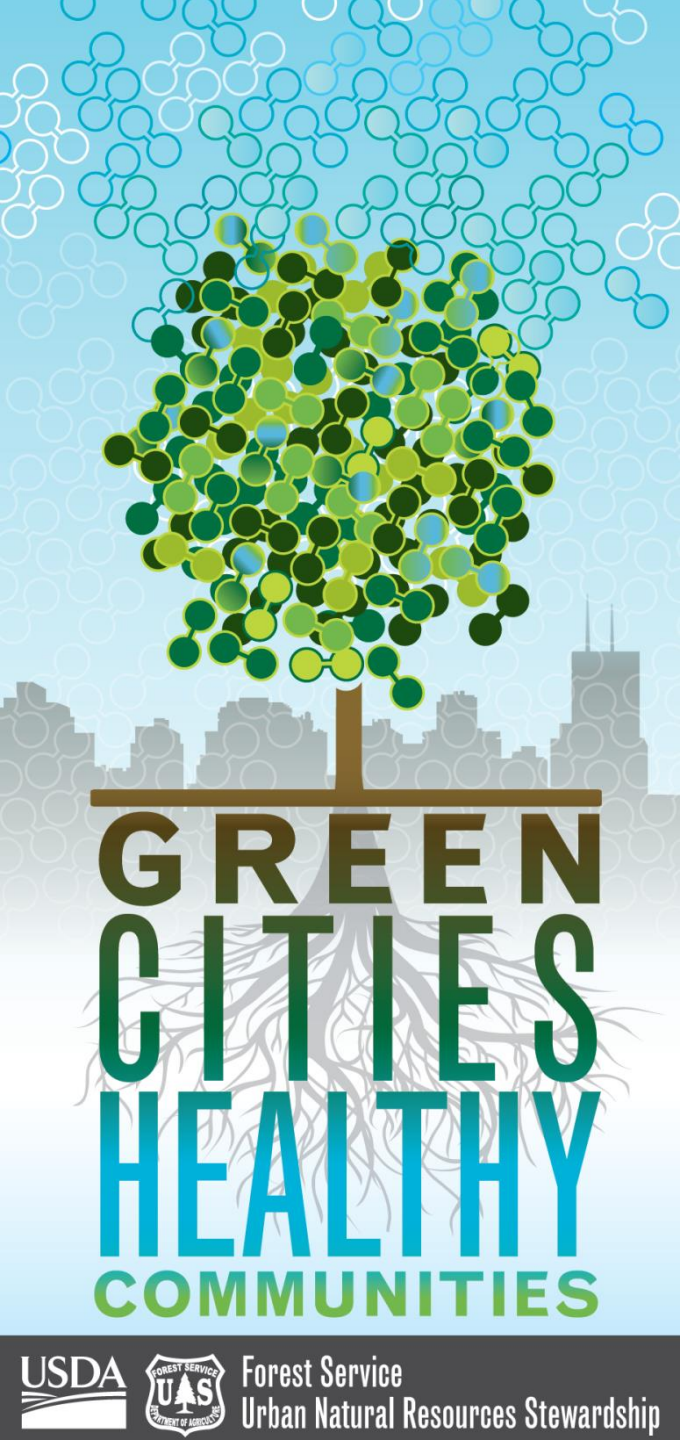

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Citizen Science and Open Data in Urban Forestry: Opportunities and challenges

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Volunteer data quality in urban tree inventories

