The Taxonomy of Community-Based Monitoring:

An overview and analysis of models

Candie C. Wilderman
Professor of Environmental Science
Founder and Science Director, ALLARM
Dickinson College
Carlisle, PA

The Alliance for Aquatic Resource Monitoring (ALLARM) is:

- A nationally recognized project of the Environmental Studies Department at Dickinson College in Carlisle, PA
- Founded in 1986, ALLARM provides technical and programmatic support to community organizations interested in watershed assessment, protection, and restoration.
- Through the work of 12-15 Dickinson College students and professional staff, ALLARM currently works with 15 watershed organizations in PA on water quality monitoring assessments.

ALLARM'S goals are:

1. To empower communities with scientific knowledge to address issues of concern, and

2. To enhance the quality of undergraduate education at Dickinson College by enabling students to participate in community-based research.

Community-based Science: The all-important partnership

- Community-based science involves a research partnership between community people and professional scientists, providing benefits to both.
- There are a variety of successful operational models for this partnership.
- These approaches can be broadly categorized into "top-down" or "bottom-up."

Models have shared challenges

- Recruiting and training volunteers
- Ensuring data quality
- Managing large data sets
- Getting volunteer-collected data accepted and used by various audiences.

Models have shared goals

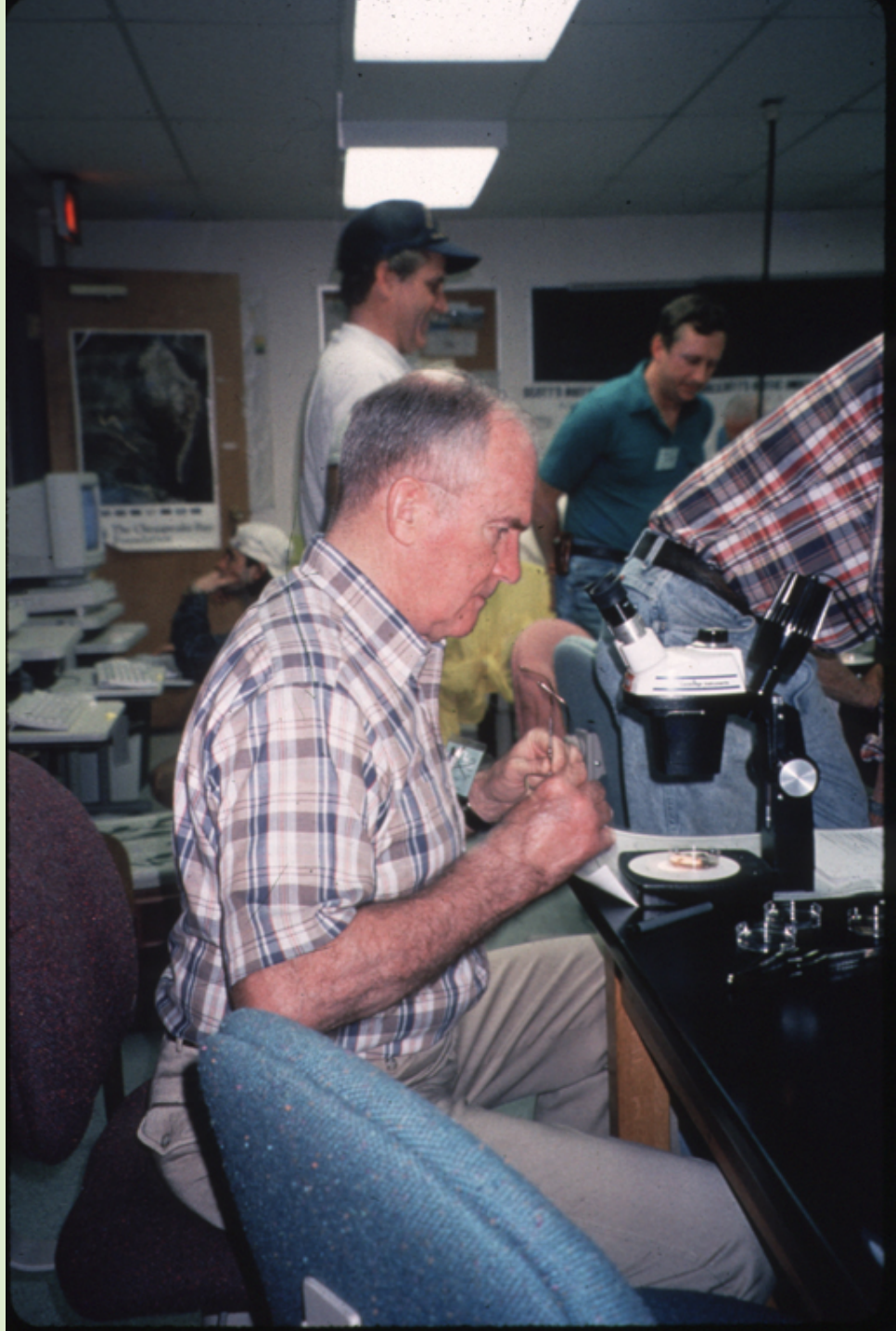
- Increasing scientific literacy of the public

Models have differences in terms of goals and outcomes

- Geographic scope of project
- Intended audience for outcomes
- Scientific value of outcomes
- Educational value of outcomes
- Actionability of outcomes
- Capacity-building value of outcomes

These attributes can be thought of as multidimensional continua along which the models can be "plotted."

The roles in which ALLARM has engaged volunteers have varied over the past 22 years, allowing us to think about the strengths and weaknesses of different models.

