

# Participation of K-12 teachers and students in paleontology: Factors impacting effectiveness and sustainability

Robert M. Ross, Carlyn S. Buckler, Daniel K. Capps,  
Kelly E. Cronin, Barbara A. Crawford, Trisha A.  
Smrecak, Andrielle N. Swaby, Alexander F. Wall

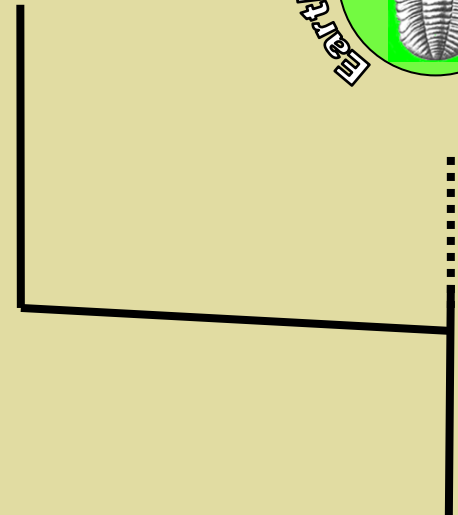


***Imagine a world in which every  
child has an experience doing  
science sometime during their  
school years....***

***....and what would be the  
impact on our field if many of  
those science experiences were  
paleontology?***

# Fossil Finders

...involves teachers and large numbers (~4000 in the testing phase) of students engaged in paleontological research, with scientists, that uses an online database

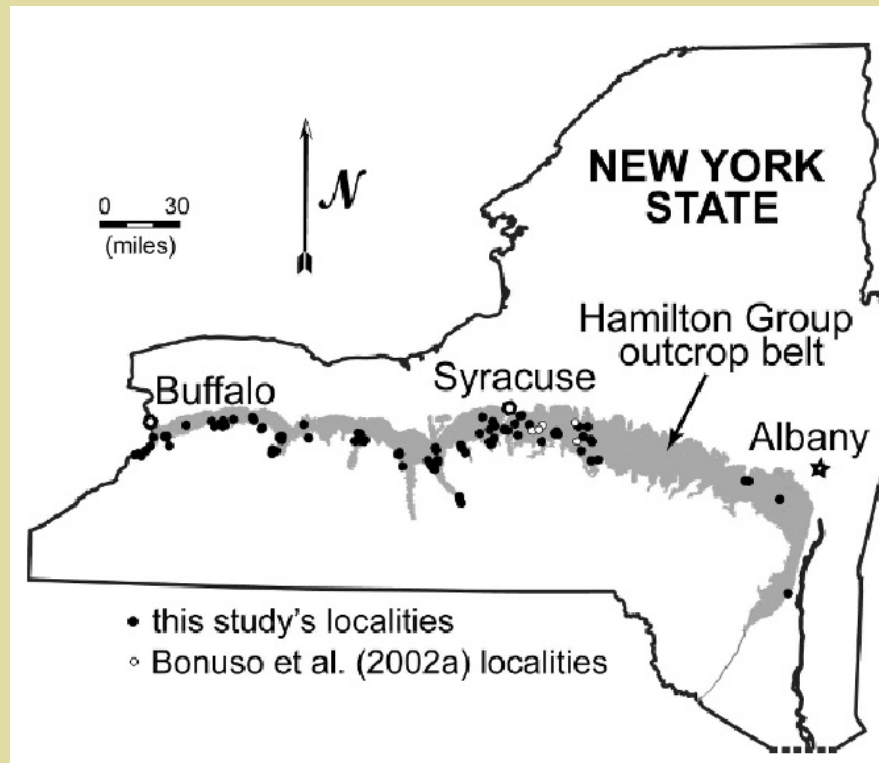


*an education research project on the impact of research on teacher practice*



# increase human resources for the data-intensive needs of some kinds of paleontological research

Brett et al 2007



AGE (SERIES)	DURATION (my)	CONODONT ZONE	GROUP	FORMATION	MEMBER	RELATIVE WATER DEPTH (Benthic Assemblage Zone)	Sequence Boundary
						BA5	BA3
GIVETIAN (MIDDLE DEVONIAN)	0.9 middle varcus	(TULLY)	MOSCOW	Windom			SB-5
				Kashong			
				Menteth			
				Deep Run			
				Tichenor			SB-4
	4.05 lower varcus	HAMILTON	LUDLOWVILLE	Jaycox			
				Wanakah/ Ivy Point			
				Ledyard/ Otisco			
				Centerfield			SB-3
				Butternut			
EIFELIAN	0.5 0.45 0.43 0.41 0.39 0.37 0.35 0.33 0.31 0.29 0.27 0.25 0.23 0.21 0.19 0.17 0.15 0.13 0.11 0.09 0.07 0.05 0.03 0.01	(UNION SPRINGS)	SKANEATELES	Pompey			
				Delphi St.			
				Mottville			SB-2
				Cherry Valley			SB-1

