near his neighbor's land. Andrei is aware of the American Birding Association's Code of Birding Ethics, and knows that he must be careful to acquire explicit permission to explore private property. So, last summer, he made sure to alert his neighbor, Anna, that he often goes birding in the area. Anna expressed enthusiasm about Andrei's hobby and his commitment to conservation and granted him the permission to explore on her property.

Andrei is also aware of the Code of Ethic's mandate to promote the welfare of birds and their environments, especially of species that are listed as threatened, endangered, or of special concern. This mandate includes protecting the birds' natural habitat and not disturbing their nests or feeding sites. The eBird website also cautions birders to consider waiting for the end of the season to record sightings of sensitive species. Following all of these guidelines, Andrei waited until late December to submit records of his sightings.

[1] This material is based upon work supported by the National Science Foundation under Award No. 1355547, Karin Ellison and Joseph Herkert, Arizona State University sub-award Co-PIs. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

At that time, he felt proud of his contribution to what he believed was a worthy project. But, last week, he noticed that conservation biologists were working in the state park next to his home. From his brief conversations with one of the scientists, he discovered that they were using biotelemetry tools to try to monitor individual owls in order to get a better understanding of their migratory patterns. These technologies involve tagging individual owls with devices to track their movement and behavior.

Andrei understands the need to acquire reliable data on migratory patterns. However, he read recently that some scientists are doubtful about the reliability or usefulness of these methods, given that there is a risk that these sorts of interventions on the birds and their habitat could cause harm. For that reason, he thinks that these technologies should probably not be used on endangered species. Andrei now feels guilty because he thinks that perhaps his contribution to the eBird database might have led to the scientists' interventions.

In addition, Andrei just received a phone call from Anna, who is now upset with him. Anna explained to him that the scientists visited her home yesterday to ask for permission to conduct research on her property. Anna claims that while she gave Andrei permission to go birding on her property, she did not give him permission to post that information on eBird, or any other open access database. Andrei apologized to Anna and told her he will try to resolve the situation.

Now, eight months after he first started contributing to eBird, Andrei is starting to regret his decision to participate in the project. He still believes that citizen science projects designed to create and manage large sets of data, such as eBird, can be extremely useful in pursuing conservation goals. But, he also thinks these projects require more oversight to deal with the emerging ethical challenges, which are beyond his expertise. Should Andrei continue to contribute to eBird?

Discussion Questions

1. What are some possible tensions between open access databases gathered from citizen science projects and the goals of conservation biology? Are any of these considerations serious enough to provide reasons to limit access to data, or to re-consider how data are collected?
2. eBird includes general guidelines and codes of ethical conduct on their website concerning how to deal with "sensitive" reports, such as those made on private property. However, it is generally up to individuals to decide what information to include with their reports. Should eBird take additional measures to protect information that reveals locations on private property?
3. Most scientists think that technologies, such as biotelemetry tools, are important and useful for monitoring biological and environmental variables and for collecting enough data to make better decisions about conservation priorities or environmental resource management. Yet, some think that there are additional ethical and epistemological issues to consider when tagging endangered species, which might give reason to limit the use of these technologies. What are some of these ethical and epistemological challenges and how might they be mitigated?

Commentary

Some of the main goals in conservation biology are to track changes in large-scale ecosystems and to conserve biodiversity. Defining and assessing 'biodiversity' presents many epistemological challenges to which many scientists attend (cf. Sarkar 2002; Sarkar *et al.* 2006). Moreover, conservation biologists must collect, maintain, and analyze large sets of data. And, with better technology to track and measure biological and environmental variables, and the ability to share or create open access databases, conservation biology faces emerging ethical issues concerning its reliance on big data.

As with other sciences, the use of big data in conservation biology has led to ethical considerations about how to best balance basic scientific virtues, like the open flow of information and collaborations across borders, with the need to protect participant privacy and to maintain confidentiality in certain contexts (Bowser *et al.* 2014).

In the hypothetical scenario described above, the context is a citizen science project in which amateur birders share records of their observations, which are then curated and annotated by experts to become data made available on an open access platform. Because private citizens are sharing information, the eBird website clearly outlines its privacy policy to inform participants that "no personal contact information is ever made public" (http://ebird.org/content/ebird/about/privacy/). However, the website also states that "all details of an observation and its associated location (species, numbers, etc.) are available to all users registered with eBird" (http://ebird.org/content/ebird/about/privacy/). Therefore, it is possible that information about sightings on private property become publicly available. In the scenario, the interactions between Andrei and his neighbor, Anna, illustrate one particular ethical issue that might arise from such circumstances.

The potential costs of reporting on the presence of sensitive or endangered species presents another concern related to confidentiality, which also arises in the hypothetical scenario. The eBird website includes guidelines for reporting on sensitive species (http://help.ebird.org/customer/portal/articles/1006789-guidelines-for-reporting-sensitive-species).

Conservationists worry that publicizing the explicit coordinates or directions to the locations of sensitive or rare species might encourage more traffic in the area, which may lead to an increase in the risk of human disturbance to a vulnerable species' habitats. There are also potential negative effects that reports of rare birds might have on the quality of the databases to which they are submitted. For example, the reports may lead to the phenomena of "twitching" – "the act of making trips specifically to see previously reported rare birds" (Straka & Turner 2013, 40). Twitching can lead to biased samples of checklists or misleading data on bird abundance in open access databases from citizen science projects (Straka & Turner 2013; Kelling *et al.* 2009).

There are additional concerns about confidentiality and security with respect to publically available data in conservation biology, sustainability, and environmental sciences (Keeso 2014). For example, poachers may gain access to the locations of endangered species and cause harm. Governments are sometimes hesitant to disclose detailed geographical maps – which might be

very useful to scientists in tracking a region's biodiversity – for reasons of national security. And, some corporations and scientists are worried about confidentiality because they view their data as proprietary.