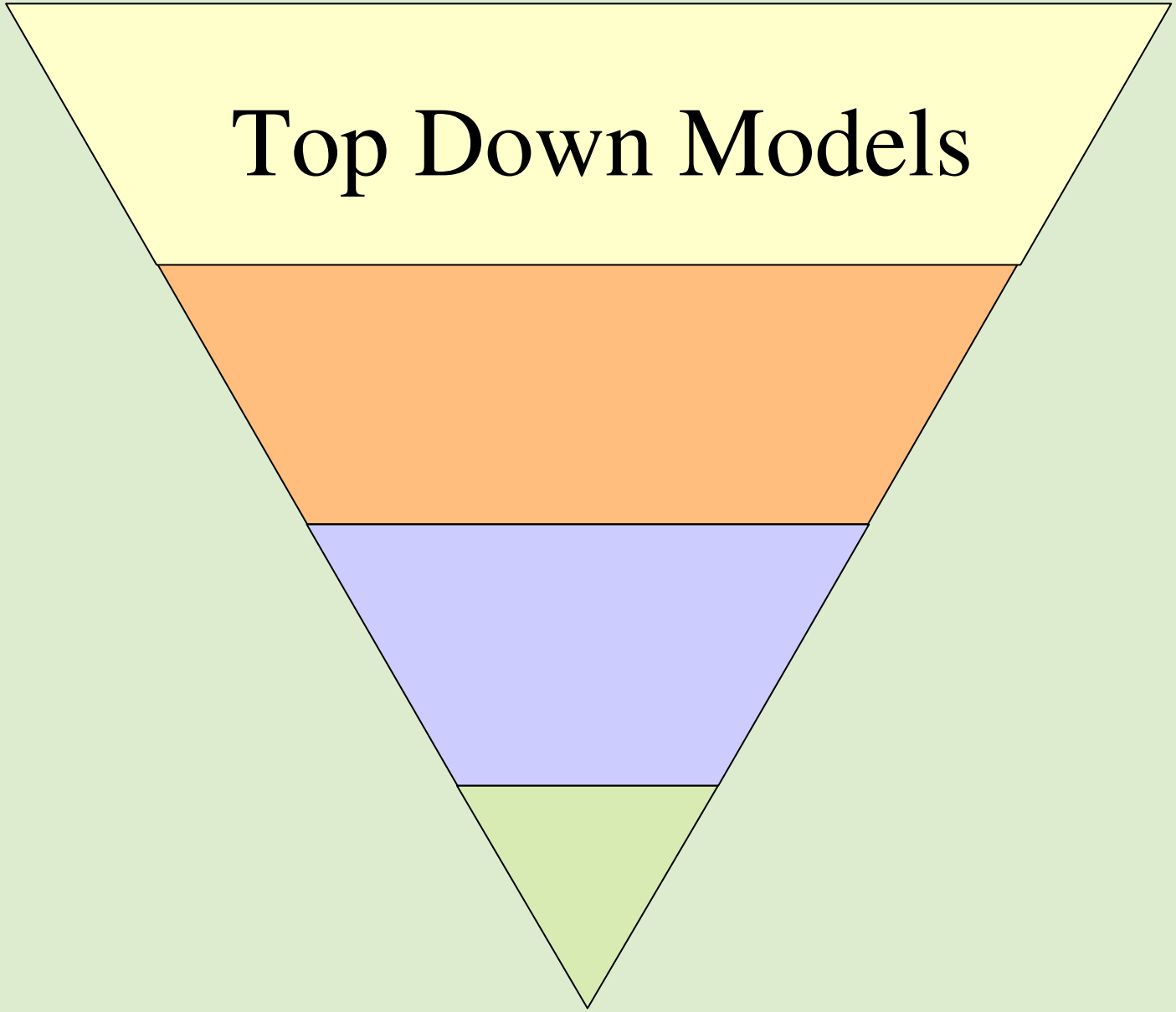


Developing a taxonomy for the various models for community science can be informed by examining the answers to the following questions:

- Who defines the problem?
- Who designs the study?
- Who collects the data?
  - Sample collection?
  - Analysis of samples?
- Who interprets the data?
- Who communicates the results (tells the story)?
- Who takes action?

As the model moves from top-down to bottom-up, the number of questions answered by "community members," rather than "professional scientists" increases.

Top Down Models



Traditional Science Research Model

Who defines the problem?	Who designs the study?	Who collects the data?	Who interprets the data?	Who tells the story?	Who takes action?
Professional scientists	Professional scientists	Professional scientists	Professional scientists	Professional scientists	Professional scientists/ Managers

Geographic scope	Variable
Strength of science	Highest
Strength of science education/empowerment	Lowest

Community Consulting Model (Science for the People)

Who defines the problem?	Who designs the study?	Who collects the data?	Who interprets the data?	Who tells the story?	Who takes action?
Community	Professional scientists	Professional scientists	Professional scientists	Professional scientists	Community

Geographic scope	Local
Strength of science	Highest
Strength of science education/empowerment	Low

Examples of the consulting model

Some PA Growing Greener Grants support programs using this model

European Science Shops

The Mully Grub Restoration Project conducted by ALLARM:

Dickinson College was the primary consultant, providing student research which documented the problem, writing the grant, and coordinating the parties involved in the restoration.

Consulting model lends itself to doing community science within a university course framework

Watershed-based Integrated Field Semester (Luce Semester)

Using the consulting or "science shop" model, all students do an independent research project on an issue defined by ALLARM's partner groups.

Data Collectors Research Model*

Who defines the problem?	Who designs the study?	Who collects the data?	Who interprets the data?	Who tells the story?	Who takes action?
Professional scientists	Professional scientists	Community	Professional scientists	Professional scientists	Professional scientists/ Managers

Geographic scope	Broad
Strength of science	High
Strength of science education/empowerment	Medium

* Also called Community Workers Model (Wilderman); Citizen-Science (Cornell U)

Examples of Data Collectors Research Models

CORNELL LAB of ORNITHOLOGY

Birdhouse Network
Birds in Forested Landscapes
Pigeon Watch
House Finch Disease Survey
eBird

Volunteers collect data to help to explain the distribution and abundance patterns of monarch butterflies in North America.