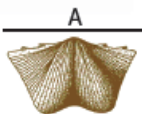
Hamilton Group, mid-Devonian



Subsample Number:

Data Collected by: \_\_\_\_\_

Length (A)



Width (B)



Coloration (1-5)

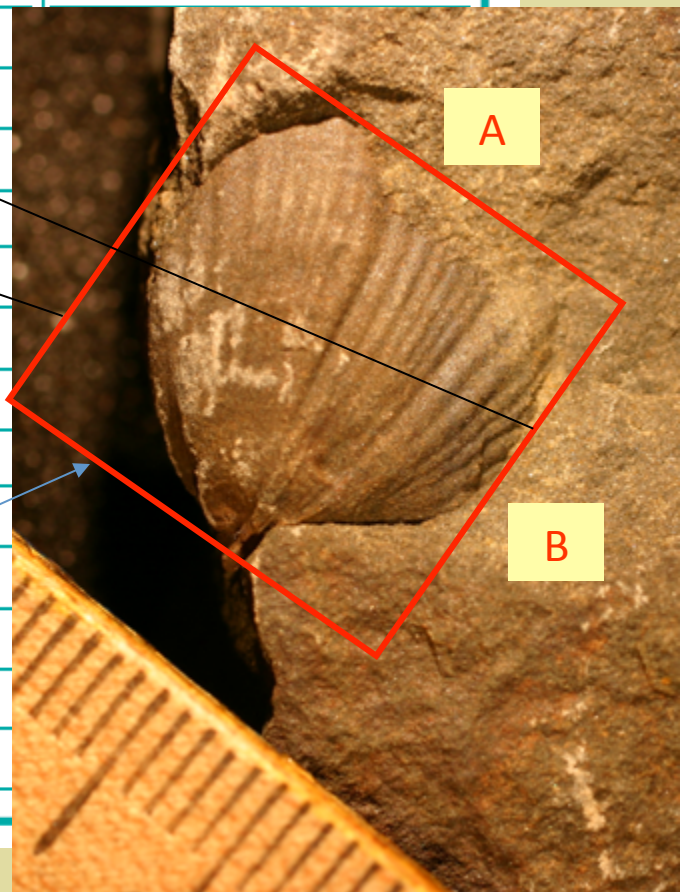


### Fragmentation (1-5)

[illegible]

- major taxon  
(brachiopods, bivalves,  
trilobites, etc.),
- size in two dimensions
- fragmentation & rock  
color (grayscale)

Measurements now made using calipers



# Fossil Finders: Multiple stakeholders

- teachers
- students
- education researchers
- teacher development educators
- sample curator and distributor
- paleontologist researchers
- external evaluators: helping determine whether teaching practices and learning outcomes improve

# Mastodon Matrix Project

Thousands of groups (~60% school classes) engaged in inventorying flora and fauna from site of Hyde Park mastodon excavation



scienceforcitizens.net BETA [About Us](#) [Contact](#) [E-](#)

THE SOURCE FOR SCIENCE YOU CAN DO

[Home](#) [Project Finder](#) [Add a Project](#) [Member Blogs](#) [Sci4Cits Blog](#) [Video](#) [Resources](#)

[HOT PROJECTS](#) [MEMBER BLOGS](#) [Find a City](#)

**Recent editors' picks**

## Mastodon Matrix Project

SUBMITTED BY [csb36](#)

The Mastodon Matrix Project needs citizen volunteers to analyze actual samples of fossil matrix (the term for material in which a fossil is found) from a mastodon excavated in New York. Volunteers sort through the find ancient shells, bones, pieces of plants, and rock to determine the time when the mastodon lived and died. The dig site will be sent back to the Paleontological Research Institute where they will be cataloged and further analyzed by paleontologists to help scientists form a true picture of the ecology and environment in which the mastodon lived. Mastodons are extinct relatives of modern elephants.

