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Lara A. Roman, Lindsay K. Campbell, and Rebecca C. Jordan

Abstract. This special issue is the second of two dedicated to civic science. As shared in the first special issue, "Civic science in urban forestry is a means of engaging the public in the study, management, and care of urban trees, and includes varied approaches with different disciplinary foundations" (Roman et al. 2018). We describe highlights from six articles (including original research and short communications) that assess program evaluation, data quality, and volunteer motivation. With these articles, we aim to continue our consideration of current best practices and future research needs for urban forestry community science.

   Key Words. Citizen Science; Civic Ecology; Co-management; Knowledge Co-production; Participatory Research; Urban Ecology; Urban Forestry; Data Quality.

Richard Hallett and Tanner Hallett

Abstract. Emerald ash borer (*Agrilus planipennis*) has killed millions of trees in the United States. Community managers face treatment or removal decisions for all publicly owned ash (*Fraxinus* spp.) trees. These decisions are based on the overall condition of each tree. In this study, the U.S. Forest Service-trained a Boy Scout troop in Oconomowoc, Wisconsin, U.S., in a tree health assessment protocol that used rubrics designed to measure physiological stress symptoms. The city provided tree inventory data, which included the location of 316 city-owned ash trees. After a two-hour training session, the Scouts and adult leaders assessed all ash trees in August 2015. A tree health expert re-assessed 20% of the trees. The protocol measured diameter at breast height and included a suite of tree stress assessment variables. Researchers used a five-class system for defoliation, leaf discoloration, and overall vigor. Fine-twig dieback was estimated in 5% classes. Digital photographs were taken and automatically processed so as to measure percent crown transparency. Expert/volunteer agreement for diameter at breast height was within 2.5 cm 92% of the time; defoliation, discoloration, and vigor were within two classes 100%, 93%, and 92% of the time, respectively. Crown dieback estimates were within 10% of each other 76% of the time, and transparency estimates were within 15% of each other 76% of the time. Researchers calculated an overall stress index value and ranked the trees from lowest to highest stress. The volunteer-generated data enabled Oconomowoc to make science-based management decisions for its infested ash trees.

   Key Words. *Agrilus planipennis*; Ash; CBM; Community-Based Monitoring; Emerald Ash Borer; *Fraxinus*; Tree Inventory; Wisconsin.

Keir Hamilton, Andrew K. Koeser, and Shawn M. Landry

Abstract. Freely available ecosystem service models, like those incorporated in the i-Tree suite of tools, have helped scientists and practitioners estimate the environmental functions and economic benefits associated with their urban forest. Traditionally, professional inventory crews have been used to collect the inventory data needed for these models, but several cities have established crowdsourcing platforms to allow volunteers to map and inventory trees. Students in this study hosted and participated in an Arbor Day inventory collection event, using a newly released crowdsourcing application for mapping trees and estimating ecosystem services. The students located, identified, and measured trees on the University of South Florida campus (Tampa, Florida, U.S.) after a brief training session. After the one-day event, a more rigorously-trained field crew attempted to relocate the inventoried trees to assess the accuracy and variability of the data collected. Of the 339 trees inventoried at the original event, only 57.8% (n = 196) had coordinates that were accurate enough to re-measure. Of the 196 re-measured trees, 91.3% (n = 179) were correctly identified. However, only 47.9% (n = 91) of trees had dbh measurements within a one inch (2.5 cm) threshold for accuracy. Results of this experiment offer insights for communities looking to host special inventorying events to increase participation in crowdsourcing tree inventory initiatives.

   Key Words. Citizen Science; Crowdsourced Data; Data Accuracy; Data Quality; Ecosystem Services; Florida; Tree Inventory; Urban Forestry.

Abstract. Citizen science programs are not static; they change over time in response to new program priorities and emerging technologies, as well as to improve work flow for program staff and volunteers. In this article, the authors present a case study of an evolving urban forestry citizen science program at the Pennsylvania Horticultural Society, a nonprofit organization in Philadelphia, Pennsylvania, U.S. The Tree Checkers program involves tree stewards recording data each summer about recently planted tree survival, growth, crown vigor, and maintenance, while also engaging their neighbors to encourage proper tree care. The program began in 2011, but changed in 2016 to use a new online data collection tool that was integrated into a larger tree data management system. Tree Checkers has also shifted to be more focused on rigorous data to report program performance and share information with researchers, whereas the earlier years of Tree Checkers were centered on enabling and encouraging neighborhood tree stewards to plan for tree care. A recent data quality evaluation showed that volunteer data was reasonably consistent with data reported by more experienced interns for tree survival, vigor, and trunk measurements, but stewardship variables were not interpreted and recorded consistently. By making rigorous data more central to Tree Checkers, program staff also sought to institutionalize monitoring within the organization, allowing for direct comparisons of outcomes year-to-year. The authors close with lessons learned that are relevant to other organizations seeking to create or enhance outcomes monitoring programs with citizen scientists.

