

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

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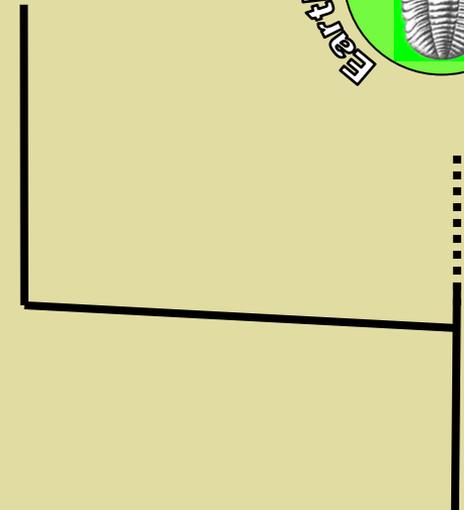


***Imagine a world in which every
child has an experience doing
science sometime during their
school years....***

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

Fossil Finders

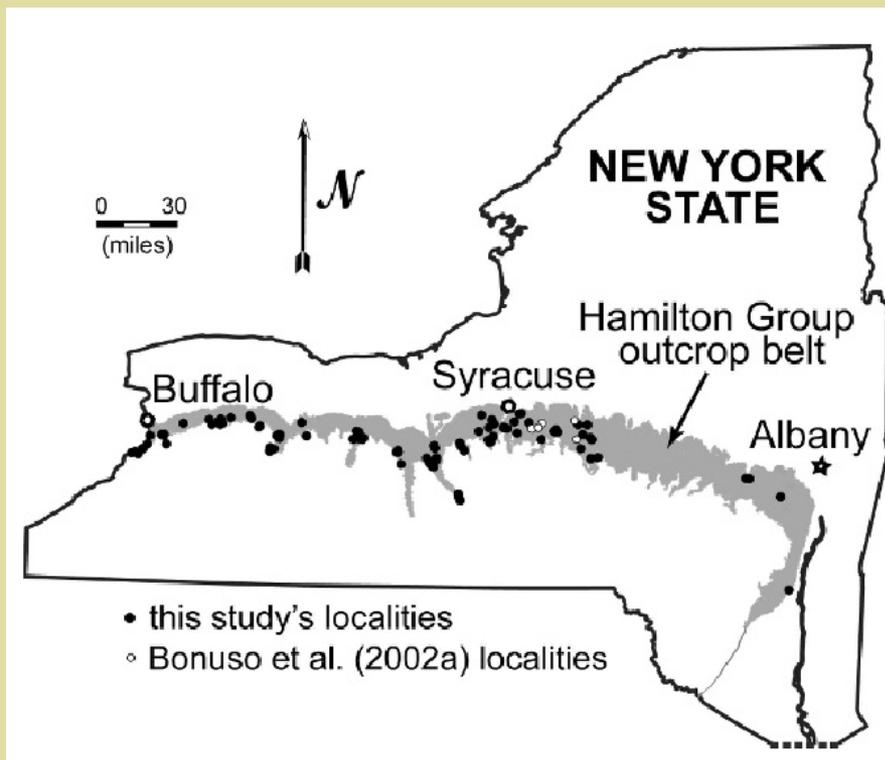
...involves teachers and large numbers (~4000 in the testing phase) of students engaged in paleontological research, with scientists, that uses an online database



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) | CONDONOT ZONE | GROUP | FORMATION | MEMBER | RELATIVE WATER DEPTH (Benthic Assemblage Zone) | |
|----------------------------|---------------|---------------|----------|-------------|--|--|-----|
| | | | | | | BA5 | BA3 |
| GIVETIAN (MIDDLE DEVONIAN) | 0.9 | middle varcus | HAMILTON | MOSCOW | Windom | SB-5 | |
| | | | | | Kashong Menteth Deep Run Tichenor | SB-4 | |
| | | | | | Jaycox | SB-4 | |
| | | | | | Wanakah/ Ivy Point | SB-4 | |
| | | | | | Ledyard/ Otisco | SB-4 | |
| | 4.05 | lower varcus | HAMILTON | LUDLOWVILLE | Centerfield | SB-3 | |
| | | | | | Butternut Pompey Delphi St. Mottville | SB-2 | |
| | | | | | Skaneateles | SB-2 | |
| | | | | | Marcellus Oatka Cr. | SB-2 | |
| | | | | | Solvile/ Pecksport Berne/Otsego Cherry Valley | SB-1 | |
| EIFELIAN | 0.5 | 0.45 | 0.43 | ens. hemt | (UNION SPRINGS) | SB-1 | |