Mastodons were numerous and widespread in North America up until around 10,000 years ago when they became extinct together with many other species of large mammals at the end of the last ice age. [More](#)

[Animals](#), [Archaeology](#), [Ecology & Environment](#), [Geology & Earth Science](#)

[Project BudBurst](#) [Report the location](#)



# Mastodon matrix project: Simpler, with fewer stakeholders

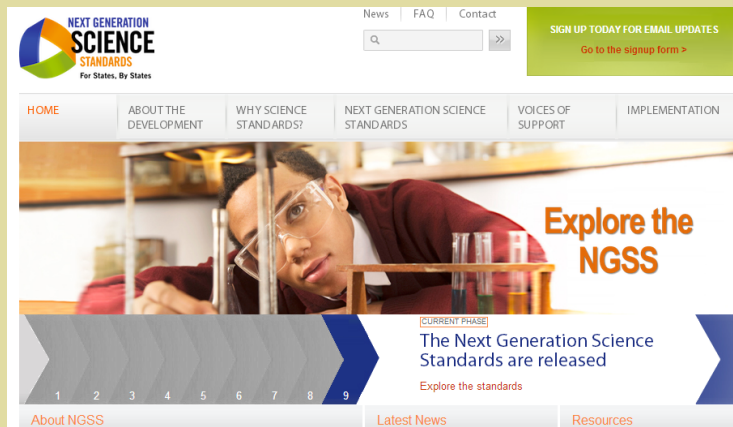
- teachers
- students
- sample curators and distributor
- paleontologist researchers

***What are some of the elements  
of K-12 citizen science projects  
that are effective and  
sustainable?....***



# *.... provide opportunities for **student learning** science through doing science*

- aligned with “National Science Education Standards” inquiry practices (NRC 1996)
- and aligned with the new “Next Generation Science Standards” (NGSS) science practices (NRC 2013)



*... facilitate **student learning** beyond that using more traditional approaches*

- what learning objectives?
- how is it assessed?



# *...increase **student engagement** via intrinsic interest in fossils & hands-on approach*

- “affective domain”
- ELL students (Meyer et al 2012)
- classrooms with underrepresented minority audiences (Harnik and Ross 2004)





***.... improve **student motivation**,  
through the perception that they are  
helping scientists to do real research***



*satisfy **teachers' existing curricular needs**  
more effectively than other potential activities*





*.... provide **teacher experiences** that foster complex science teaching skills*





