



Monitoring nature...

... through citizen science

# The Art and Science of Multi-Scale Citizen Science Support:

Guidelines, Recommendations, and Lessons Learned in  
Developing Cyberinfrastructure Support Systems

Presented by: Greg Newman  
August 13<sup>th</sup>, 2010





# Context

- Many citizen science programs
- Generating volumes of ecological data
- With different goals & objectives
- In different domains or subject areas
- Using different data collection protocols
- Having different data curation needs



# Objectives



- Develop a cyberinfrastructure system in support of citizen science programs
- Offer guidelines to those developing cyberinfrastructure systems for programs operating at multiple spatial and temporal scales in many domains



# www.citsci.org

Development Server (Ibis-dev)

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## CitSci.org

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Photo By: Linda Hurt

**How you can help**

CitSci.org is website in support of citizen science. It allows citizens, school groups, and professionals to enter species observations into a global database. The observations are then used for natural resource management, scientific studies, and environmental education. CitSci.org provides an opportunity for students and volunteers to perform field studies that contribute to our collective biological understanding. Submit your observations today!

### Featured Project

[Jim](#)  
[All Projects](#)

### Featured Species

[Tamarisk \(\*Tamarix\*\)](#)



### New Discoveries

[August 11th, 2010](#)  
[All Sightings](#)



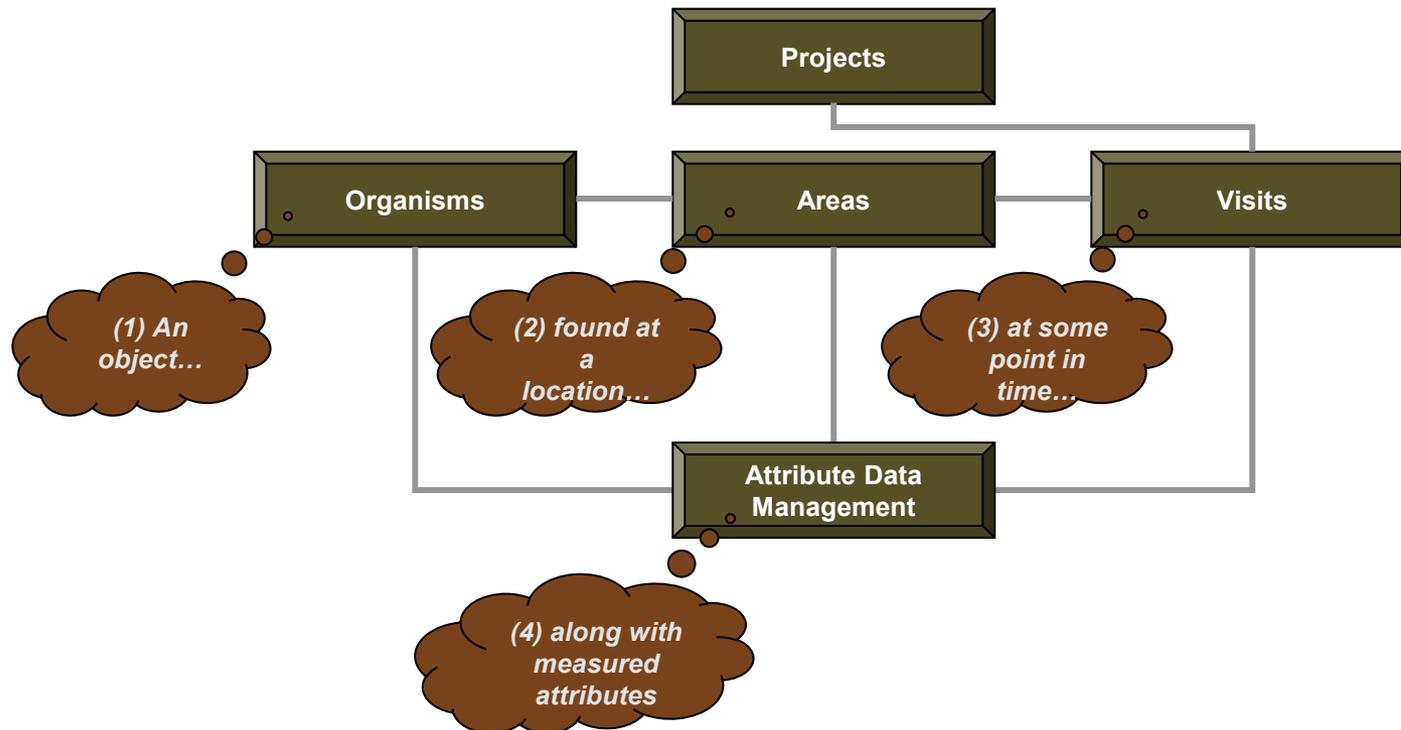
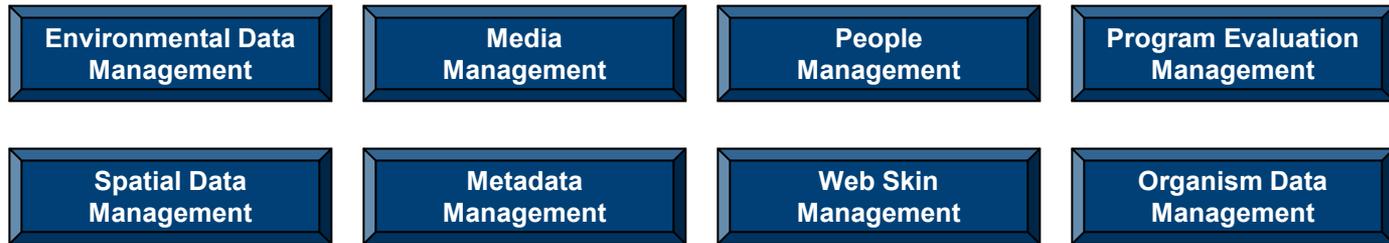
# Approach