Key Words. Adaptive Management; Citizen Science; Data Quality; Tree Mortality; Tree Survival; Urban Environmental Stewardship; Urban Forestry; Volunteer Monitoring.

Abstract. Environmental restoration projects are widely used as a means to reverse the degradation and damage done to an ecosystem by a range of different disturbances. Literature shows that engaging the public in restoration projects is important to long-term success; therefore, it is important to understand who participates in stewardship of these projects and why. Here, researchers investigate what aspects of individuals' environmental knowledge, environmental identity, demographics, views of and engagement in their community, and current civic stewardship might predict willingness to engage in restoration stewardship activities. This project takes place in the context of an ongoing maritime restoration planting experiment in the Jamaica Bay region of New York City, New York, U.S. The study authors developed a questionnaire with scales of the metrics above. Researchers found that individuals who were most willing to engage in environmental restoration stewardship had high sense of personal agency (i.e., their actions can have impact), saw value in their stewardship contributions for their community, were older, and were very knowledgeable about environmental issues. Additionally, the desire to preserve local biodiversity was not correlated with engagement in environmental restoration programs, whereas a desire to help and improve the local community was positively correlated. These results suggest a need to reframe how scientists and practitioners approach and discuss future restoration projects with community members to garner support for these types of programs.

Key Words. Biodiversity; Civic Science; New York City; Restoration; Stewardship; Urban Ecology.

Abstract. The Forest Health Ambassador Program, a joint public-private initiative in Oakville, Ontario, Canada, recruits volunteers from the community to assess municipal street trees for health issues and signs of invasive insects. In partnership with municipal employees, staff from BioForest, a private consultant, trains volunteers to inspect trees for a suite of structural and foliar conditions, as well as for signs and symptoms of infestation by emerald ash borer, gypsy moth, and Asian longhorned beetle. Since 2014, 4,871 street trees have been assessed by a growing base of volunteers. The program effectively increases the number of participants involved in the early detection of invasive pests, beyond what government resources typically allow. Thus, the program entails a low-cost investment that provides multiple ancillary benefits and channels community efforts into a cohesive product. The results provide data with direct implications for municipal forestry operations and help identify trends in urban forest health over time. For example, detections of relatively high numbers of gypsy moth egg masses were reported by volunteers, allowing the municipality to take remedial action and mitigate damage. A variety of media are used to advertise the program, including community newspapers and social media, as well as communications in local schools and at community events. The program is well-suited to high school students, who are able to complete curriculum-mandated volunteer hours through the program, while simultaneously gaining environmental knowledge. The program allows for the proliferation of awareness and education pertaining to municipal urban forest issues, particularly those related to invasive species and urban tree health.

Key Words. Canada; Citizen Science; Community Engagement; Environmental Awareness; Invasive Species; Monitoring; Ontario; Urban Trees.

Edith de Guzman, Rachel Malarich, Lori Large, and Sharon Danoff-Burg

Inspiring Resident Engagement: Identifying Street Tree Stewardship Participation Strategies in Environmental Justice Communities Using a Community-Based Social Marketing Approach.....291

Abstract. Tree-planting municipalities and organizations face multiple challenges to achieving thriving urban forests, among which is providing establishment-period care to young trees. In arid and semi-arid regions in particular, delivering water to trees is a resource- and time-intensive activity often not covered by funding specified for tree planting. This study sought to address the need for establishment-period care by producing a replicable approach to engaging residents in environmental justice communities to actively care for young street trees planted in front of their homes. Using community-based social marketing in the community of Huntington Park (Los Angeles County, California, U.S.), researchers investigated socioeconomic and cultural characteristics to barriers and motivators regarding tree stewardship (i.e., watering, mulching, and weeding) and developed an outreach program strategy accordingly. The program was pilot-tested and evaluated for effectiveness in changing behaviors. Active, in-person outreach (door-to-door engagement with residents using program materials and demonstrating tree care actions) was tested against passive outreach (program materials were left at the doorstep); both were compared to baseline conditions. Evaluation of soil moisture, tree health, and presence of mulch was conducted over a six-week period after program outreach. Trees at homes in the active outreach group had significantly higher soil moisture, more mulch, and better observed health than trees at homes in the passive outreach group. Both groups had better outcomes as compared to pre-outreach baseline conditions. Results indicate that tree planting programs with limited resources for maintenance may find success in fostering tree stewardship among residents through active engagement.

Key Words. Behavior Change; California; Community Forestry; Community-Based Social Marketing; Environmental Justice; Environmental Psychology; Los Angeles; Nonprofit Organization; Resident Engagement; Social Marketing; Stewardship; Watering.