

The Importance of Citizen Science in Forming Scientific Communities from the Local to the National Level

Big Visions, Big Data ... Big Problems, **RUSTY RUSSELL** (Department of Botany, Smithsonian Institution, Washington, DC 20013; russellr@si.edu).

There is an axiom of science is that there is never enough data. This is, of course, true for natural history sciences as well. However, a great deal of natural history data that has already been collected over the course of more than 250 years is still unavailable, locked in analog form, distant from most research efforts. Another common saying is that you cannot be in two places at the same time. Being in one body in one location also places a certain constraint on one's capacity to collect 'enough data'. In the last decade (and, technically, over many decades) a phenomenon generally called 'citizen science' has opened the doors to the creation of huge amounts of data on a scale previously unimaginable. From tiny, local projects to global efforts to better understand our planet and deep space, the incorporation of volunteers, both known and anonymous, has made a significant difference. This presentation will provide an overview of global 'big science' efforts that employ public participation, a discussion of the nature of projects that do and don't work, and a study of the mindset and behavior of individuals who commit themselves to help move science forward.

Rediscovering California: Engaging the Public in Biodiversity Research and Conservation, **ALISON YOUNG***, **REBECCA JOHNSON***, **SCOTT LOARIE**, **TERRENCE GOSLINER**, **ELIZABETH BABCOCK**, and **JEAN FARRINGTON** (California Academy of Sciences, 55 Music Concourse Dr., San Francisco, CA 94118; ayoung@calacademy.org, rjohnson@calacademy.org).

The mission of the California Academy of Sciences is to explore, explain, and sustain life. Our museum inspires visitors about the natural world, while our scientists document biodiversity and discover new species in hotspots around the globe. Our citizen science program combines science learning with research, empowering the public to do the same type of work as our scientists, while engaging communities to answer real research questions and connecting people to biodiversity all around them. We are developing a community of naturalists while simultaneously providing scientists and management partners with data required to better understand and conserve biodiversity.

Partnerships have been key to the success of the Academy's citizen science program. Strong partnerships with management organizations ensure data collected support both research and conservation outcomes. We have organized a citizen science coalition in the Bay Area to further best practices and biodiversity research in the region. With iNaturalist.org, we are building a global network of volunteers and professionals working together to tackle pressing biodiversity and conservation challenges. We are encouraging people to document organisms around them, to help answer research questions, and to come together in "bioblitzes" of parks and open spaces – all with iNaturalist and their smartphones. Together with iNaturalist we developed and launched an app that enables people globally to resurvey historical museum specimens. This experience in the field provides participants the excitement of discovery and demonstrates the importance of museum specimens while generating invaluable data about the changing distributions

of plants and animals, key information for conservation.

Thinking about Knowledge and Power: Orienting Undergraduates to the Potential and Limits of Citizen Science/PPSR, **DANIELA SOLERI** (Geography Department, University of California Santa Barbara, Santa Barbara, CA 93106-4060; soleri@geog.ucsb.edu).

"Citizen" science, or public participation in scientific research (PPSR), is quickly gaining attention and diversifying. Practitioners and other researchers are trying to delineate PPSR's theoretical and practical bases, even as its significance is being demonstrated. For example, there is accumulating evidence that PPSR can foster scientific literacy, environmental awareness, conservation activism, and community organizing; that different forms of participation are associated with different outcomes; and that data gathered by the public and by professionals can be comparable.

At its most fundamental level, PPSR is about knowledge and power. It addresses knowledge in applying the scientific method, though possibly in unconventional ways, but may also include other sources of knowledge. It addresses power because it broadens participation in scientific knowledge generation beyond the academy to any interested member of the public, and to any stage of the scientific process. Given its engagement with knowledge and power, and the hopes and ambitions of the many different current actors, PPSR appears to have much to offer higher education. In this presentation I explore some questions regarding how best to support PPSR's potential contributions to science and society in undergraduate education: What are the salient characteristics and critical issues to explore when introducing undergraduate students to PPSR and its unique strengths and shortcomings? How can we help students think critically and practically about the validity of scientific knowledge and democratizing potential of participation? The goal of this presentation is to stimulate discussion and exchange of ideas.

Urban Citizen Science and the Future of Cities, **LILA M. HIGGINS***, **GREGORY B. PAULY**, and **BRIAN V. BROWN** (Natural History Museum, 900 Exposition Boulevard, Los Angeles, CA 90007; lhiggins@nhm.org).

Los Angeles is the 14th largest urban agglomeration in the world, with over 18 million people inhabiting 4,850 square miles. Los Angeles also sits in the California Floristic Province, one of Conservation International's 34 global "biodiversity hotspots." Despite the high biodiversity and remarkable urbanization of the region, very little research has focused specifically on urban biodiversity even though such studies can be quite fruitful. For example, in sampling insects for one week in one backyard, scientists at the Natural History Museum of Los Angeles County (NHMLAC) discovered one fly species new to science and two other species never before documented in North America. But how do you study biodiversity across a large urbanized region where much of the land is private? We suggest that citizen science is the best answer. Over the last 11 years the NHMLAC has developed a suite of citizen science projects that meet the needs of both scientists and urban residents. Nature Gardens were constructed as a field site and training ground for citizen scientists, and two signature projects were begun that study insects and herpetofauna. Both projects examine how urbanization is impacting the distribution of species and also document introduced species. By engaging citizen scientists to document L.A.'s biodiversity, the Museum is building a dataset, through crowdsourcing, that can influence conservation

and urban planning. These data will help Angelenos build a city that works better for humans and for wildlife and can serve as a model to other urban agglomerations around the world.

*Seeking Out Stink Bugs in Southern California: Using Citizen Scientists to Learn More About Stink Bug Diversity, Behavior and Distribution, and Track the Spread of the Invasive Brown Marmorated Stink Bug (*Halyomorpha halys*)*, **JAMES M. BRYANT**^{1*} and **MARK S. HODDLE**² (¹Museum Department, City of Riverside, 3580 Mission Inn Ave., Riverside, CA, 92501; ²Center for Invasive Species Research, University of California, Riverside, CA, 92521; jrbryant@riversideca.gov).

The Brown Marmorated Stink Bug (BMSB), while a severe agricultural and home owner pest on the US east coast, is a relatively new invasive pest in CA and its distribution within the state is not well understood. For this reason, the project partners are launching an effort to recruit citizen science volunteers to employ smartphone applications and other digital methods for recording and sharing nature observations, in order to document “finds” of stink bugs, in general, in Southern California, and ultimately provide early detection of additional occurrences of BMSB. Most stink bug species are large, easy to photograph, with conspicuous egg masses, and the partners would provide on-line instructions for collecting georeferenced observations as well as simple tools for stink bug identifications and recognition of evidence of parasitism. Once submitted, photo reports would be verified by Museum and UCR Entomology personnel and then databased for analysis. The national BMSB research team will be aided in its planning for deployment and evaluation of a biological control program for this pest. Via on-line sharing tools, volunteer participants would quickly see concrete results of their efforts, acquire a positive picture of native species while heightening alertness to BMSB and other invasive species, and ultimately gain appreciation for the role of naturally-occurring enemies of pests as well as species used in biological control programs.