Citizen Science: Creating a Research Army for Conservation

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What is Citizen Science?

Citizen science projects involve people who are not professional scientists in scientific research. Most projects involve professional scientists at some level (e.g., training, designing protocols, analyzing and publishing data). Ideally, they result in data that advance scientific understanding and can be applied to real-world problems. Many programs have clearly defined educational components. Unlike most scientific research, citizen science is focused not solely on obtaining answers to questions; it often combines research, education, community development, and conservation outcomes.

Citizen scientists have been collecting weather data for more than two centuries. The first organized biological projects probably engaged citizens in collecting data on avian distribution and abundance (Droege 2007). There is also a long history of lay interest in insects; for example, the field notes and reports of many Victorian collectors comprise important contributions to our understanding of butterfly range, behavior, and abundance. The first citizen science project designed to answer a specific research question (versus inventory and monitoring projects) probably involved an insect, the monarch butterfly (Urquhart 1976). Today, organized citizen science programs are flourishing, and the Cornell Lab of Ornithology has recently developed a "toolkit" for program managers (www.birds.cornell.edu/citscitoolkit/).

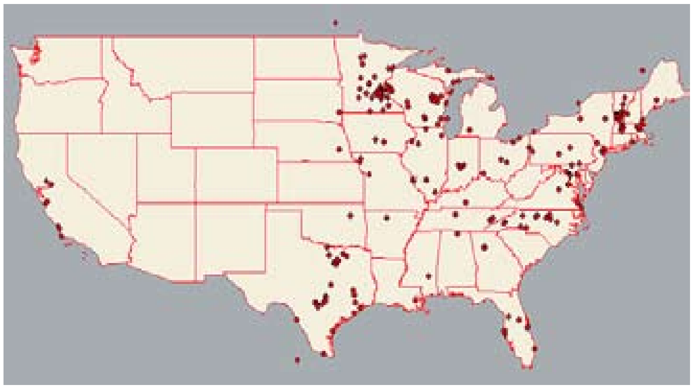

Fig. 1. Location of monarch larva monitoring sites. Each point represents a location that has been monitored for at least one summer.

Case Study: The Monarch Larva Monitoring Project

The Monarch Larva Monitoring Project (MLMP: www.mlmp.org) began in 1996; it was designed to describe temporal and geographical variation in monarch butterfly egg and larval abundances, and quantify monarch egg and larval survival (Prysby and Oberhauser 2004). Volunteers are recruited via ListServs and Web sites, word-of-mouth, or a network of cooperating nature centers. They learn monitoring protocols from hardcopy or downloaded instructions, or in training workshops.

Volunteers choose and describe their own monitoring sites, which include backyard gardens, abandoned fields and pastures, and restored prairies located throughout the monarchs' eastern breeding range (Fig. 1). The only requirement is that the site contain milkweed; there are no minimum requirements for the number of milkweed plants, and site size, type, and location; and they vary greatly. Volunteers estimate monarch densities weekly throughout the summer either by examining all the milkweed in smaller sites or a subset of plants in larger sites. They record the number of eggs and larvae observed and the number of milkweeds examined, and they identify larvae to stadium. Three optional activities include comparing characteristics of milkweed occupied by monarchs with the characteristics of randomly selected plants; collecting larvae to rear in captivity and estimate rates of parasitism by parasitoids; and collecting weather data.

Almost all of the volunteers enter their data into an online Microsoft Access relational database. They also send hard copies of the data, which are used to spot check online data for validation. Project managers contact volunteers for additional information when values seem unusual.

MLMP data have been used in articles that have been published in a variety of peer-reviewed publications; for example, Prysby and Oberhauser (2004) addressed basic distribution and abundance questions; Oberhauser et al. (2007) reported the rates of tachinid fly parasitism; Batalden et al. (2008) assessed potential effects of climate change. The protocol was used in a risk assessment of Bt corn, and the data are currently being analyzed to look for the impacts of land use changes and pesticide use on the abundance of monarch butterflies.

Project Outcomes

From a scientific perspective, a key outcome of the MLMP is the reminder that there is still much to be learned from basic distribution and abundance data. Volunteer-collected data have helped us to understand the patterns by which monarchs move into and out of breeding and migratory locations, and how these patterns vary from year to year. In addition, the data have provided direction for experimental and theoretical research. From an educational perspective, volunteers, including many children, have learned data collection protocols and had the opportunity to be engaged in authentic research. Many teachers, parents and other youth leaders use this program to engage children in scientific process.

Whereas scientific and educational outcomes of the MLMP and other citizen science projects are well documented, less attention is given to conservation outcomes. Volunteer assessments demonstrate that citizen science may provide broad conservation benefits by helping to develop a concerned and educated public who take an active stewardship role in conservation (Fig. 2). The most important reason MLMP volunteers give for their involvement is that their "work may help promote monarch conservation." Volunteers learn about the value and characteristics of monarch habitat, both through their own observations and project analyses distributed in an annual newsletter. They work to preserve habitat at many levels, from advocating a more environmentally friendly mowing regimen and insect-friendly pest control, to challenging parking lot, building, and road development projects that threaten monarch habitat. They describe their work to passersby, family, and friends, and local media, and often visit schools, clubs, and nature centers to present this work. These concerned, vocal, informed citizens have become members of a "research army for conservation."

