Citizen Science: The Benefits and Challenges of Using Volunteers for Invasive Species Monitoring and Management

National Ecological Observatory Network

A project sponsored by the National Science Foundation and proudly operated by Battelle
What is Citizen Science?
Benefits of Citizen Science

- Data relevant to local conservation issues
Example: Japanese Stilt Grass

- Rare, fire-dependent pine savannah habitat, home to endangered Red-cockaded Woodpecker population (Piney Grove, TNC)
- Recent Japanese Stilt Grass incursion, known to alter normal fire dynamics
- Hotter, more intense fires, damaging to native shrubs and trees
Benefits of Citizen Science

• Data collection across space and time
Benefits of Citizen Science

• Changes in attitudes and behavior
RESEARCH REPORT

Scientific knowledge and attitude change: The impact of a citizen science project

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This paper discusses the evaluation of an informal science education project, The Birdhouse Network (THIN) of the Cornell Laboratory of Ornithology. The Elaboration Likelihood Model and the theory of Experiential Education were used as frameworks to analyze the impact of THIN on participants' attitudes toward science and the environment, on their knowledge of bird biology, and on their understanding of the scientific process. The project had an impact on participants' knowledge of bird biology. No statistically significant change in participants' attitudes toward science or the environment, or in participants' understanding of the scientific process, could be detected. The results suggest that projects must make explicit to participants the issues that they are experiencing. In addition, the results suggest that more sensitive measures need to be designed to assess attitude change among environmentally aware citizens.

Introduction

The need to encourage public understanding of science is rarely contested. In societies more and more technological, individuals must be able to make informed decisions regarding scientific issues that affect their personal lives, the well-being of their communities, and national issues such as health care and energy policy. Research has shown, however, that in the United States, the general level of understanding of basic scientific concepts and of the nature of scientific inquiry may be insufficient for the average citizen to be able to make informed decisions (National Science Board, 2002). In this context, efforts have been made in the last decade not only in reforming science education in the nation's school system (National Research Council, 1996), but also in promoting informal science education, or science education outside the classroom (Cline et al., 1994; Falk, Donovan, & outros).

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The impacts of an invasive species citizen science training program on participant attitudes, behavior, and science literacy

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Abstract

Citizen science can make major contributions to informal science education by targeting participants' attitudes and knowledge about science while changing human behavior towards the environment. We examined how training associated with an invasive species citizen science project affected participants in these areas. We found no changes in science literacy or overall attitudes between tests administered just before and after a one-day training program, matching results from other studies. However, we found improvements in science literacy, and knowledge using science-specific measures and in self-reported intention to engage in pro-environmental activities. While we noted modest change in knowledge and attitudes, we found comparison and interpretation of these data difficult in the absence of other studies using similar measures. We suggest that alternative survey instruments are needed and should be calibrated appropriately to the pre-existing attitudes, behavior, and levels of knowledge in these relatively sophisticated target groups.

Keywords: attitudes, behavior, citizen science, global positioning systems, invasive species, science literacy, vegetation monitoring

1. Introduction

A scientifically literate citizenry is necessary to understand and make informed decisions surrounding science, technology, and environmental issues (Miller, 2004). Although science literacy among the American population as measured by the Science and Engineering Indicators (SEI) has

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neon BATTelle
CHALLENGES
THIS IS BOB, OUR NEW CITIZEN DATA SCIENTIST. HE PREVIOUSLY WORKED AS A CITIZEN DENTIST AND A CITIZEN PILOT.
“Citizen scientists: I may come round to thinking that this term has a place in the scientific lexicon the day the US medical community agrees to use the term ‘citizen surgeons’ to describe well-meaning souls with a day’s medical training…Remember your audience: you are writing for science professionals, so let’s not indulge in the cant and pretense of managerial jargon.”
Example 1: Setting Eligibility Criteria

- Delaney et al. Biological Invasions, 2008
  - Using volunteers to identify Asian shore crab
  - Tested protocol in field to determine eligibility criteria
    - Species differentiation: over 80% accuracy for 3rd graders and 95% accuracy for 7th graders
    - Gender: exceeded 80% for 7th graders, while 95% accuracy was found for students with at least 2 years of university education
  - Identified a range expansion, 60-km northeast of previously recorded locations
Example 2: Integrating Efforts

  - Quantified observer variability during pika surveys
  - Volunteers can reliably detect pika site occupancy
  - Data on population dynamics should be collected by professionals
Example 3: Online Data Validation