- Follow User-Centered Design
- Use iterative software development lifecycle
  - Investigation, design, development, testing, evaluation, and maintenance
- Develop CitSci.org ([www.citsci.org](http://www.citsci.org))
  - Organize data into projects within CitSci.org
- Create cyberinfrastructure flexible enough to rapidly develop targeted “web skins”
  - Create an online website management system
- Learn from our mistakes



# General Database Schema





# Join a Project

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## Projects [help](#)

[Any Letter](#) [A](#) [B](#) [C](#) [D](#) [E](#) [F](#) [G](#) [H](#) [I](#) [J](#) [K](#) [L](#) [M](#) [N](#) [O](#) [P](#) [Q](#) [R](#) [S](#) [T](#) [U](#) [V](#) [W](#) [X](#) [Y](#) [Z](#)

Search for:  Advanced:  Only Species For This Website:

Projects 1 through 10 of 28:



### [Absolute Zero: Reed Canary Grass](#)

We educate property owners and train volunteers to identify reed canary grass and GPS its locations in the vicinity of a Northeast Wisconsin lake. Qualified individuals seek to control the invasive with the property owner's permission. Wetlands with varying amounts of RCG allow us to test treatment protocols ...



### [Absolute Zero: EWM](#)

We educate boaters and property owners about the threat of Eurasian water-milfoil and train those interested in preserving surface water resources to locate and remove Eurasian water-milfoil from a 200 acre lake in Northeast Wisconsin. Identified at an early stage of infestation, the goal is to keep the incidence low, ...



### [Absolute Zero: Phragmites](#)

We educate riparian property owners on a lake in Northeast Wisconsin about the detrimental effects of phragmites. Property owners and volunteers report outbreaks along



# Enter Data

Test Server (Ibis-test)

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## Pika Monitoring Form

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### Date of the observation

Date:	July	22nd	2010
Recorder:	-- Select a Recorder --		
Authority:	-- Select an Authority --		
Search Time (minutes):			Minutes
Comments:			

### Location information

Name:		Required
Datum:	WGS_84	Required
Longitude <sup>1</sup> :		Required
Latitude <sup>2</sup> :		Required
Accuracy <sup>3</sup> (meters):		Required



# Make a Map

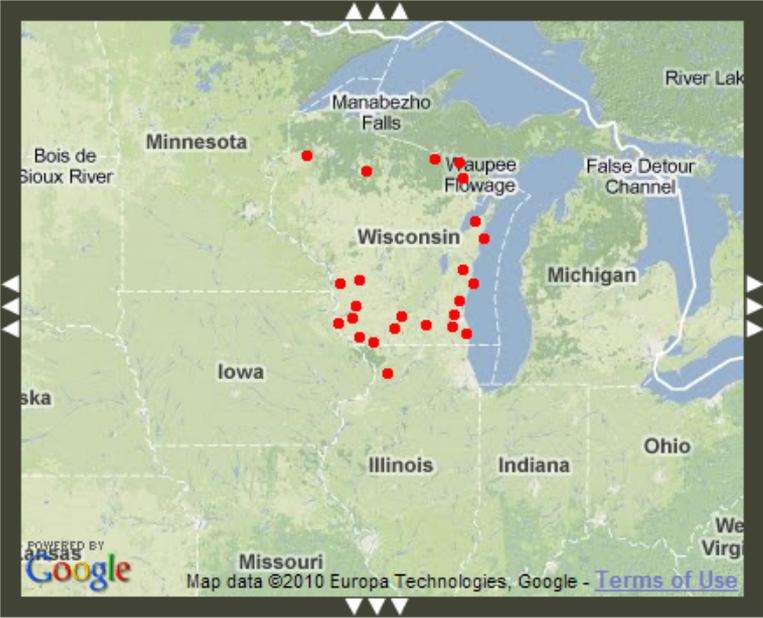
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  - Google: Terrain
  - Google: Map
  - Google: Satellite
  - Google: Hybrid

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# View Project Statistics

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Fighting invasive species...