Hamilton Group, mid-Devonian

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



The screenshot shows the homepage of scienceforcitizens.net. The header includes the site name, a 'BETA' badge, and navigation links for 'About Us', 'Contact', and 'E-'. Below the header is a blue navigation bar with links for 'Home', 'Project Finder', 'Add a Project', 'Member Blogs', 'Sci4Cits Blog', 'Video', and 'Resources'. The main content area features a 'HOT PROJECTS' tab and a 'MEMBER BLOGS' section. The featured project is the 'Mastodon Matrix Project', submitted by user 'csb36'. The project description explains that citizen volunteers will analyze fossil matrix samples from a mastodon excavation in New York to find ancient shells, bones, and plants. The project is categorized under 'Animals, Archeology, Ecology & Environment, Geology & Earth Science'. To the right of the text is a grid of ten fossil matrix samples, labeled A through J, showing various shapes and textures.

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Mastodon Matrix Project

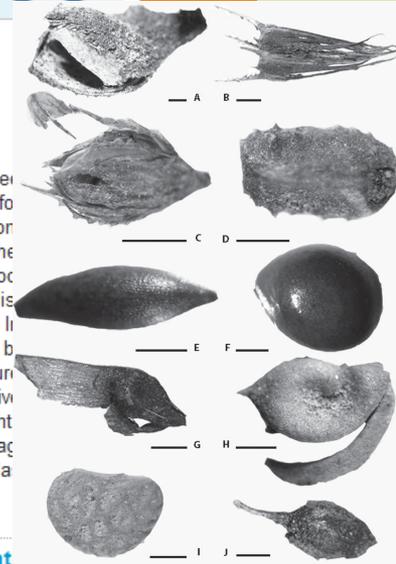
SUBMITTED BY [csb36](#)

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 rocks to determine the time when the mastodon lived and died. The data 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 glacial period. [More](#)

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

Project BudBurst Report the Location



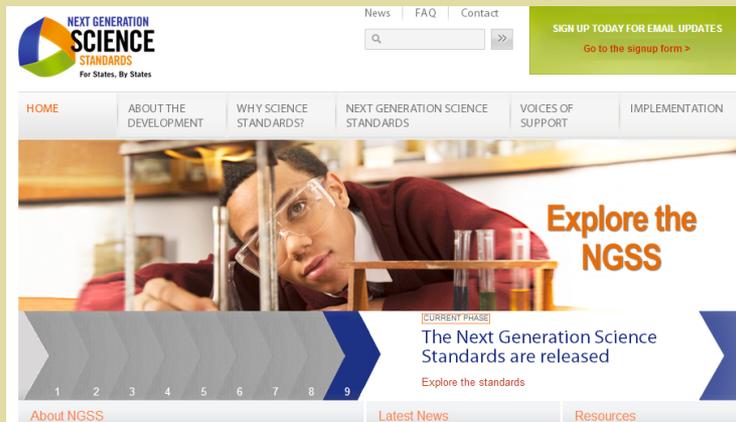
Mastodon matrix project: Simpler, with fewer stakeholders

- 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)



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



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



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

“opinionnaires”