Assessing data quality in citizen science

Margaret Kosmala\textsuperscript{1,*}, Andrea Wiggins\textsuperscript{2}, Alexandra Swanson\textsuperscript{3}, and Brooke Simmons\textsuperscript{3,4}

Ecological and environmental citizen-science projects have enormous potential to advance scientific knowledge, influence policy, and guide resource management by producing datasets that would otherwise be infeasible to generate. However, this potential can only be realized if the datasets are of high quality. While scientists are often skeptical of the ability of unpaid volunteers to produce accurate datasets, a growing body of publications clearly shows that diverse types of citizen-science projects can produce data with accuracy equal to or surpassing that of professionals. Successful projects rely on a suite of methods to boost data accuracy and account for bias, including iterative project development, volunteer training and testing, expert validation, replication across volunteers, and statistical modeling of systematic error. Each citizen-science dataset should therefore be judged individually, according to project design and application, and not assumed to be substandard simply because volunteers generated it.


Citizen science – research that engages non-professionals in the process of creating new scientific knowledge (Bonney \textit{et al.} 2014) – has expanded greatly in the past decade (Figure 1; McKinley \textit{et al.} 2015). Rising interest in this approach has been fueled in part by rapid technological developments (Newman \textit{et al.} 2012), by policy and management needs for large-scale and long-term monitoring datasets (Conrad and Hilchey 2011), and by increased emphasis on science outreach and education (Silvertown 2009). While the ecological and environmental sciences have been leaders in citizen science, boasting some of the longest-running projects that have contributed meaningful data to science and conservation, including the Cooperative Weather Service (first year of data collection: 1890), the National Audubon Society’s Christmas Bird Count (1900; >200 publications have relied on the resulting dataset), the North American Breeding Bird Survey (1966; >670 publications), the leafing and flowering times of US lilacs and honeysuckles (1956; >50 publica-
“Successful projects rely on a suite of methods to boost data accuracy and account for bias, including iterative project development, volunteer training and testing, expert validation, replication across volunteers, and statistical modeling of systematic error. Each citizen-science dataset should therefore be judged individually, according to project design and application, and not assumed to be substandard simply because volunteers generated it.”
Resources Available to You
The power of citizen science

Citizen science is the involvement of the public in scientific research – whether community-driven research or global investigations. The Citizen Science Association unites expertise from educators, scientists, data managers, and others to power citizen science. Join us, and help speed
In 2019, we celebrate and explore the *deep roots* and *broad branches* that form the *strong core* of this field.
What are Invasive Species?

Any species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health. These non-native species aggressively compete with and displace the associated flora and fauna communities.

Bring the power of EDDMapS to your smartphone

Introducing BugwoodApps - comprehensive mobile applications that engage users with invasive species, forest health, natural resource and agricultural management.

iPhone | iPad | Android

Projects

- EDDMapS IPM
- Southeast Early Detection Network
- EDDMapS West
- EDDMapS Midwest
- Mid-Atlantic Early Detection Network
- Invasive Plant Atlas of New England
- Florida Invasive Species Partnership
- EDDMapS Alberta - Alberta Invasive Plants Council
- EDDMapS Ontario
- EDDMapS Prairie Region - Manitoba and Saskatchewan
- Biological Control Agents of Weeds

Recent Reports

Burmese python (Python molurus ssp. bivittatus)

Kevin Reich

October 11, 2013
Collier County, Florida
Welcome to the EDDMapS Midwest!

EDDMapS Midwest (formerly the Great Lakes Early Detection Network) is a collaboration among multiple stakeholders working to rapidly respond to new invasive species sightings in the Great Lakes and Midwestern states (Minnesota, Wisconsin, Illinois, Indiana, Iowa, Michigan, Missouri, and Ohio). To accomplish this, we have developed this website and associated smartphone and tablet app to make it easy to report sightings of invasive species. We have developed a web-based alert system that emails users when new sightings for species or areas of interest are entered into our member data management systems. As new sightings are reported, a network of professionals will be available to verify new sightings and natural resource managers will be notified to take appropriate management actions.

The website will serve as a communication tool to facilitate volunteer networks. Through these partnerships, we hope to make effective early detection and rapid response a reality.

Can I Report from a Smartphone?

Yes, regional apps are available for iPhones, iPads, and Android devices. These apps include high-resolution images, descriptions, and distribution maps. Users can take pictures and use the built-in GPS to quickly report from the field.