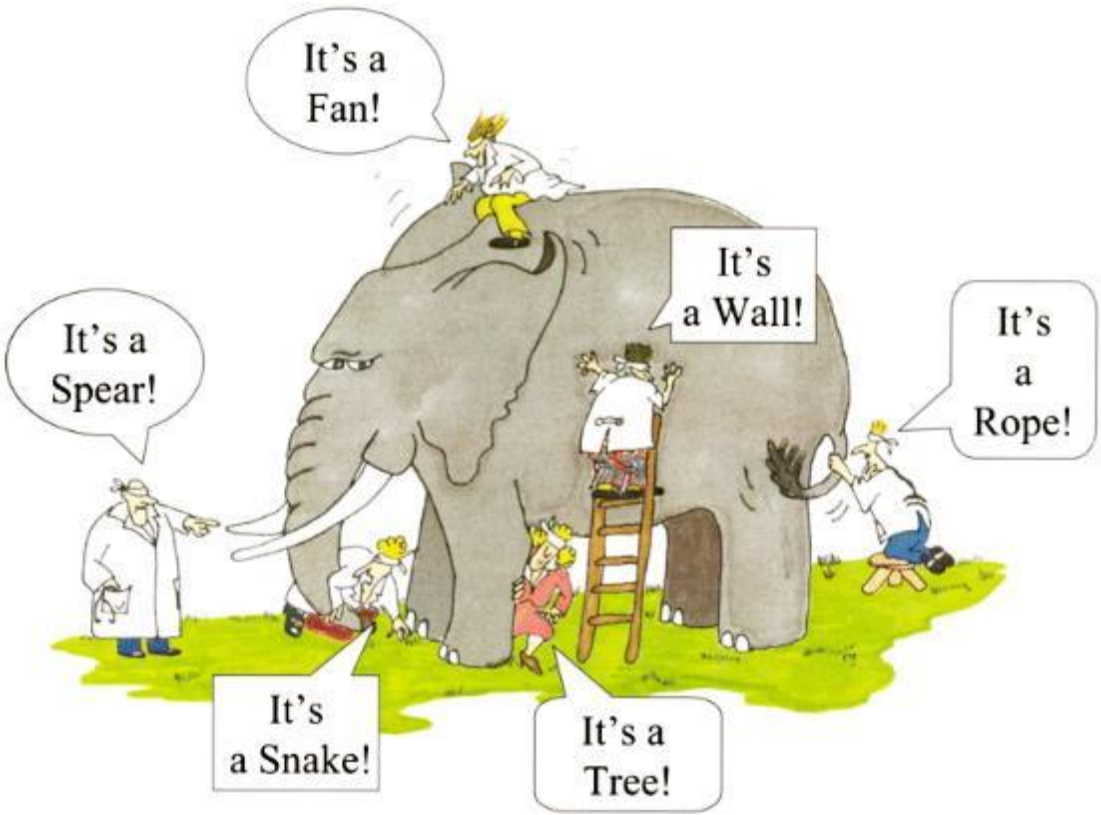
FS Urban Forest Connections Webinar

14 June 2017

Lara Roman, Research Ecologist

Philadelphia Field Station, US Forest Service

What is citizen science?



G. Renee Guzlas, artist

Citizen science definitions

- The **collection and analysis of data** relating to the natural world by members of the general public, typically as part of a collaborative project with professional scientists. (Oxford Dictionary 2015)

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- The **collection and analysis of data** relating to the natural world by members of the general public, typically as part of a collaborative project with professional scientists. (Oxford Dictionary 2015)

- Partnerships between the public and professional scientists to address questions and issues of common concern. Usually when people refer to citizen science they mean projects for which members of the public **collect, categorize, transcribe, or analyze scientific data**. (Cornell Lab of Ornithology)

Citizen science definitions

- Participation by the public in a scientific project. Projects can involve public participation in **any or all stages of the scientific process**. Projects can involve professional scientists or be entirely designed and implemented by volunteers. (McKinley et al. 2015)

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- Participation by the public in a scientific project. Projects can involve public participation in **any or all stages of the scientific process**. Projects can involve professional scientists or be entirely designed and implemented by volunteers. (McKinley et al. 2015)

- The public participates voluntarily in the **scientific process, addressing real-world problems** in ways that may include formulating research questions, conducting scientific experiments, collecting and analyzing data, interpreting results, making new discoveries, developing technologies and applications, and solving complex problems. (White House Office of Science and Technology Policy)