More Examples of Data Collectors Research Models

Audubon

Backyard bird counts

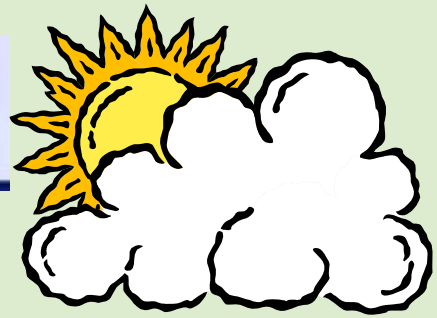
Rivers and Streams

MD DNR Stream Waders Volunteer Monitoring Program (Macroinvertebrate Analysis)

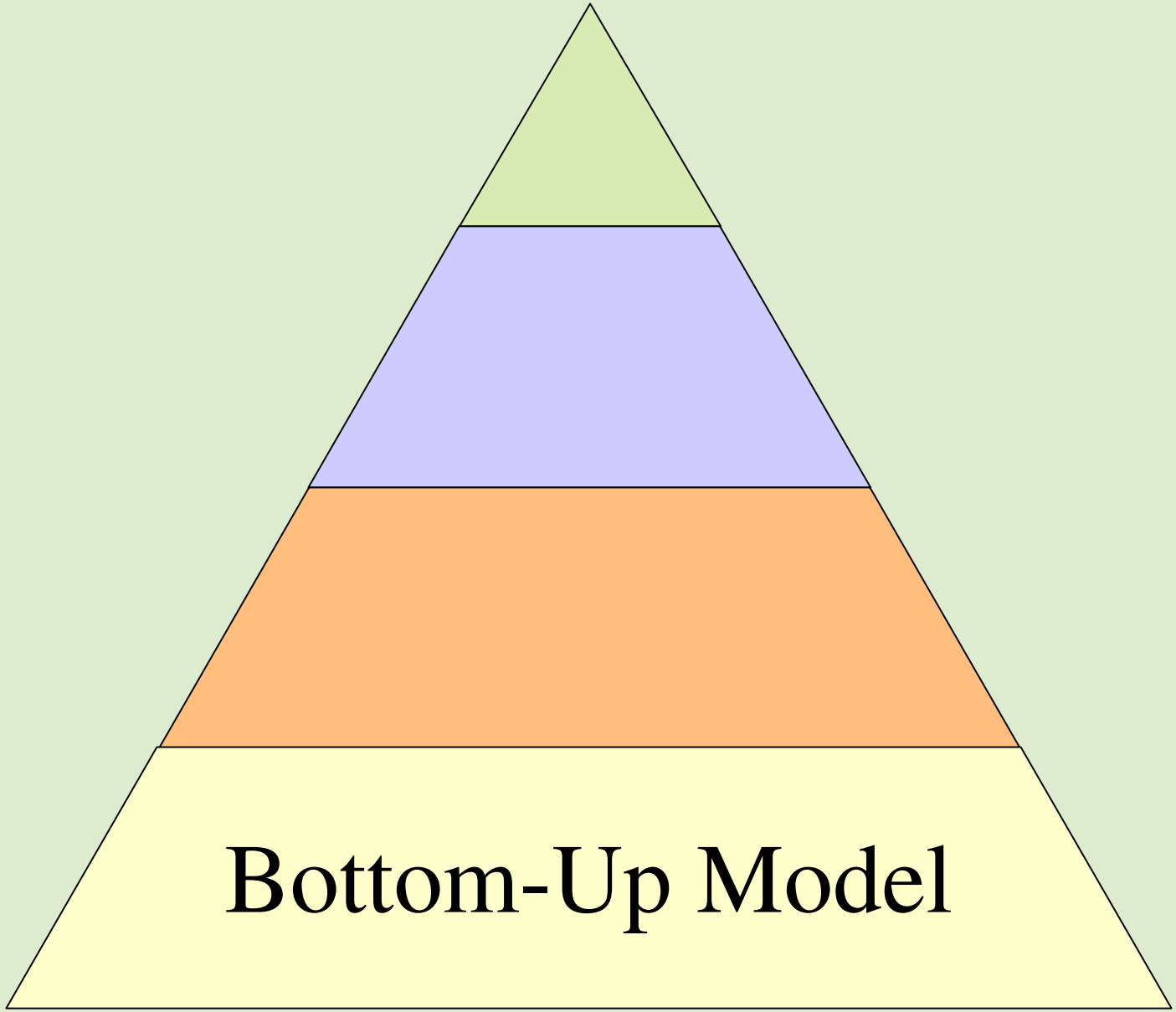
National Weather Service

WORKING TOGETHER TO SAVE LIVES

Weather monitoring stations



ALLARM's acid rain project


Bottom-Up Model

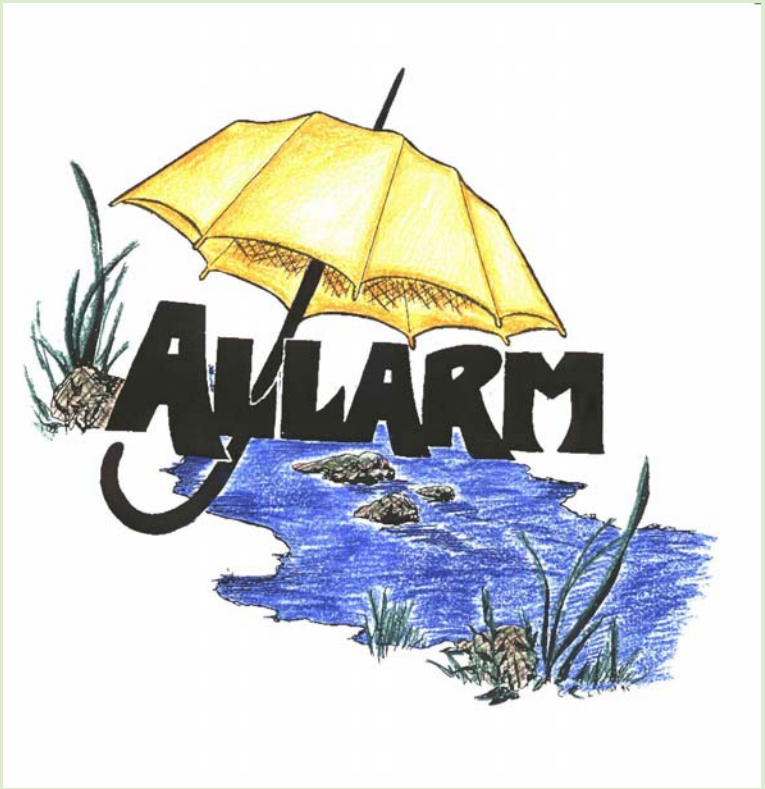
Community-based, Participatory Research Model (Science by the People) *

Who defines the problem?	Who designs the study?	Who collects the data?	Who interprets the data?	Who tells the story?	Who takes action?
Community	Community	Community	Community	Community	Community

Geographic scope	Narrow
Strength of science	Medium
Strength of education/empowerment	Highest

* Also called Participatory Action Research (PAR)

Example of Community-based, Participatory Research Model



Watershed-based projects

Students, faculty and staff teach community members to collect and analyze their own data; this model requires full partnership of community and scientists.