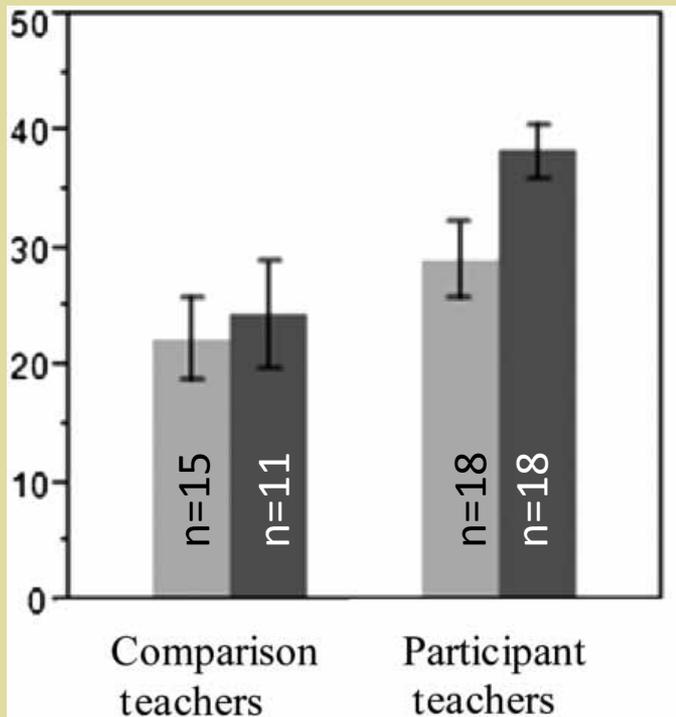
interviews and roundtables

measurements

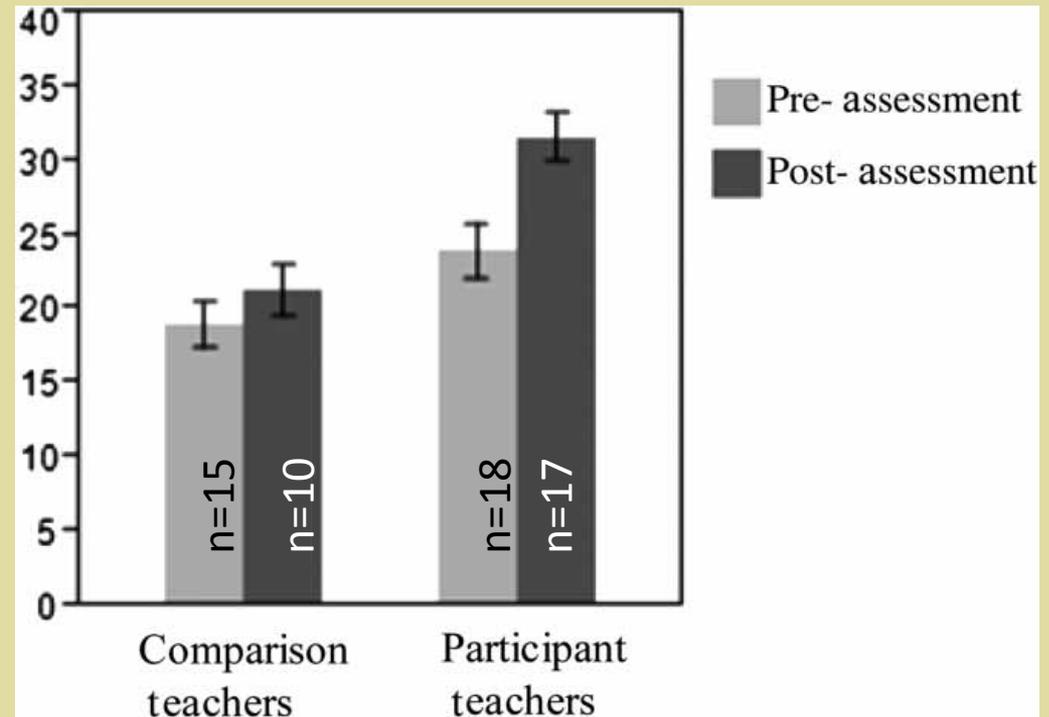
external evaluation

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

science content



inquiry & nature of science understanding



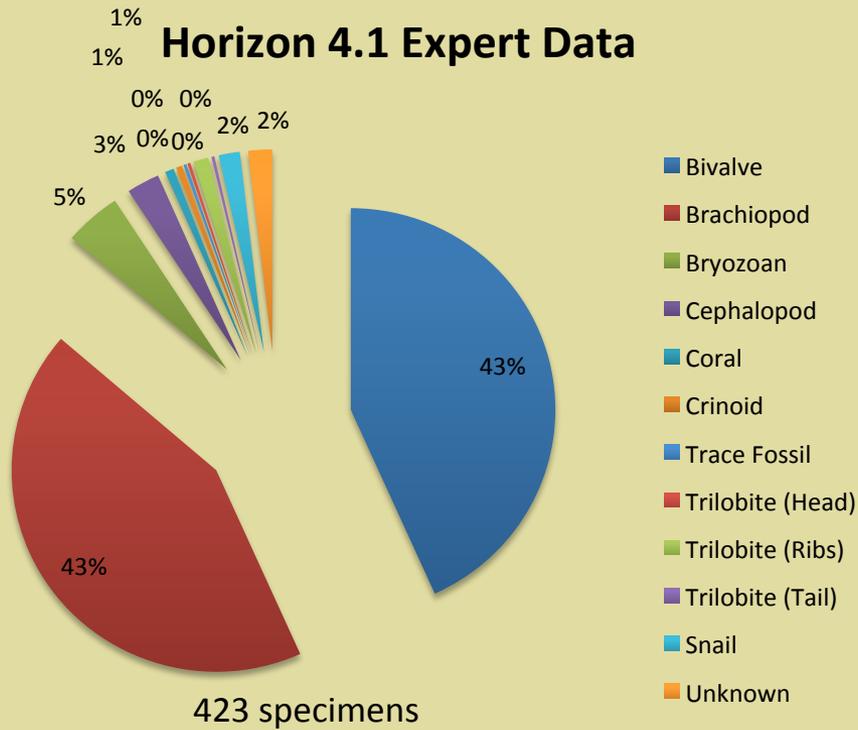