*....verify through **evaluation**.*

*“opinionnaires”*

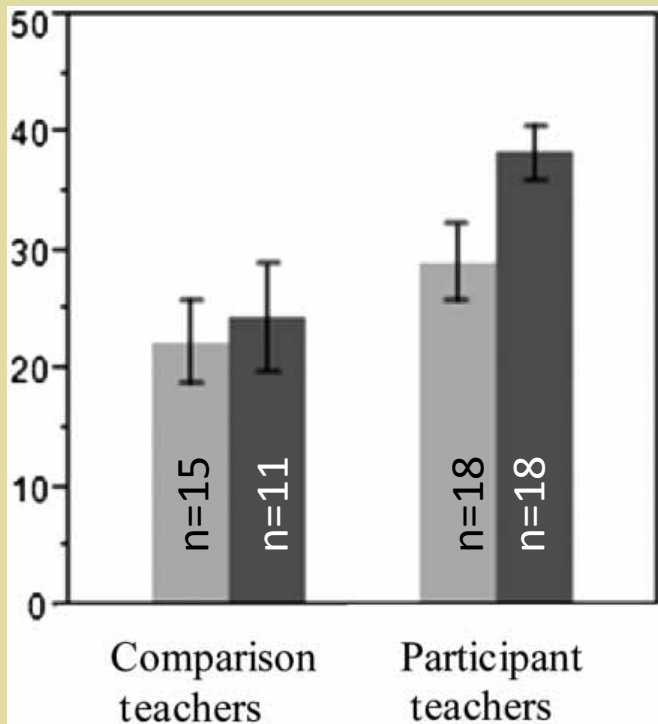
*interviews and roundtables*

*measurements*

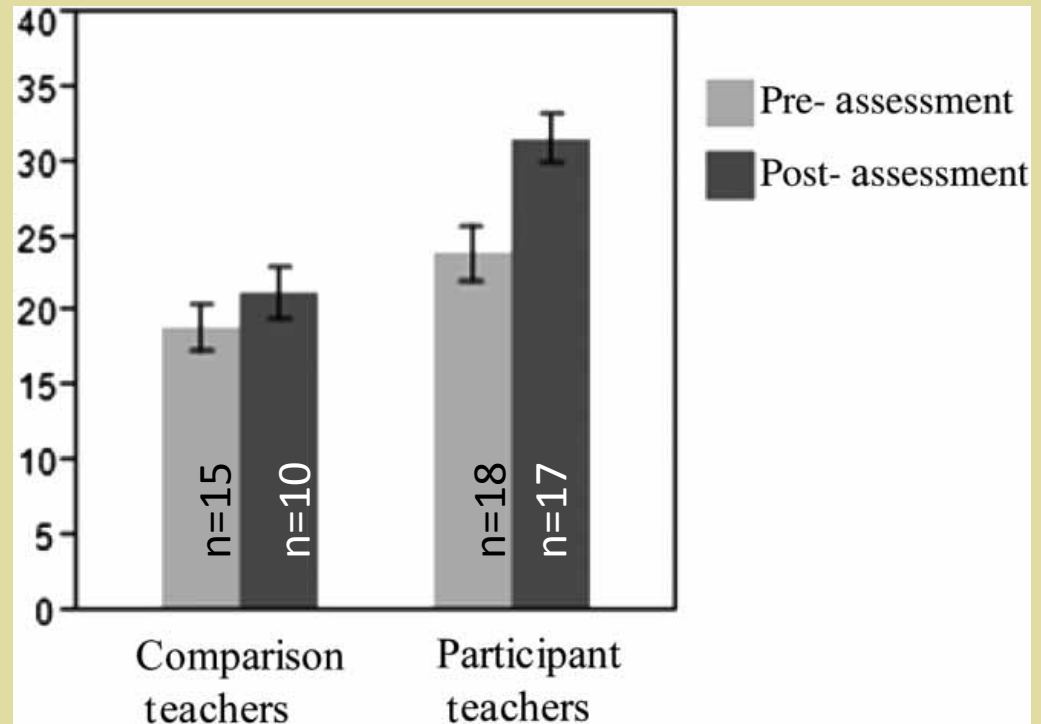
*external evaluation*

**... offer *education researcher opportunities* to study the relationship between authentic science experiences and student and teacher learning**

science content



inquiry & nature of science understanding



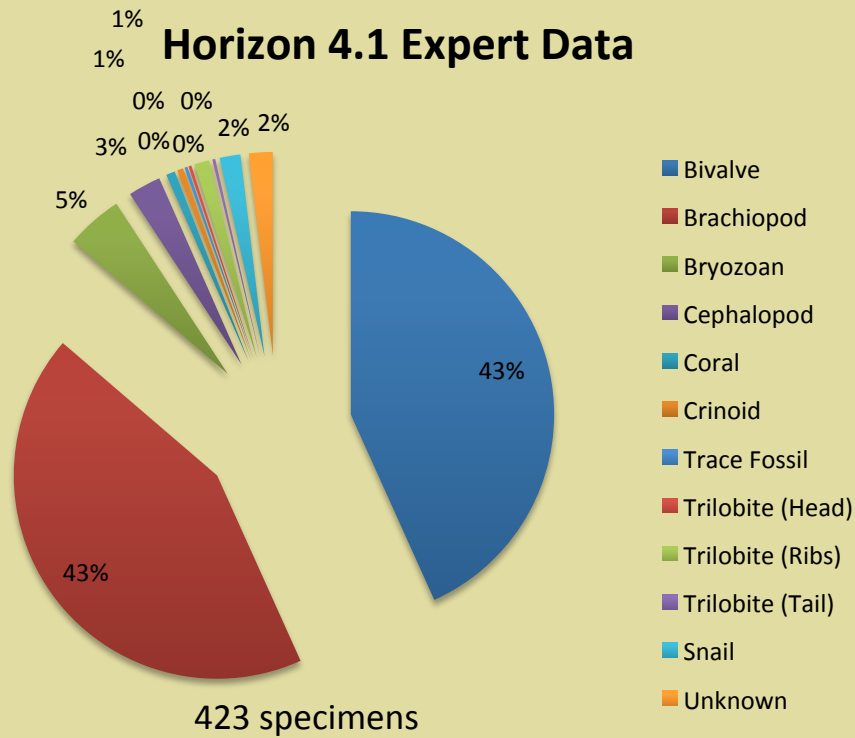
*... offer **paleontologists** meaningful collections or data.*