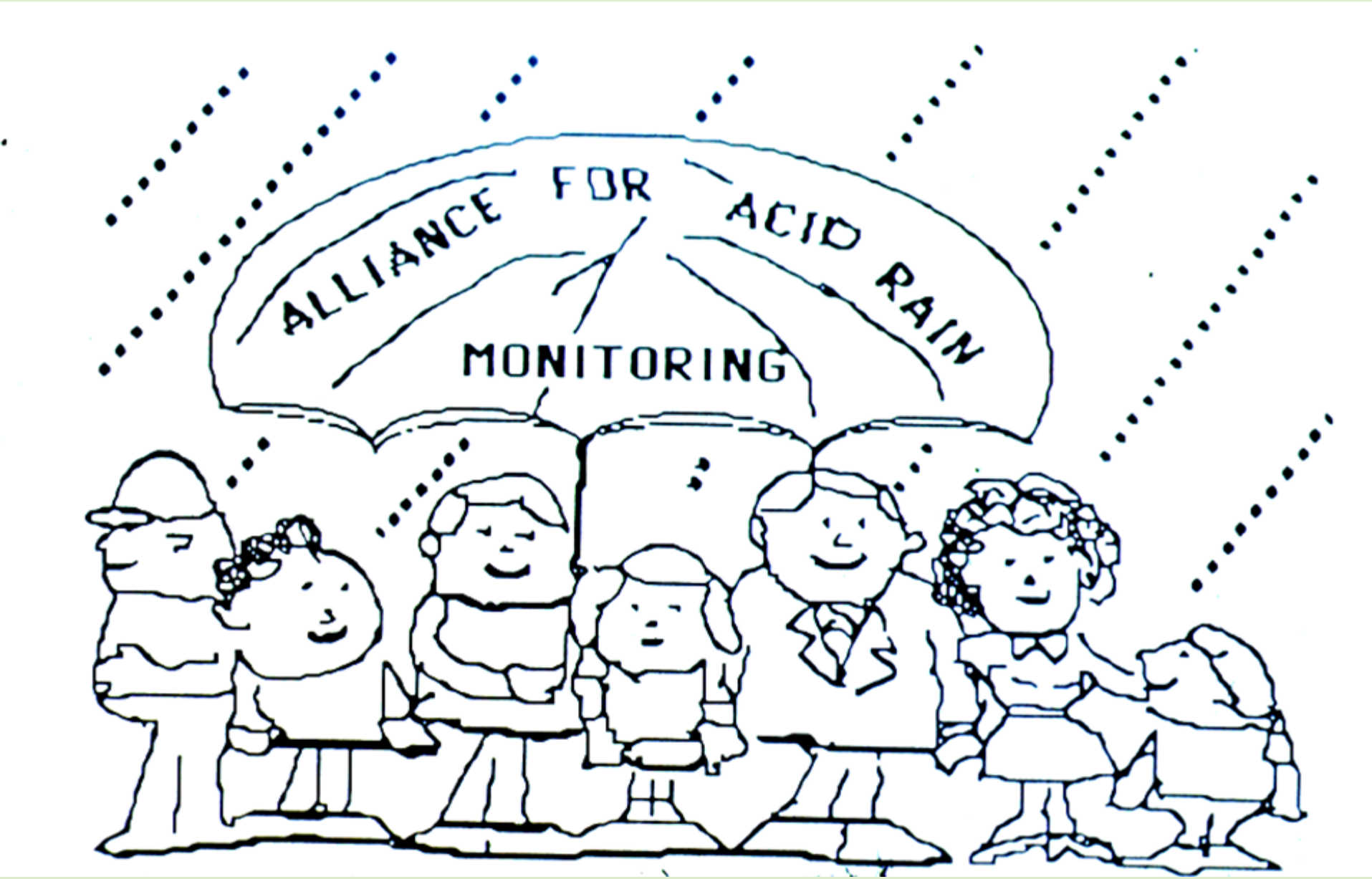
Shermans Creek Conservation Association

Antietam Watershed Association

TROUT UNLIMITED

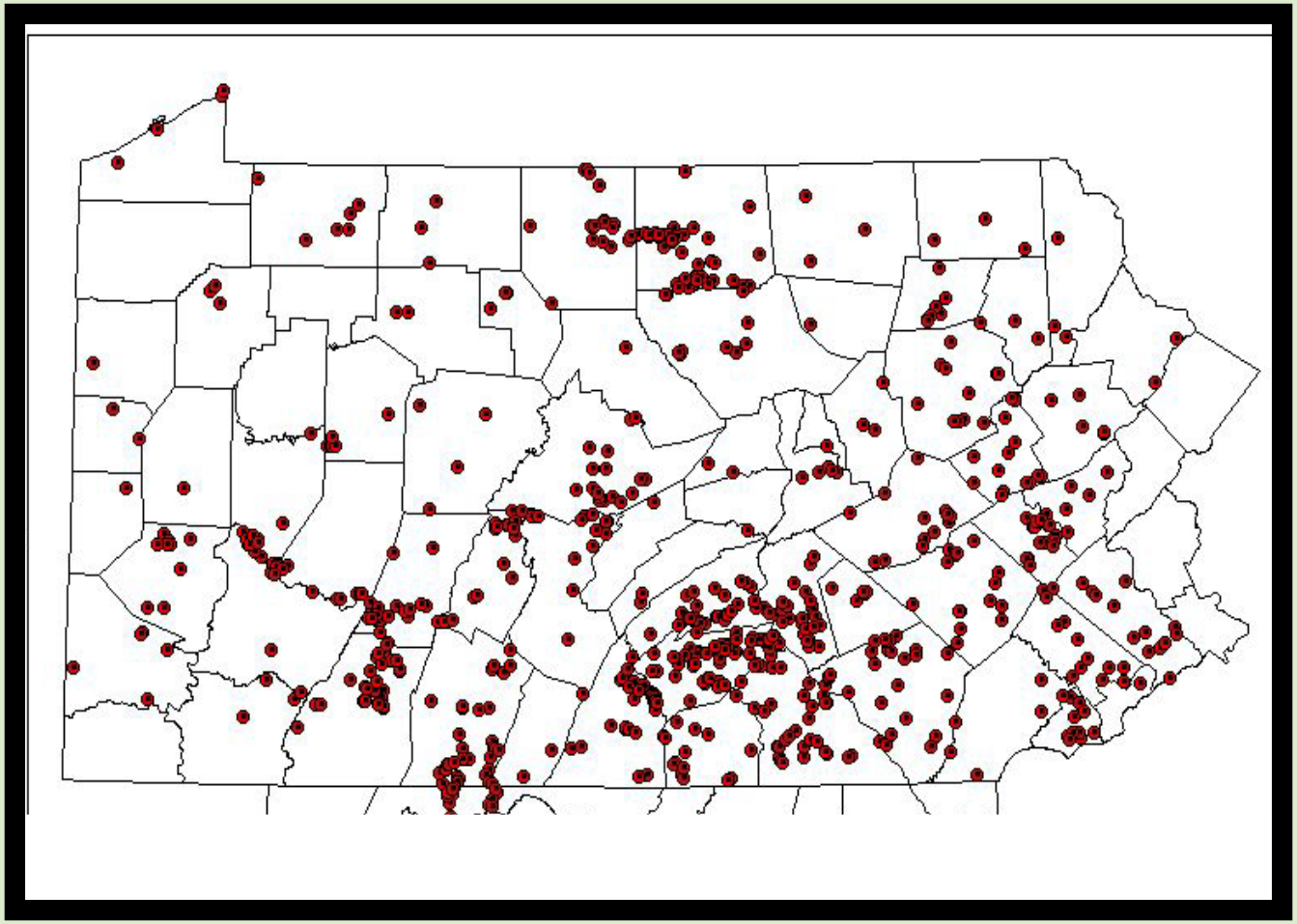
SIDELING HILL CREEK WATERSHED
Pennsylvania and Maryland