Moreover, new technologies used by conservation biologists in the field to gather data, such as biotelemetry, might require interventions in natural habitats, which raise some ethical concerns, especially in the context of research on endangered species or sensitive ecosystems (Cooke 2008; Jewell 2013). The use of biotelemetry often requires tagging individuals of a species. This generates valuable information that may be useful to inform conservation priorities and meet conservation goals, and the assumption is that such interventions will not harm the welfare of individuals or populations, but the risk of harm is still a possibility. To mitigate these harms, biologists have made efforts to weigh the relative benefits of the research and any costs to individuals and populations. Researchers also investigate the impacts of tagging activities and test tagging techniques to develop better intervention practices (Cooke 2008, 172).

Furthermore, researchers have considered some of the large-scale effects of big data biodiversity projects, such as the global biodiversity information facility (GBIF), on the priorities and practices of ecological sciences (Devictor & Bensaude-Vincent 2016). They argue that the conversion of records and observations into data – what they call the process of datafication – results in the loss of information (e.g. de-contextualization) about particular environments or ecosystems, which in turn transforms the science of ecology from one centered on environmental management to one centered at providing and managing data for environmental management. They refer to this shift of focus as a transformation of ecology into a "technoscience" (Devictor & Bensaude-Vincent 2016, 20). This transformation might have harmful implications if it leads to a situation where scientists feel justified in accumulating data and monitoring global diversity without any concern for consequences occurring at smaller, local scales, or concern about the lack of political action needed to protect local environments or ecosystems (Devictor & Bensaude-Vincent 2016, 19-20).

While an emphasis on the accumulation of big data for conservation biology and environmental science might lead to a neglect of local contexts, some researchers have instead emphasized potential ethical upshots and societal benefits of big data, and data sharing in particular, within these fields. For example, Soranno *et al.* (2015) claim that "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" (Soranno *et al.* 2015, 71). According to these authors, the increasing reliance on public participation in, and sponsorship of, research creates an ethical obligation for scientists to promote and facilitate data sharing.

Bibliography

Bowser, Anne, Andrea Wiggins, Lea Shanley, Jennifer Preece, and Sandra Henderson. "Sharing data while protecting privacy in citizen science." *Interactions* 21, no. 1 (2014): 70-73.

Cooke, Steven J. "Biotelemetry and biologging in endangered species research and animal conservation: relevance to regional, national, and IUCN Red List threat assessments." *Endangered species research* 4, no. 1-2 (2008): 165-185.

Devictor, Vincent, and Bernadette Bensaude-Vincent. "From ecological records to big data: the invention of global biodiversity." *History and philosophy of the life sciences* 38, no. 4 (2016): 13.

Hampton, Stephanie E., Carly A. Strasser, Joshua J. Tewksbury, Wendy K. Gram, Amber E. Budden, Archer L. Batcheller, Clifford S. Duke, and John H. Porter. "Big data and the future of ecology." *Frontiers in Ecology and the Environment* 11, no. 3 (2013): 156-162.

Jewell, Zoe. "Effect of monitoring technique on quality of conservation science." *Conservation Biology* 27, no. 3 (2013): 501-508.

Keeso, Alan. *Big data and environmental sustainability: a conversation starter*. Smith School Working Paper Series, 2014-04. University of Oxford, 2014.

Kelling, Steve, Wesley M. Hochachka, Daniel Fink, Mirek Riedewald, Rich Caruana, Grant Ballard, and Giles Hooker. "Data-intensive science: a new paradigm for biodiversity studies." *BioScience* 59, no. 7 (2009): 613-620.

Kitchin, Rob. "Big Data, new epistemologies and paradigm shifts." *Big Data & Society* 1, no. 1 (2014): 2053951714528481.

Sarkar, Sahotra. "Defining 'biodiversity'; assessing biodiversity." *The Monist* 85, no. 1 (2002): 131-155.

Sarkar, Sahotra, Robert L. Pressey, Daniel P. Faith, Christopher R. Margules, Trevon Fuller, David M. Stoms, Alexander Moffett et al. "Biodiversity conservation planning tools: present status and challenges for the future." *Annu. Rev. Environ. Resour.* 31 (2006): 123-159

Soranno, Patricia A., Kendra S. Cheruvelil, Kevin C. Elliott, and Georgina M. Montgomery. "It's good to share: why environmental scientists' ethics are out of date." *BioScience* 65, no. 1 (2015): 69-73.

Straka, Jason R., and Devin ME Turner. "What Those Who Seek Rare Birds Do For Ornithology." aba.org/birding. Accessed on October 27, 2016.

Sullivan, Brian L., Christopher L. Wood, Marshall J. Iliff, Rick E. Bonney, Daniel Fink, and Steve Kelling. "eBird: A citizen-based bird observation network in the biological sciences." *Biological Conservation* 142, no. 10 (2009): 2282-2292.

Wood, Chris, Brian Sullivan, Marshall Iliff, Daniel Fink, and Steve Kelling. "eBird: engaging birders in science and conservation." *PLoS Biol* 9, no. 12 (2011): e1001220.

Websites

eBird. 2012. eBird: An online database of bird distribution and abundance [web application]. eBird, Cornell Lab of Ornithology, Ithaca, New York. Available: http://www.ebird.org Accessed: October 27, 2016.

American Birding Association's Code of Birding Ethics: http://listing.aba.org/ethics/

Global Biodiversity Information Facility (GBIF): http://www.gbif.org/what-is-gbif

National Audubon Society: http://www.audubon.org