That is, paleontologists must:

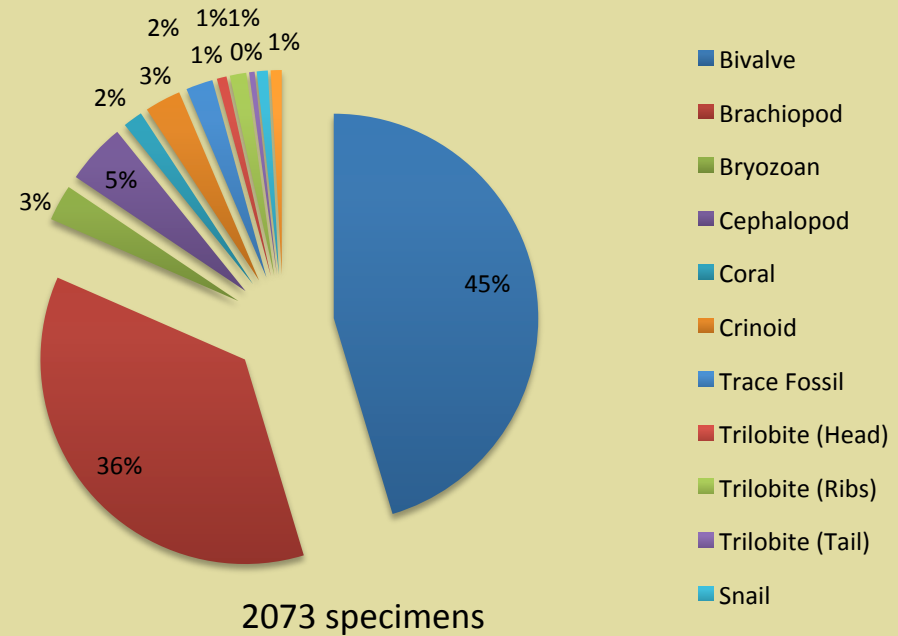
- care about the data collected;
- be able to access the data easily;
- trust data was collected carefully;
- be able to use data in spite of some error;
- get the specimens back safely.