Example of a Data Collectors Model: ALLARM's beginnings

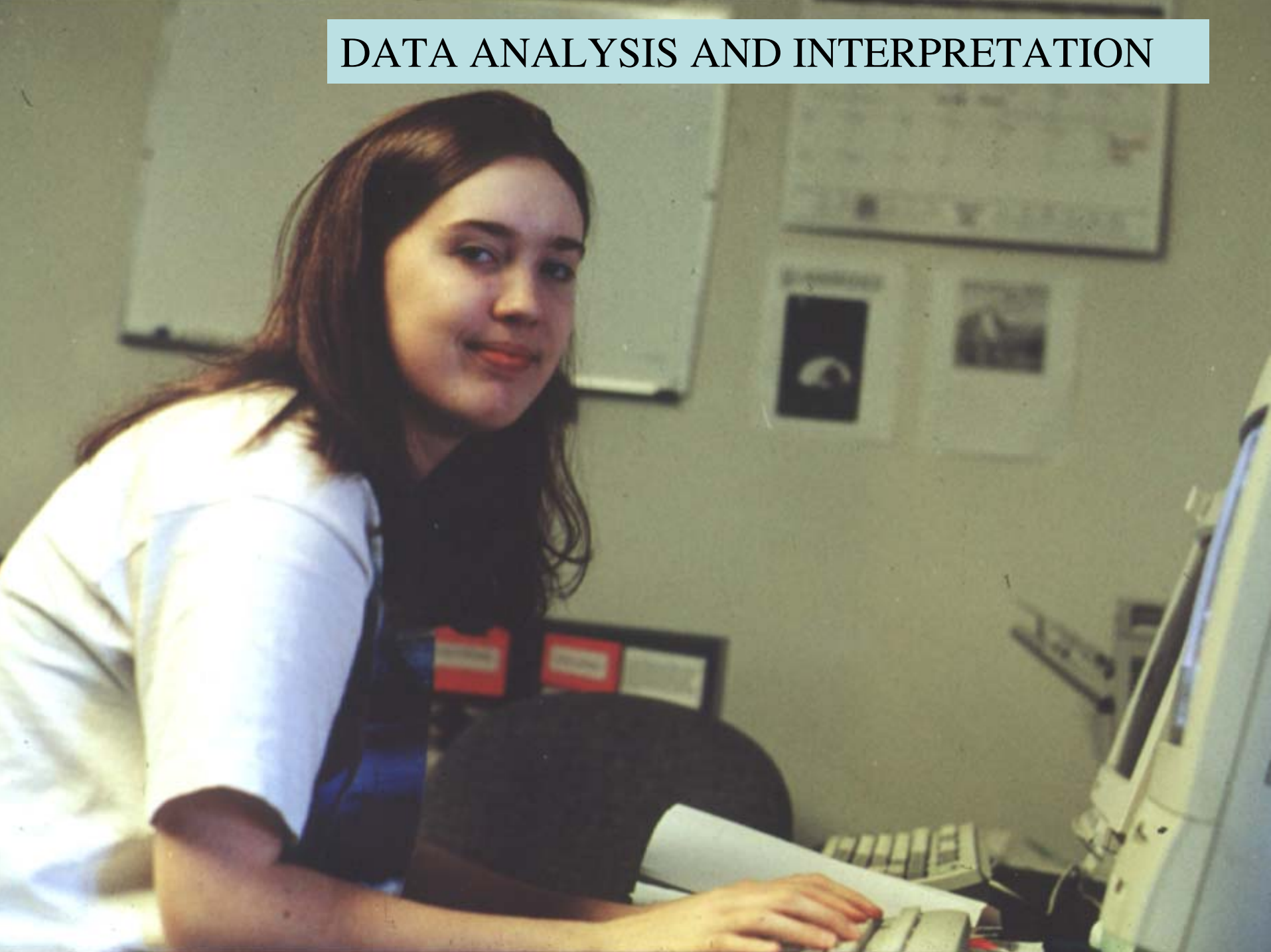

ALLIANCE FOR ACID RAIN
MONITORING

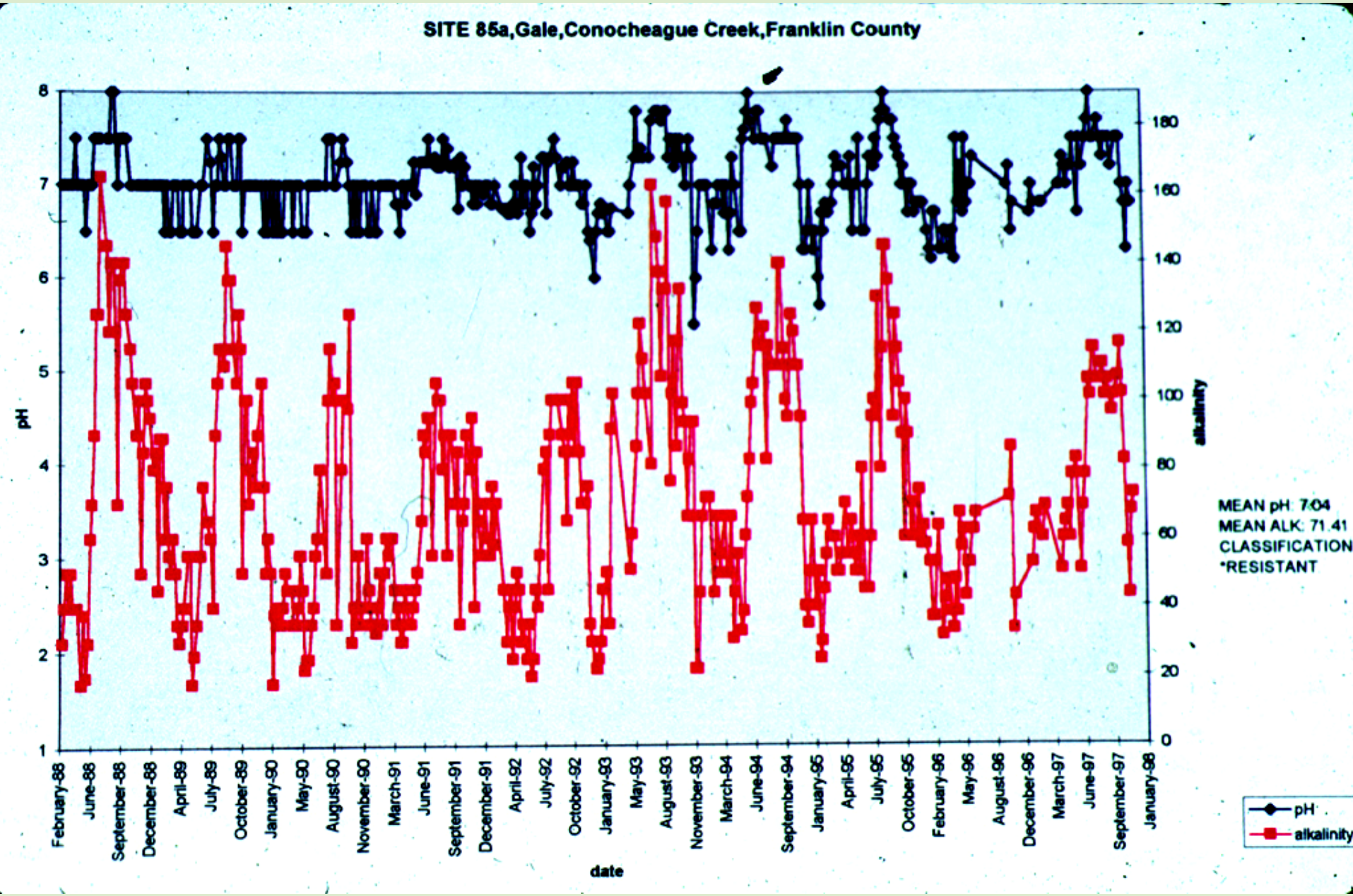

JACK'S SPOT
PITMAN, PA

Sites Monitored by Volunteers



DATA ANALYSIS AND INTERPRETATION




SITE 85a,Gale,Conocheague Creek,Franklin County
pH
alkalinity
date
MEAN pH: 7.04
MEAN ALK: 71.41
CLASSIFICATION
*RESISTANT
pH
alkalinity

Data have been used (by "experts"):