Statistics

1,090,661 County Reports
899,471 Point Reports
1,548 Species

Recent Reports in EDDMapS Midwest

- meadow knapweed by Mari Hartel in Pine County, Minnesota
- meadow knapweed by Mari Hartel in Pine County, Minnesota
- Bohemian knotweed by Mari Hartel in St. Louis County, Minnesota
- meadow knapweed by Mari Hartel in Pine County, Minnesota
- brown marmorated stink bug by Marc Thravits in Portage County, Wisconsin
- More Reports

Training Power Points

- EDDMapS Midwest Training Revisits and Edits
- EDDMapS Midwest Training Bulk Data
- EDDMapS Midwest Training Smartphone App
- EDDMapS Midwest Training Using the Website
- EDDMapS Midwest Advanced Training

Queries and Reports

- Minnesota Department of Natural Resources
### Data Quality Assessment

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<th>Yes</th>
<th>No</th>
<th>Quality grade</th>
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<td>No</td>
<td>0 people agree</td>
<td>casual</td>
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<tr>
<td>Date?</td>
<td>Yes</td>
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<td></td>
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<tr>
<td>Georeferenced?</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photos or sounds?</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the organism wild/naturalized?</td>
<td>Unknown</td>
<td>What do you think?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>Does the location seem accurate?</td>
<td>Unknown</td>
<td>What do you think?</td>
<td>Yes / No</td>
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<tr>
<td>Does the date seem accurate?</td>
<td>Unknown</td>
<td>What do you think?</td>
<td>Yes / No</td>
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<tr>
<td>Appropriate?</td>
<td>Yes</td>
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<td><strong>Community-supported ID?</strong></td>
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</table>
Project Finder

invasive species

Enter a location

All Activities

All Topics

only for projects that...

only show projects for...

1-10 of 25 (Order by: match quality, newest, oldest)

Midwest Invasive Species Information Network

MISIN

Midwest Invasive Species Information Network

MISIN: Midwest

Goal: EDRR resource for invasive species in the Midwest region of U.S.

Task: report sightings of invasive species in their area

Where: See project description

Learn More

iMapInvasives

iMapInvasives

Goal: Observe and report invasive species in New York State

Task: Create observations using mobile application or online form

Where: New York, USA
Find Your Local Master Naturalist Program: ANROSP.ORG
Invasive Species

Invasive Species Blitz Program Materials

As you may know, invasive species such as buckthorn, garlic mustard, and wild parsnip pose serious threats to Minnesota's natural resources, ecosystems, and economy. These materials help new volunteers to join in a statewide effort to tackle the growing problem of invasive species.

The tools in this page and the links below will help you make a plan to manage invasive species at a site of your choosing and host local invasive plant removal events. You may even wish to adopt a local natural area you can regularly monitor and provide stewardship for into the future.

Quick Menu

Tools | Recommended Resources | Species-specific Resources | Story Map

Tools

Invasive Species Project Planner

A useful document to help you plan your own event with one or more partner organizations. (PDF, 433KB.)

Photo Credit: UMN Extension.
Helping federal agencies accelerate innovation through public participation.
Explore Projects
This searchable database provides a government-wide listing of citizen science and crowdsourcing projects designed to improve cross-agency collaboration, reveal opportunities for new high-impact projects, and make it easier for volunteers to find out about projects they can join.

Read more

Join Us
There are two primary groups within the federal government working collaboratively to advance the use of these tools, namely the Federal Community of Practice on Crowdsourcing and Citizen Science (CCS) and the Agency Citizen Science and Crowdsourcing Coordinators.

Read more

Plan Your Projects
The Toolkit provides five basic process steps for planning, designing and carrying out a crowdsourcing or citizen science project to help federal employees use crowdsourcing and citizen science to advance the missions of their agencies.

Read more
People-powered research

WHAT’S THIS?

Discover

The Zooniverse brings people across the sciences together to unlock answers to big challenges.

DO SCIENCE

Bring the Zooniverse to your community.

Sign in

383,901,345
CLASSIFICATIONS SO FAR BY
1,592,264 REGISTERED VOLUNTEERS

A vibrant community. Zooniverse gives people of all ages and backgrounds the chance to participate in real research with over 50 active online citizen science projects. Work with 1.6 million registered users around the world to contribute to research projects led by hundreds of researchers.
Feedback and Acknowledgement