***Data assessment is critical....***

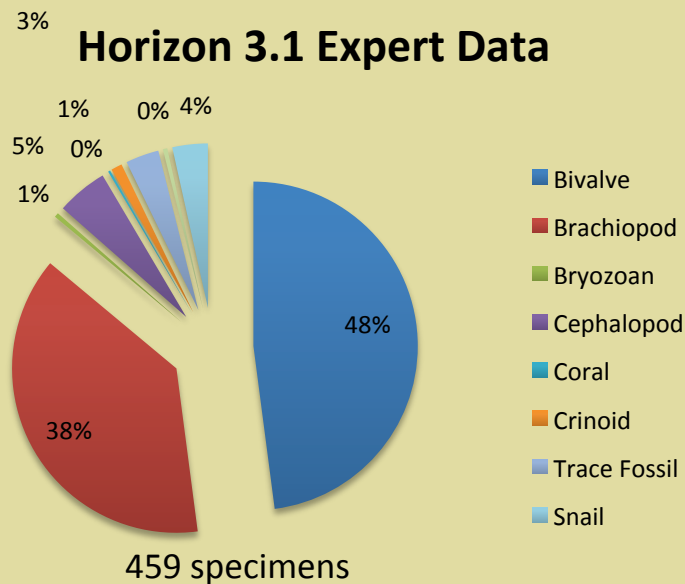
## Horizon 4.1 Expert Data



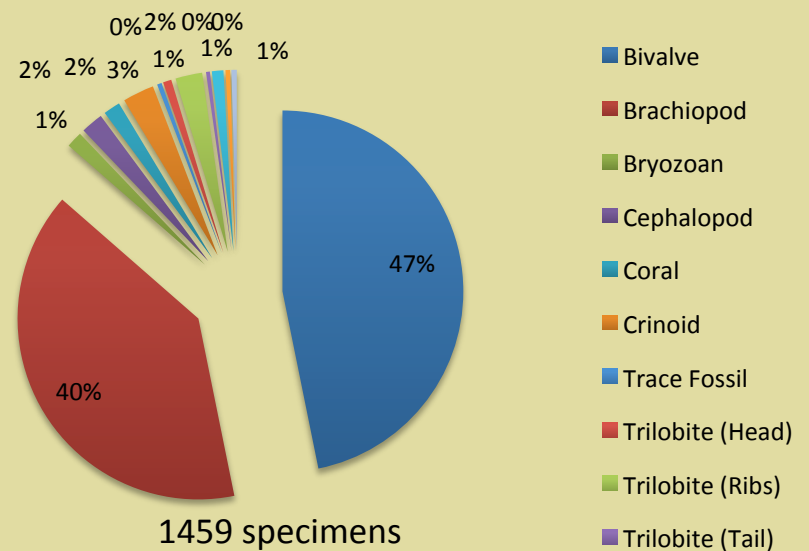
## Horizon 4.1 Student Data



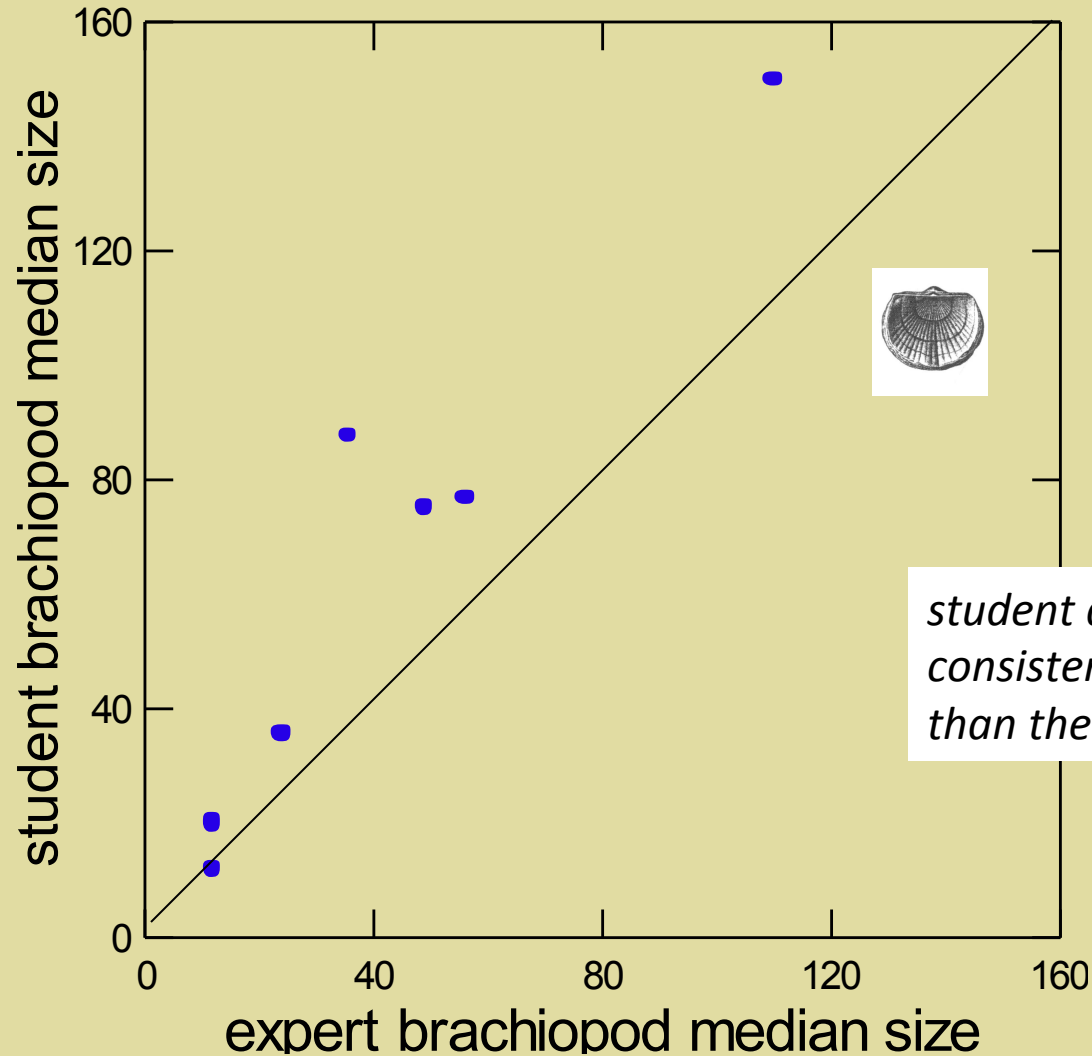