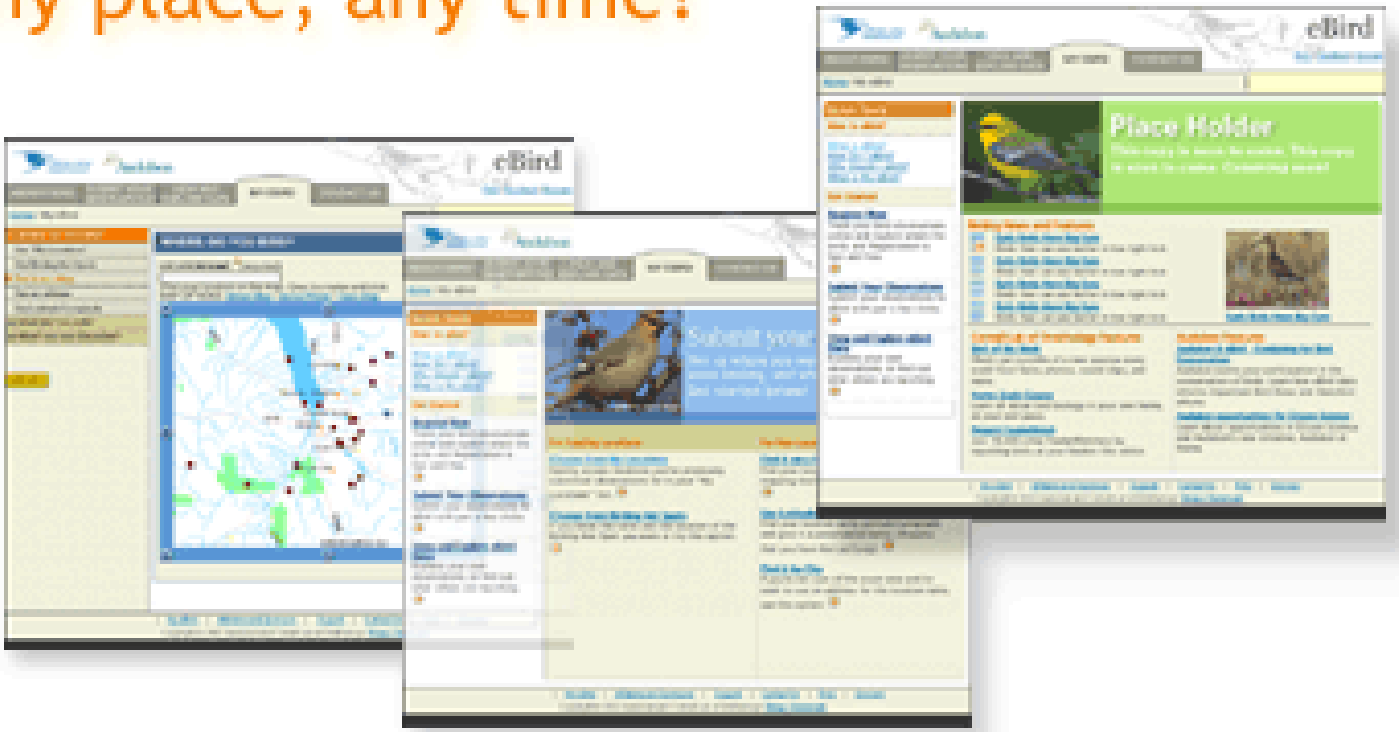
Related terms

- BioBlitz: An intense biological survey that attempts to record all the species within an area, often done by groups of professional scientists, naturalists and volunteers over a short time frame (Wikipedia)

- Crowdsourcing: Organizations submit an open call for voluntary assistance from a large group of individuals for **online, distributed problem solving**. (White House Office of Science and Technology Policy)