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## Project Statistics

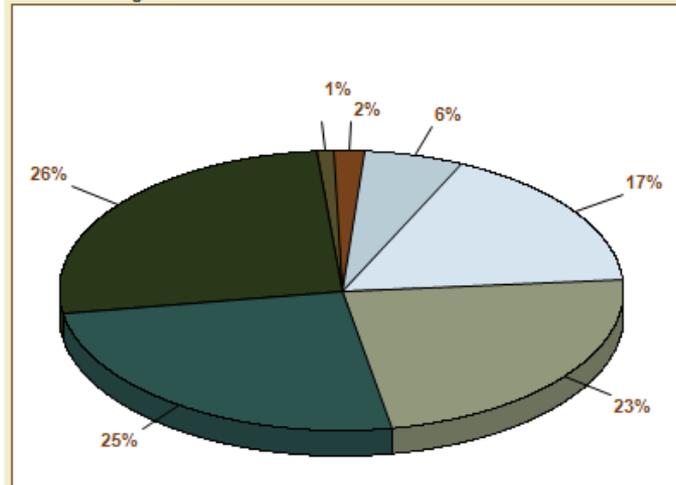
[To Project Information](#)

### Top Ten Sightings By Species



### Overall Project Statistics

Number of species: 7  
Number of surveys: [104](#)





# Targeted Web “Skins”

- Required when features go beyond basic functionality
- Appropriate when user-base dictates focused website
- Possible when funding is available to develop custom features and provide maintenance support



# Skins: Africanized Honey Bees



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## Africanized Honey Bees



Decision Support Through Earth Science Research

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Photo by Diana Yates / U. of Illinois

European honey bees (pictured above) are disrupted by the spread of the invasive Africanized Honey Bee (AHB).

## Welcome!

The Africanized Honey Bee (AHB) project is funded under the Decisions Support ROSES Program to address national needs related to: (1) the prediction of suitable habitat for the AHB as an invasive species and (2) the agricultural requirements related to the health of the Nation's honey bees with respect to climate impacts on forage availability. In addition to NASA and USGS, the U.S. Department of Agriculture (USDA) Agricultural Research Service (ARS), Arizona State University, and Apiary Inspectors from several states are participating as concerned decision makers.

## HoneyBeeNet - Creating a national network

There are over 100,000 beekeepers in the US, with an average distribution of 1 hive per 2 square kilometer. Hives can be easily placed on scales to produce valuable and highly informative data on the timing of nectar flow. The [HoneyBeeNet](#) website provides a central location for the collection and



# Skins: Forest Health Data



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Colorado State University

## Colorado Forest Restoration Institute

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 Welcome to CFRI

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Heading 2

Paragraph



# However...

“The hubris surrounding new technical solutions for effective data standards, data sharing, and cyber-infrastructure development may mask complications experienced by developers (Ribes and Finholt 2009).”

Novel platforms ... often lack the human resources required to maintain and upgrade technology (Ribes and Finholt 2009)

Ribes, D. and T. A. Finholt. 2009. The Long Now of Technology Infrastructure: Articulating Tensions in Development. *Journal of the Association for Information Systems* 10:375-398



# Guidelines



- Follow User-Centered Design
- Use iterative development lifecycle
  - Investigation, design, development, testing, evaluation, and maintenance
- Stay flexible and be ready to adapt
- Create short and simple documentation
- Avoid feature creep
- Build capacity (education in informatics)
- Keep it simple



# Recommendations

- Start with a requirements specification
- Organize data into projects
- Customize using web skins when needed
  - Complexity of custom features required
  - Level of engagement and longevity of use expected
  - Maintenance and customer support funds available
- Allow custom data attributes by project
- Add volunteer management features
- Incorporate program evaluation features
- Make sure that data come back to volunteers
- Make the system as participatory as possible



# Recommendations (cont.)

- Standardize within projects (be consistent)
- Fix data quality errors before data are entered
- Automate features where appropriate... but...
- Keep humans involved as much as possible
- Ensure data interoperability with standards where standards exist
- Use appropriate social media and web 2.0
- Focus on data sharing and data use /re-use
- Use HCI testing
- Make it fun and easy to use



# Conclusions

- Carefully designed systems can support programs when built with a flexible architecture
- Web skins allow us to rapidly develop unique systems for unique circumstances, yet share common base classes and database tables
- Using standards, controlled vocabularies, and mutually exclusive attributes allows for data exchange data through web services easily
- Integrating program evaluation into cyber-infrastructure systems improves our ability to track effectiveness



# Thanks!

- Dr. Jim Graham
- NSF, USGS, NASA, Nick Young, Kirstin Holfelder, Lee Casuto, Tom Stohlgren, Paul Evangelista, Sara Simonson, Michelle Kinseth, Melinda Laituri, Sophia Linn, Kris Kodrich, John Moore, NREL, CSU, ISTECC, and so many others...