*... offer **paleontologists** meaningful collections or data.*

That is, paleontologists must:

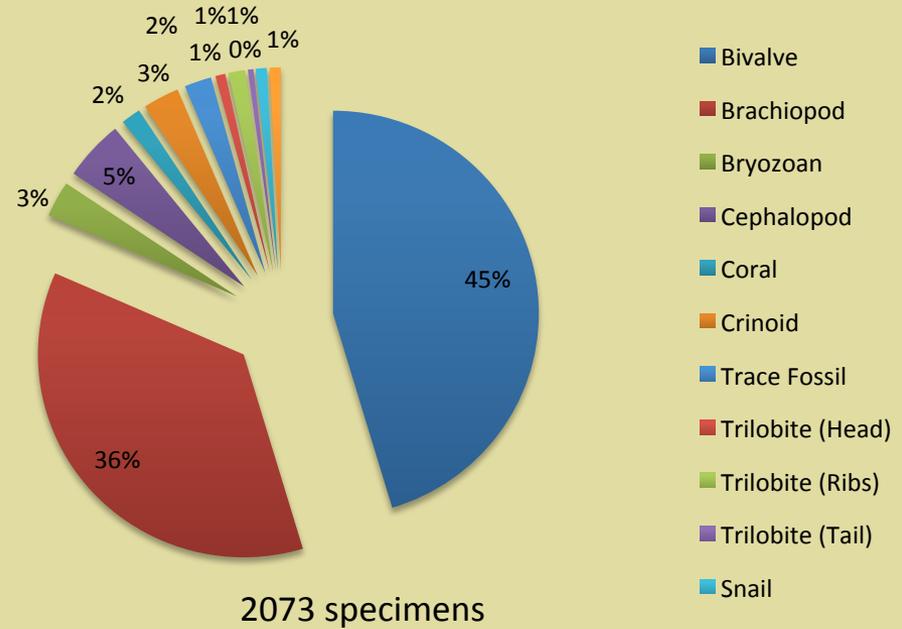
- care about the data collected;
- be able to access the data easily;
- trust data was collected carefully;
- be able to use data in spite of some error;
- get the specimens back safely.

Data assessment is critical....