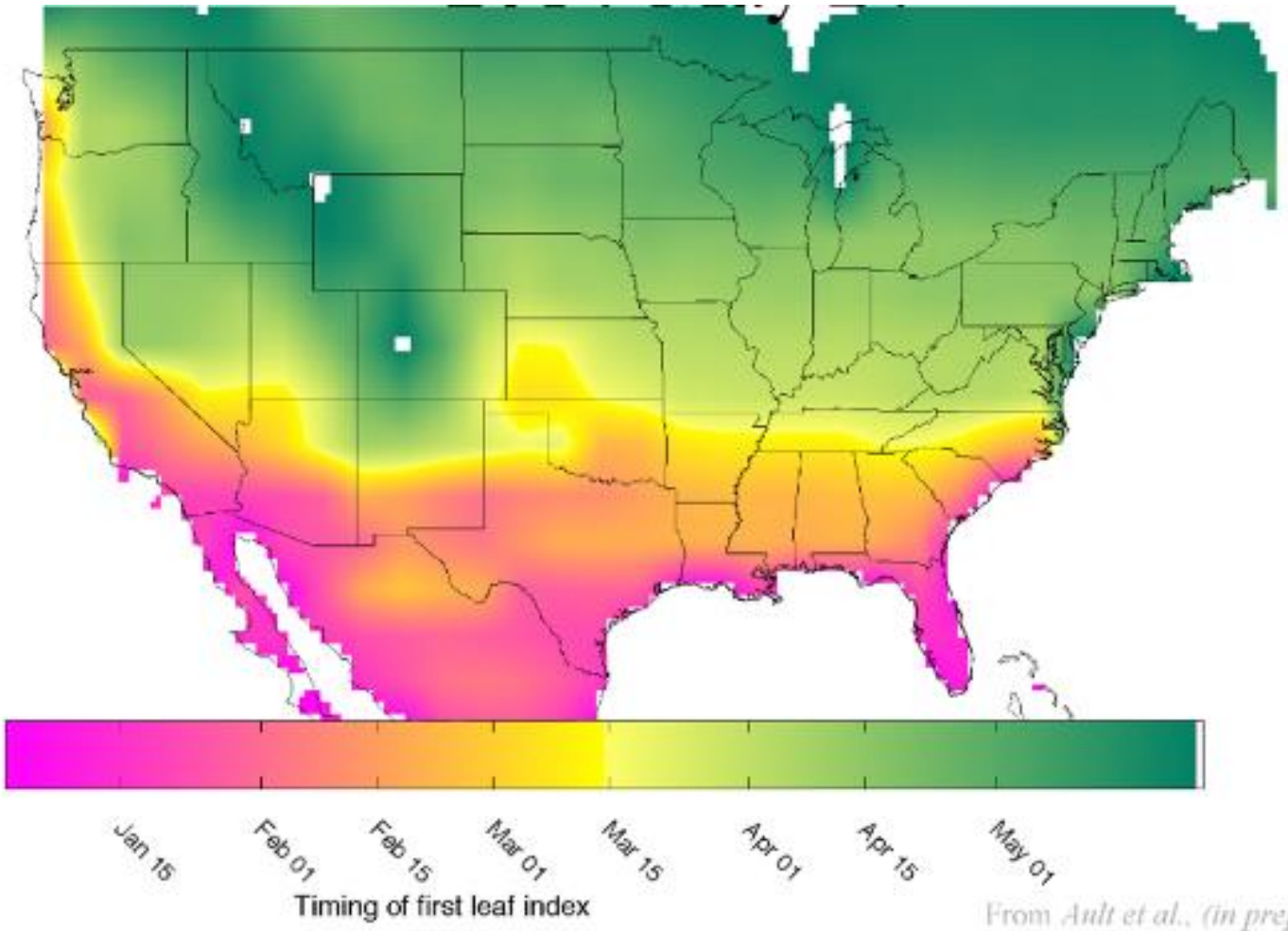
eBird

Report and track the birds online – any place, any time!