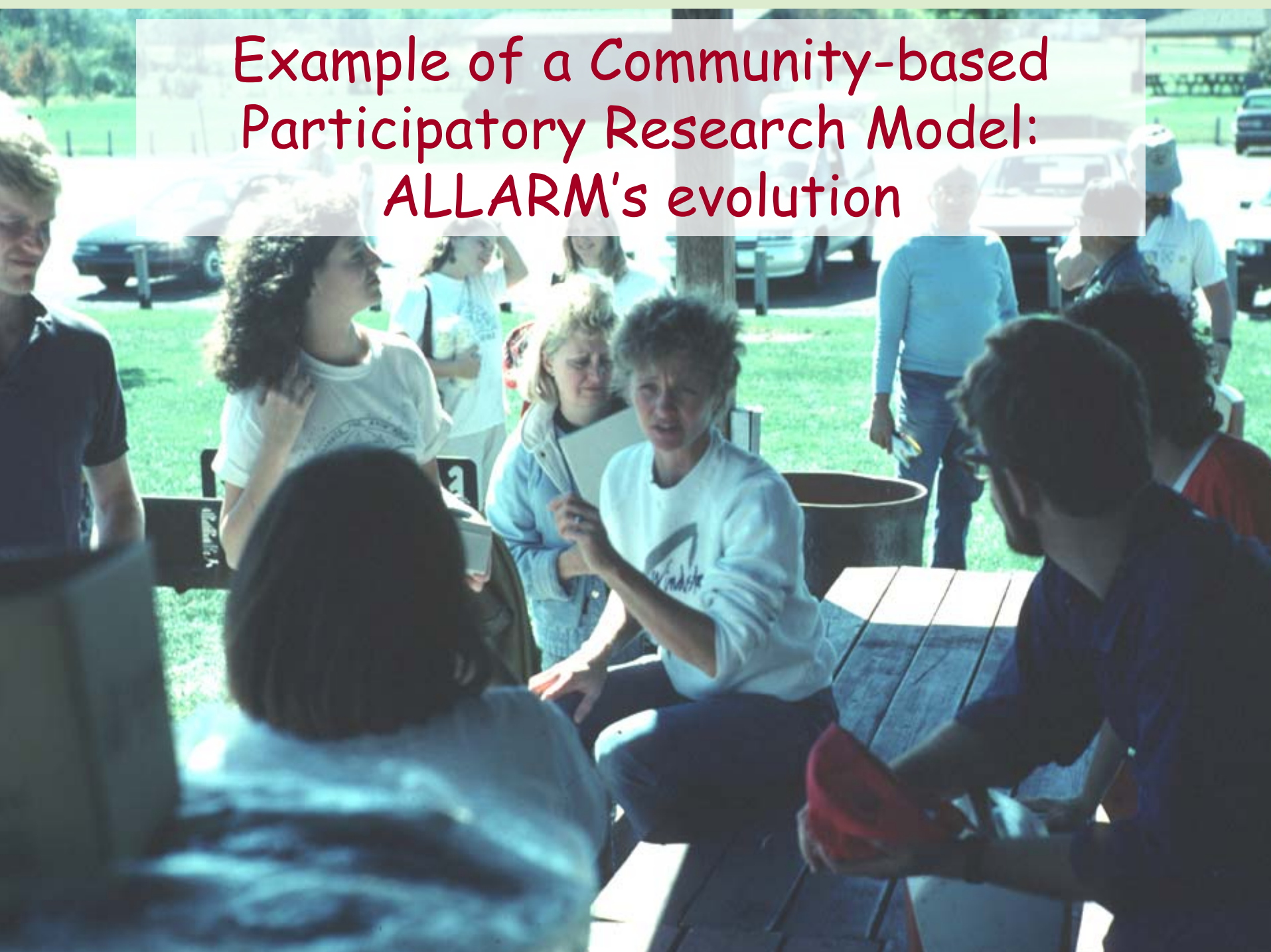
- In published studies connecting watershed attributes to stream vulnerability
- In published studies evaluating the extent of the impact of acidic deposition in PA
- To revise fish stocking practices
- To craft expert testimony in support of acid deposition control legislation
- To conduct studies assessing the impact of the 1990 Clean Air Act amendments, by comparing to data taken prior to their implementation (ongoing)

Data Collectors Research Model

Who defines the problem?	Who designs the study?	Who collects the data?	Who interprets the data?	Who tells the story?	Who takes action?
Professional scientists	Professional scientists	Community	Professional scientists	Professional scientists	Professional scientists/ Managers

Which Model?

Example of a Community-based Participatory Research Model: ALLARM's evolution



ALLIANCE FOR AQUATIC RESOURCE MONITORING

Educate Engage Empower

In this model, the scientists now play the role of "service providers" for the community

- Provide capacity-building programmatic and scientific technical assistance to groups who request assistance to address their concerns.

- Service providers often come from educational institutions, private firms, and government agencies.
  - In PA, state government is funding a consortium of service providers (CSAW) to provide free technical support to watershed associations.

- In the case of ALLARM, this involves student, staff and faculty mentoring groups through every phase of the scientific study:
  - Study design
  - Lab and field training
  - Data management, analysis, and interpretation
  - Data to action planning

We have found the greatest challenges in this model are the design and the interpretation of the study