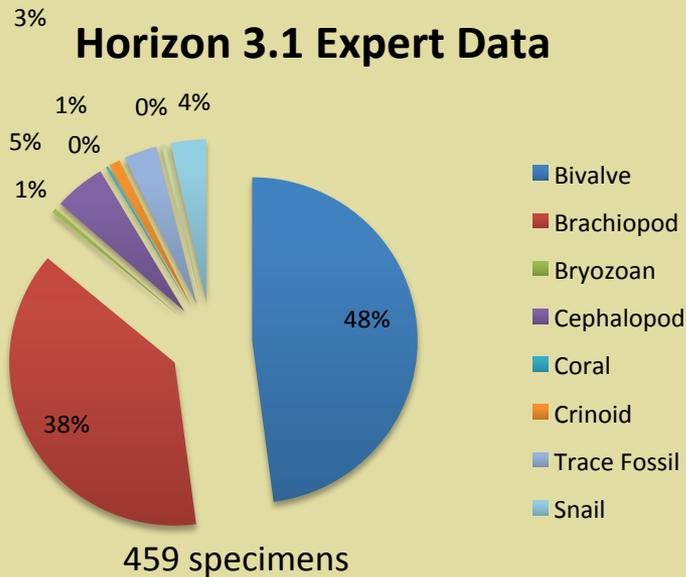
Horizon 4.1 Expert Data



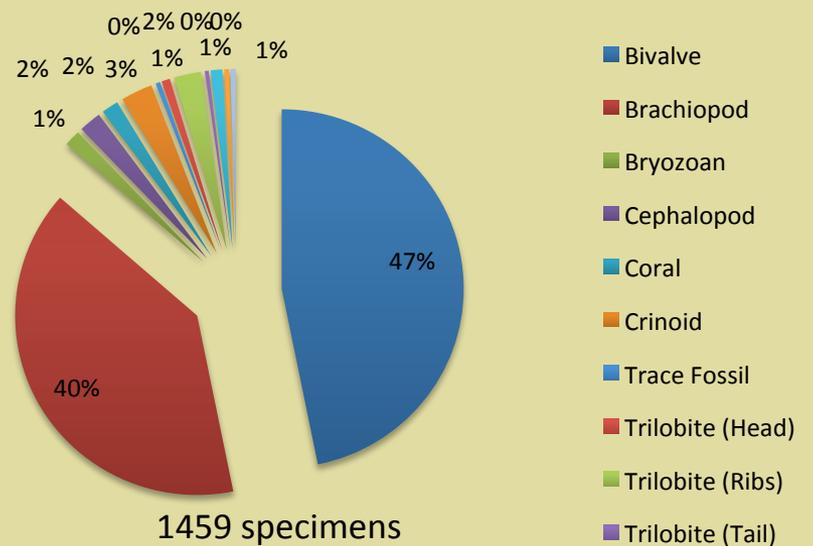
Horizon 4.1 Student Data



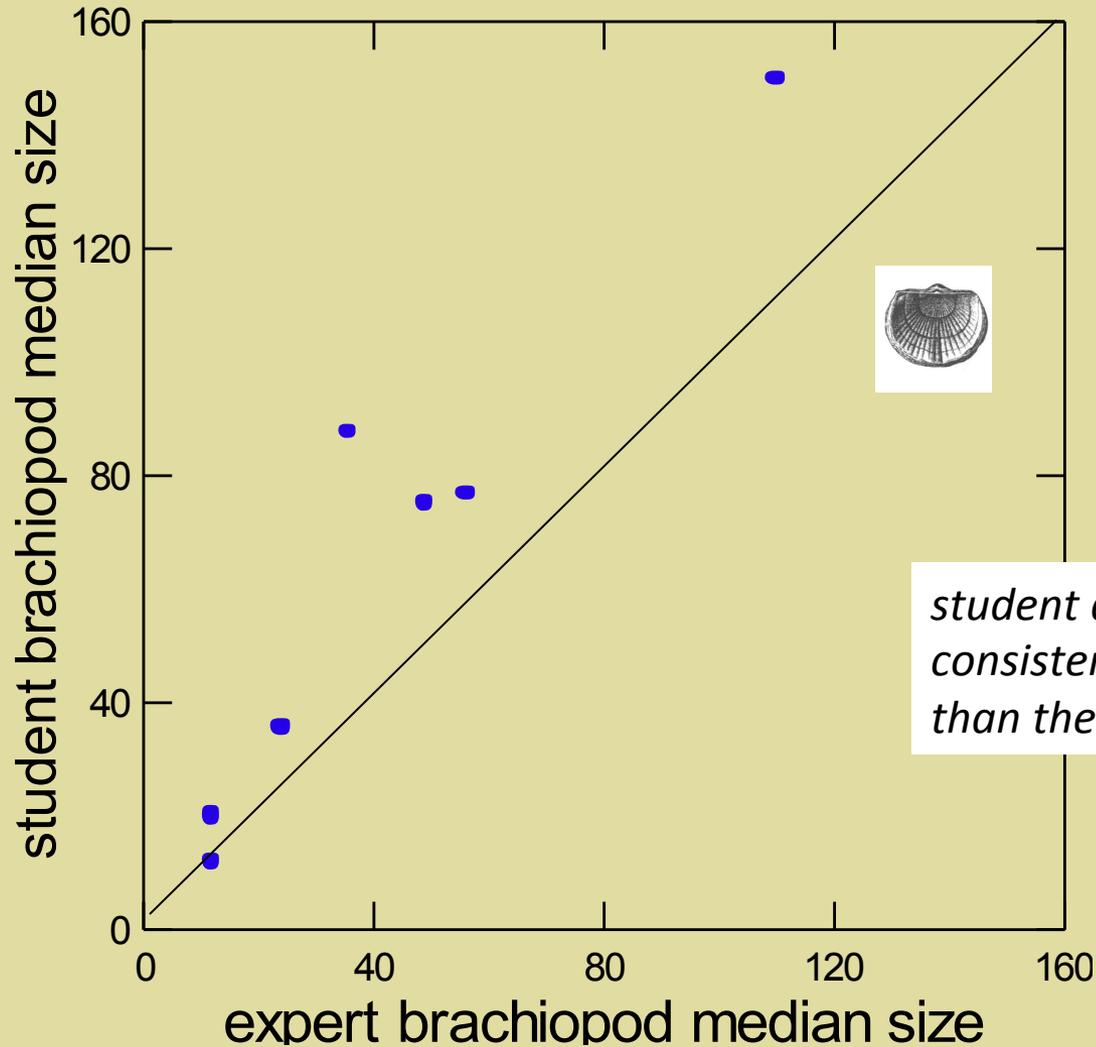
Horizon 3.1 Expert Data



Horizon 3.1 Student Data

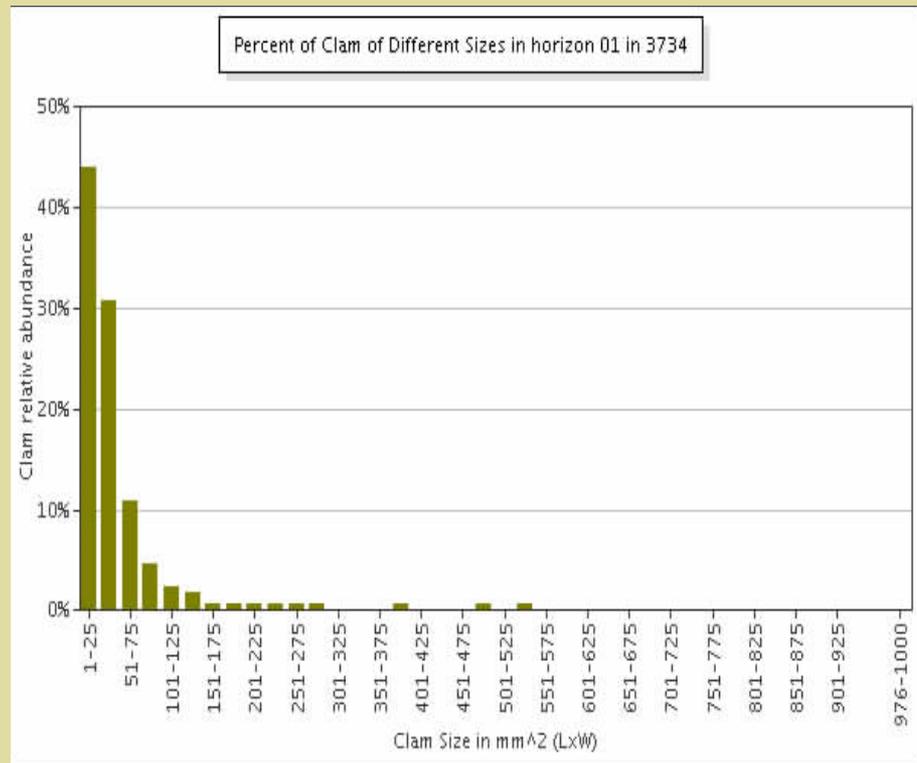
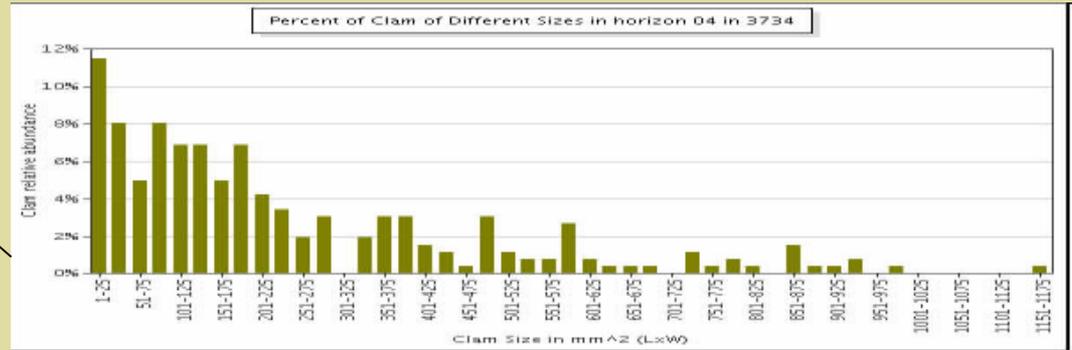