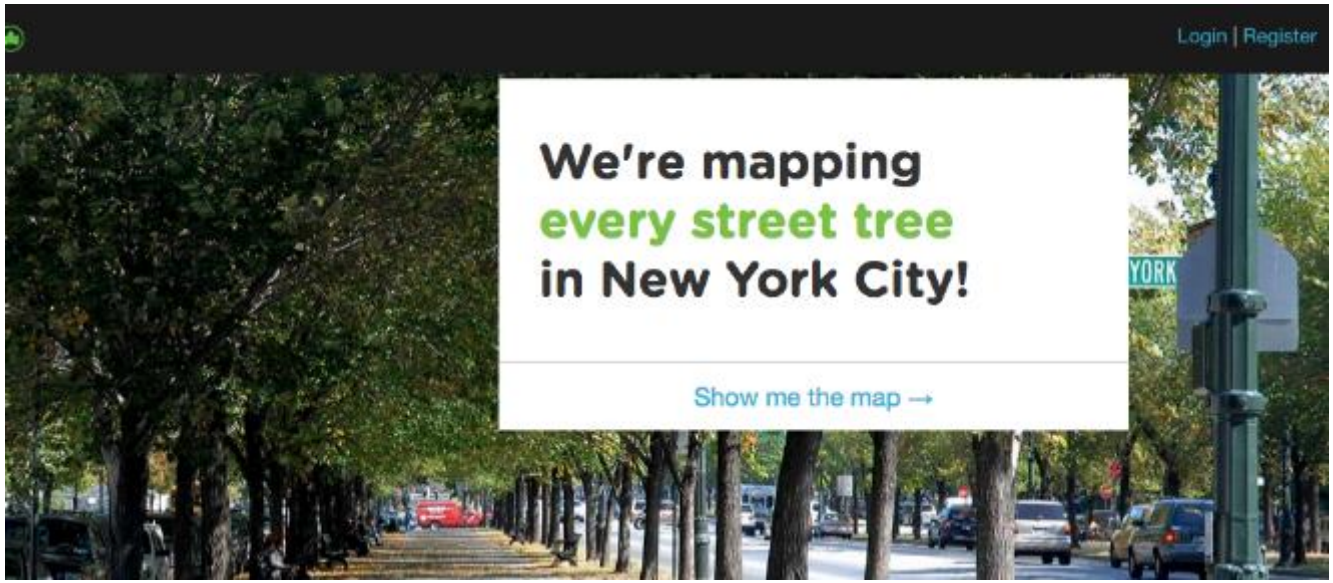


Go

USA npn National Phenology Network



Courtesy of NPN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TREES COUNT

PHS PENNSYLVANIA HORTICULTURAL SOCIETY

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Dual aims of citizen science

- Outreach and education
  - Science literacy
  - Conservation ethic
  - Build constituencies

- Quality data for research and management
  - Produce higher volumes of data
  - Geographic distribution of observations
  - Data reliable for intended uses

Data quality issues in citizen science

- Observation error
  - Species misidentification
  - Measurement error
- Spatial & temporal bias (crowdsourced data)
  - Volunteer report clustering
- Lack of metadata

Bird et al. (2013), Hunter et al. (2013), Wiggins et al. (2011)

Data quality issues in citizen science

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What does the literature tell us about volunteer data quality?

A few case studies (part 1)

- Bird species ID
  - Online experiment with bird sounds
    - Conclusion: Common species more accurate. Volunteers with higher skill levels more accurate
    - Rare species false detections for higher skill levels
- Invasive plant species ID
  - Plants flagged in the field for professionals and volunteers
    - Conclusion: 88% accuracy for professionals, 72% for volunteers
    - Volunteers better at “easy” species. Comfort level correlated with correct species

Crall et al. (2001), Farmer et al. (2012)

A few case studies (part 2)

- Forest carbon stocks
  - Community members forest structure data vs. professional foresters
    - Conclusion: Volunteers and professionals had similar tree counts, DBH, and biomass estimates

- Street trees
  - Volunteer vs. arborist
    - Conclusion: 91-95% genus agreement (for common genera), 46-96% species agreement

Bloniarz & Ryan (1996), Danielsen et al. (2013)

What is “error”?

From Wikipedia:

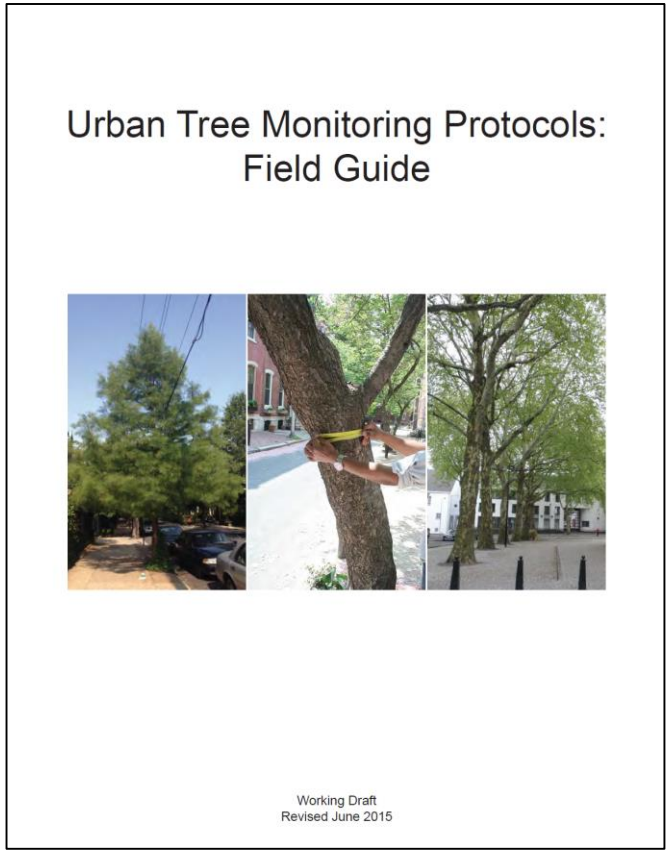
> **“Observational error** (or **measurement error**) is the difference between a measured value of a quantity and its true value. In statistics, an error is not a ‘mistake.’ Variability is an inherent part of things being measured and the measurement process.”