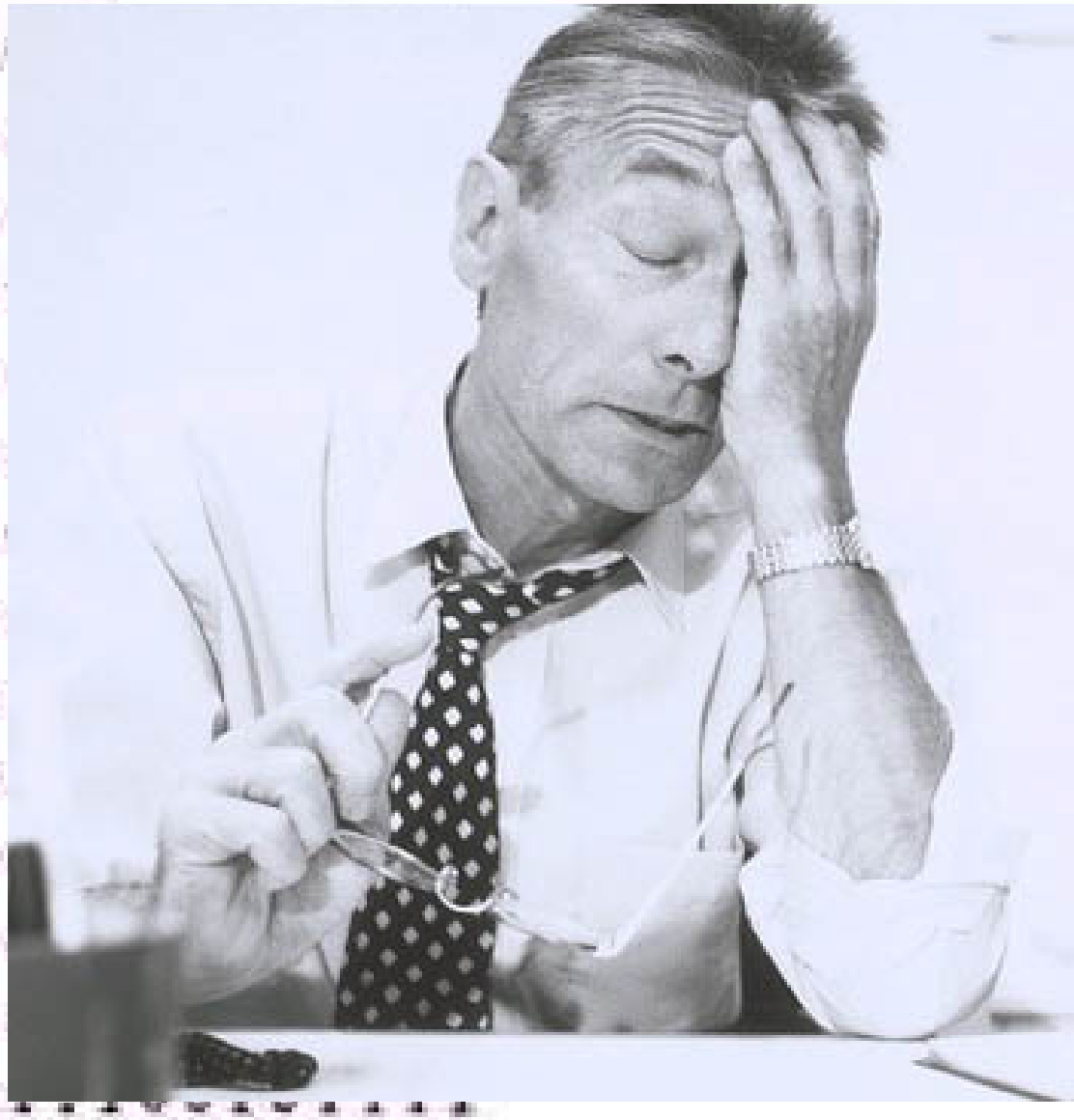
Who defines the problem?	Who designs the study?	Who collects the data?	Who interprets the data?	Who tells the story?	Who takes action?
Community	Community	Community	Community	Community	Community

These steps involve intensive mentoring by the professional partner (service provider) and a high level of commitment by the volunteers. This involves the public in the full range of scientific research and is most effective in developing public understanding of not only the content, but of the processes of science.

Study Design Facilitated Sessions

A study design is a written document that describes the choices you make about monitoring: the intended data use determines design.

The Data Interpretation Step: Can Volunteers Climb the Learning Curve to Convert their Data to Information?

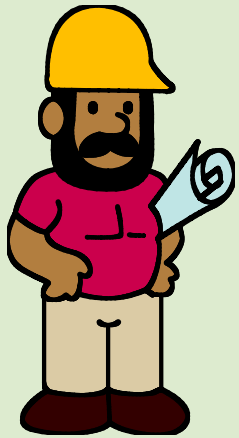


Presenting the story to the group

Training the volunteers to find the story in the da elves

Typical watershed action plans based on volunteer data and carried out by volunteers

- Developing grant proposals for restoration projects
- Developing watershed fact sheets for public education
- Working with landowners to implement "best management practices"
- Developing conservation easement programs
- Upgrading stream protection status
- Removing dams
- Implementing stream and riparian zone restoration projects
- Using data to advocate for sound land use decisions by local municipalities

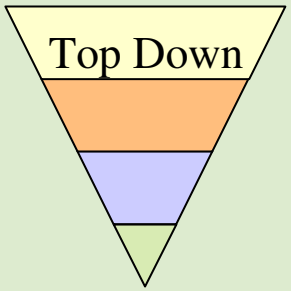
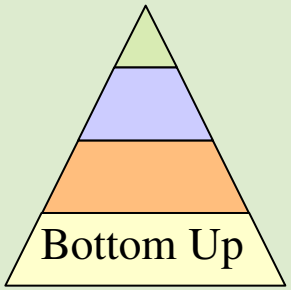


What special attributes of volunteer water monitoring make it uniquely well-suited to a bottom-up, community-based approach?

- Narrow geographical range (in our backyard)
- High social relevance (problems matter to us)
- Problems are actionable (there are solutions)

These attributes provide the necessary motivation for volunteers to stick with steep learning curves needed to fully engage in the scientific process, and to produce sound science.

In the gathering of scientific knowledge, there is a trade-off between efficiency on the one hand and democracy and sustainability on the other hand.

Operational Model	Efficiency	Democracy "knowledge is power"	Sustainability
	Immediate, reliable, scientific results	Only experts can use the data; volunteers are dependent on them	Money runs out, scientists leave, activities end
	Requires time, patience, and commitment for complex training process	Volunteers can shape the interpretations based on their own knowledge and can use the data; levels the playing field in decision-making	Builds community capacity to continue even after experts and monies are gone

Remember: the story in the data belongs to those who understand it, and knowledge is power!

For more information:
http.//www.dickinson.edu/allarm

- Wilderman, C.C., 2007. "Models of Community Science: Design Lessons from the Field," pp. 83-97 *in* McEver, C., Bonney, R., Dickinson, J., Kelling, S., Rosenberg, K., and Shirk, J. (Eds). Proceedings of the Citizen Science Toolkit Conference. Cornell Laboratory of Ornithology, Ithaca, NY, June 20-23, 2007.

- Wilderman, C.C., and J. Vastine, 2005. "Breaking the Code: Data Analysis Workshops," *The Volunteer Monitor,* 17(1), pp. 11-14.

- Wilderman, C.C., A. Barron and L. Imgrund, 2003."The ALLARM program: growth, change, and lessons learned," *The Volunteer Monitor*, 15(1), pp. 1-4.

- Session F4 (Tuesday, 3:30) and Session L5 (Thursday, 10:00)