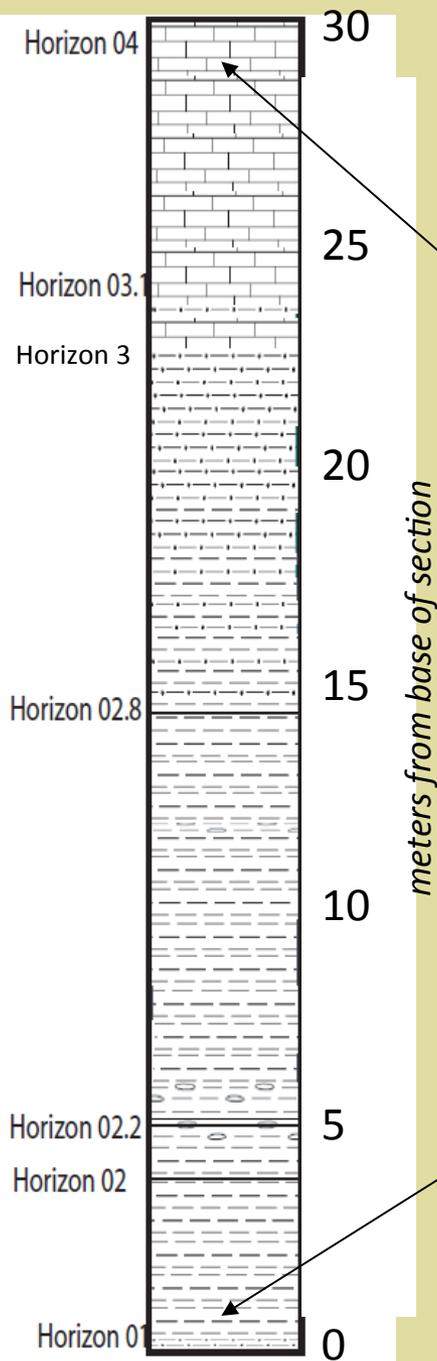


*comparison median size of brachiopods in
seven individual samples*



*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

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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

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Data Observation Network for Earth

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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

A CAISE Inquiry Group Report
July 2009

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