The MLMP also produces data with applied conservation value. Like many other citizen science programs, it focuses on monitoring, and as such, can have particularly important conservation impacts. Monitoring differs from other research in an important way; most research questions could potentially be answered in many locations and at many times. Monitoring data, however, are specific to location and time; a missed monitoring opportunity can never be recovered. Because so many conservation programs depend on understanding how human activities affect particular species, species assemblages, or populations, we often use monitoring data to assess the need for and success of conservation efforts.

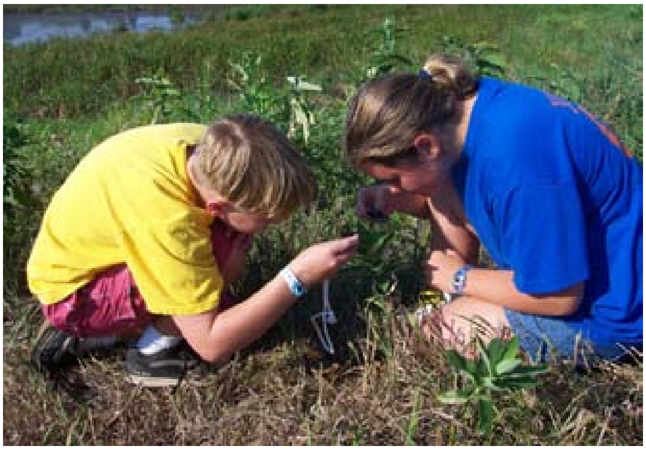

Fig. 2. Monarch larva monitoring project volunteers.

Using Citizen Science as a Research and Conservation Tool

Clearly, not all insect ecology research would benefit from the help of citizen scientists; however, this approach can be valuable to answering ecological questions. Appropriate projects include those for which large temporal and spatial scales are valuable; at least parts of the research are interesting and accessible to nonscientists; research protocols can be simple and inexpensive; and data quality can be judged fairly easily. Additionally, it is helpful if the project organizers have interest and expertise in conservation and education goals.

Data quality is an issue even with more centralized projects; many data published in scientific venues are collected by undergraduates with varying degrees of investment in their accuracy. However, scientists who use citizen-collected data often need to defend the quality of the data. Generally, there are two main sources of inaccuracies: identification or observation errors, and errors resulting from nonrandom observations. It is important for project coordinators to think about the ways in which these kinds of errors occur and develop ways to avoid and detect them. Face-to-face training with hands-on practice is probably the optimum way to develop accurate data collection strategies. However, easy-to-follow instructions that can be modified based on volunteer feedback are critical, as is training on random observations for many projects. It is also important that project organizers check all data and be familiar with "normal" data patterns. When necessary, they should delete impossible data sets, and if possible, interview volunteers with questionable data sets.

Summary

Citizen science can be a useful tool for entomological research—increasing general knowledge about and concern for insects and providing data with clear conservation relevance. If we could engage as many people in insect citizen science projects as are currently engaged in bird projects, insects and their habitats would be wellserved.

Acknowledgments

We thank the hundreds of MLMP volunteers who have contributed to this project; and Sonia Altizer, Michelle Solensky, Jolene Lushine, Cindy Petersen, Laura Molenaar, Liz Goehring, Alma De Anda, Reba Batalden, Grant Bowers and Dina Kountoupes for their help in developing protocols and communicating with volunteers.

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American Entomologist Summer Issue 2008 B08-012-D *Faith Kuehn*

The Cultural Connection

Faith B. Kuehn

Should the Entomological Society of America's (ESA) approach to insect conservation issues be guided strictly by science? What about using visual art, literature, or music to convey messages about threatened habitats, species declines, and the need for conservation? Pyle et al. (1981) argued that insects should be conserved, in part, because they provide inspiration for art and popular aesthetics. That this artistic inspiration enriches our lives is quickly evident, based on numerous depictions of butterflies, dragonflies, and bees in everything from paintings and sculpture to rock music and greeting cards. The ephemeral beauty of butterflies, along with their powerful associations with freedom and rebirth, make them popular images in art. These widely held, positive associations help in drawing the public's attention to the plight of many butterfly species. For example, reports of the monarch's population decline, attributed to over-logging in their overwintering forests in Mexico, brought public calls for protective action. Honey bees have been associated with human civilization for thousands of years and valued for their industry, as well as production of honey and wax. When colony collapse disorder was first noted in 2006, it was front-page news and generated widespread concern.

But developing public support for insect conservation beyond butterflies and honey bees involves overcoming "the perception challenge" (Samways 2005). The public's view of many insects is often shaped by negative messages that play on entomophobia or people's fear of insects inhabiting their homes and yards. Many insect taxa of conservation concern are small, obscure, and hard to identify; they don't sell for large sums of money; they do not bite or otherwise harm people; and generally they manifest features that continue to guarantee them political obscurity. Conservation programs for most insect species will require gaining support for the small and politically obscure, the "weak inheritors" (New 2000).

Joseph Scheer's "Sound Prints" provide one example of how art can broaden and transform the public's view of insects. Many microlepidoptera can be described as small and obscure moths. But Scheer's artistry transforms them into creatures of commanding beauty. "Sound Prints" are large, exceedingly detailed images of microlepidoptera that have been first scanned and then printed on specially chosen papers. Sewn within the seam of these prints are speakers that play sound recordings of moths' wing motions. (Fig. 1). These enlarged images are a window into previously unseen