Citizen science in urban forestry

Urban tree monitoring pilot test

Goal: Evaluate observation errors from field crews with varying experience levels. Revise protocols based on findings and make recommendations for using volunteer data.

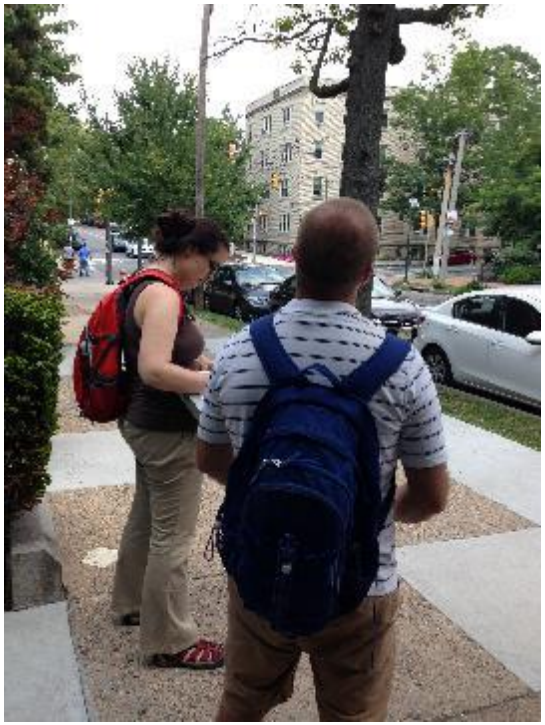
www.urbantreegrowth.org


Urban Tree Monitoring Protocols:
Field Guide

Working Draft
Revised June 2015

Campbell et al. (2016), Roman et al. (in revision)

Study design



- 4 cities
  - Grand Rapids, MI
  - Lombard, IL
  - Malmo, Sweden
  - Philadelphia, PA
- 150 street trees
- 7 field crews recording the same trees
  - 1 expert (“correct” data)
  - 3 intermediate
  - 3 novice

Urban tree monitoring protocols

Location data	Location Site type Land use
Tree data	Species Trunk diameter Mortality status Dieback Transparency Wood condition

Parameter	Mean (all cities)
Time per tree	3.0 min
Extra trees	1.0%
Omitted trees	1.2%
Site type	90%
Land use	89%

Parameter	Mean (all cities)
Mortality: Dead Alive	100% 99.8%
Dieback	92%
Transparency	72%
Wood condition	55%

Parameter	Mean (all cities)
Genus	91%
Species (within correct genus)	85%

Parameter		Mean (all cities)
Stem count		91%
DBH	Exact	20%
	0.1 inch tol.	54%
	1 inch tol.	93%

Systemic bias: participant DBH was 0.13 inch higher than expert

Pilot test conclusions

- Most variables: novice as good as intermediate
- How to use citizen science in urban forestry?
  - Survival monitoring
  - Don’t use transparency and wood condition
  - DBH is fairly good within 1 inch
    - Revise multi-stem methods
  - Species ID needs better resources and potentially photo validation

Moving forward

Dealing with data quality in citizen science

- Connecting the dots…
  - Volunteer skill level
  - Volunteer training and resources
  - Task complexity
  - Data quality necessary for intended data uses (what is acceptable error?)
- Implications of data quality studies
  - Revise study design & training
  - Quantify uncertainty for modeling
  - Data and metadata standards

A final take-home message…

Citizen science is *science*

Acknowledgements

Dan Betz, Rutgers
Anne Bowser, Wilson Institute
Jason Fristensky, U Penn
Jason Henning, Davey Institute
Andrew Koeser, UFL
Rebecca Jordan, Rutgers
Igor Lacan, UC Berkeley
Susannah Lerman, USFS
Duncan McKinley, USFS
Greg McPherson, USFS
John Mills, USFS
Lee Mueller, Grand Rapids
Vi Nguyen, UC Berkeley
Thomas Omolo, USFS
Johan Ostberg, SLU
Paula Peper, USFS
Jess Sanders, Casey Trees
Lindsay Shafer, U Penn
Bryant Scharenbroch, U Wisc
Natalie van Doorn, USFS

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