## Horizon 3.1 Expert Data



## Horizon 3.1 Student Data

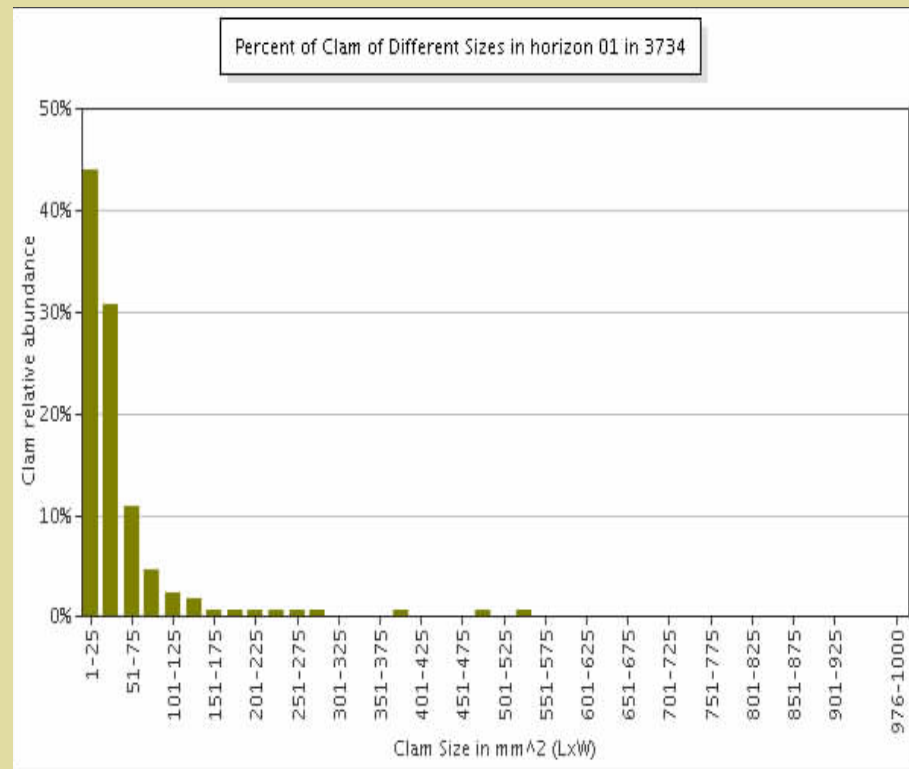
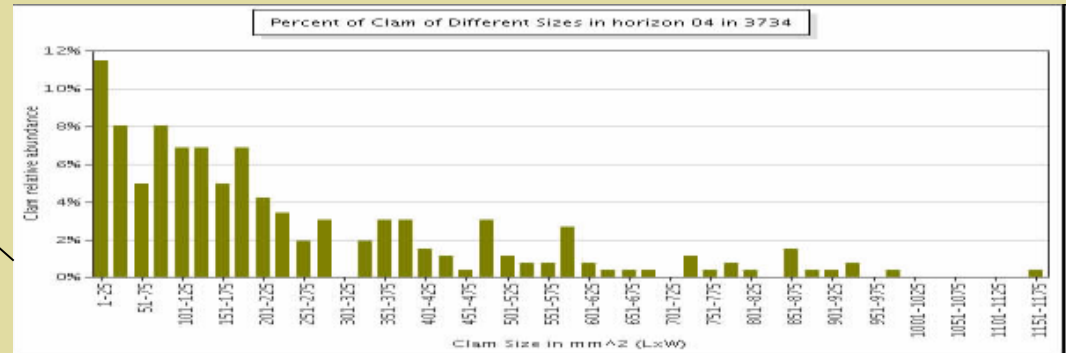
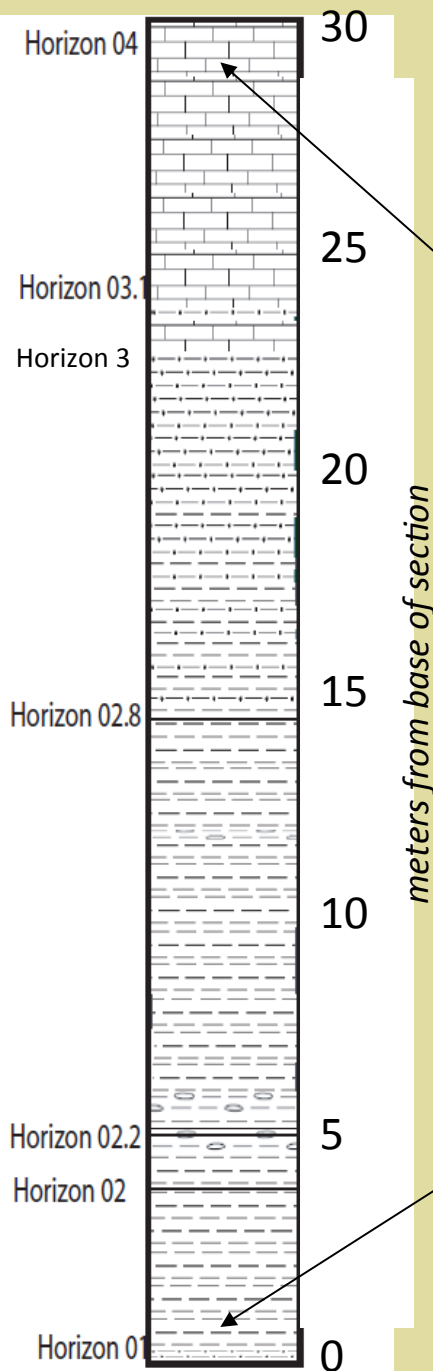


*comparison median size of brachiopods in  
seven individual samples*



*student data give correlated, yet  
consistently higher, size values  
than the expert data*

bivalve size distribution changes  
*substantially* from horizon 1 to 4





*...incorporates timely feedback **between teachers and scientists***

- questions for researchers from teachers and students
- analysis of results from researchers
- feedback from researchers
- new research questions posed by teachers and students?
  - iterative process....

# To make it work, identify your goals:

## **education:**

- to provide an engaging educational experience?
- to meet “standards” or assessment goals?
- to improve teacher practice?

## **research:**

- to gather or sort paleontological specimens?
- to collect exploratory scientific data?
- to solve an existing research problem with the collected data?

# Resources and research exist....

← → ↺ [https://www.idigbio.org/wiki/index.php/Citizen\\_Science/Crowdsourcing\\_Best\\_Practices\\_for\\_Digitization](https://www.idigbio.org/wiki/index.php/Citizen_Science/Crowdsourcing_Best_Practices_for_Digitization)

**iDigBio**  
Integrated Digitized Biocollections

[About iDigBio](#) | [Portal](#) | [Technical Information](#) | [Education](#)

[Log In](#) | [Sign Up](#)

[iDigBio Home](#) | [Wiki](#) | [Working Groups](#) | [Workshops](#) | [Wiki Formatting Help](#)

[Wiki Home](#)  
[Digitization Resources](#)  
[Workshop Summaries](#)  
[Working Group List](#)

[iDigBio Working Groups](#)

Page [Discussion](#)

## Citizen Science

The Citizen Science/Crowdsourcing scientific collections.

### CITIZEN SCIENCE

## Data validation in citizen science: a case study from Project FeederWatch

David N Bonter\* and Caren B Cooper

To become more widely accepted as a valuable research tool, citizen-science projects must find ways to ensure that data gathered by large numbers of people with varying levels of expertise are of consistently high quality. Here, we describe a data validation protocol developed for Project FeederWatch, a continent-wide bird monitoring program, that is designed to increase researchers' and participants' confidence in the data being collected.

## Public Participation Research: Defining Assessing Its Potential Science Education

A CAISE Inquiry Group Report  
July 2009

From **DataONE**  
Data Observation Network for Earth

Search

ONEMercury

For

Go

Connect



[About](#)

[Participate](#)

[Resources](#)

[Education](#)

[Data](#)

[Home](#) » [About](#) » [Working Groups](#) » [Public Participation in Science and Research Working Group](#)

[About](#)

[What is DataONE?](#)  
[DataONE Organization](#)  
[Working Groups](#)  
[Partners](#)  
[News](#)

### Public Participation in Science and Research Working Group

The goal of the Public Participation in Science and Research (PPSR) Working Group (WG) is to describe and understand the potential contribution of PPSR projects to generate information useful to, and used by, various end-users (e.g., scientists, resource managers, decision-makers, the public). Participatory scientific data gathering, monitoring, evaluation and assessment of environmental data by PPSR (i.e., volunteer-based) programs can provide substantial

***What would we need to do to  
work together so that every  
child has an experience doing  
paleontology sometime during  
their school years....***

