Workshop Outline

- 1:30 – 2:00PM - Introductions of participants, introduction to EREN and teaching about carbon in trees, introduction to the PFPP database
- 2:00PM - Measuring tree diameters
- 2:30PM - Excel data example
- 3:00-3:30PM - Break
- 3:30-4:00PM - R data example
- 4:00-4:30PM – Open discussion, brainstorming and feedback

EREN

ECOLOGICAL RESEARCH AS EDUCATION NETWORK

Founded using a grant from the NSF Research Coordination Network-Undergraduate Biology Education Program (RCN-UBE)

Award # 0955344

Funding Dates: 2010-2016

The EREN Mission

To create, facilitate, and promote **collaborative** ecological research that generates high-quality, publishable data involving undergraduate students and faculty at primarily undergraduate institutions (PUIs).

That is, EREN works to bring “big” science to “small” institutions!

Coordinating undergraduate research across many sites enhances the scientific and educational value of these activities.

EREN's philosophy

EREN projects are:

- Collaborative
- High impact science and education
- Ecological or environmental research
- Feasible for all kinds of institutions
  - PUI Research Limitations: Time, financial resources
  - PUI Research Strengths: Labor, enthusiasm, low publication pressure allows flexibility for long term work.

EREN leverages the **research strengths** of PUIs to advance **both** science and education.

As of August, 2017, EREN had over 300 members from at least 200 institutions in 41 states, Puerto Rico, Canada, Scotland, the Bahamas, Colombia, Mexico and Singapore**!**

How does EREN work? It's all about THE PROJECTS

- EREN invites people to propose projects to the network through an e-mail call for participants.
- Participants volunteer to join projects of interest.
- Each project organizes under a Lead Scientist to develop protocols, collect data, and seek funding.
- EREN facilitates opportunities for project participants to communicate, share data, post information and meet face-to-face.

EREN projects are diverse but linked by common themes. All…

- focus on ecological or environmental science.
- involve coordinated data collection at multiple sites using common protocols.
- involve undergraduate researchers.
- strive to make unique and meaningful contributions to the peer-reviewed scientific literature.
- strive to educate students and their faculty mentors through immersion in the collaborative research process.

EREN's Permanent Forest Plot Project (PFPP)
Lead Scientists: Dr. Karen Kuers and Dr. Erin Lindquist

- The PFPP is a network of 20 x 20 m permanent forest plots distributed around the world where tree diameters are measured with a consistent protocol.

- The protocol is designed for an undergraduate lab setting (1-3 labs).

- Educational materials are available for student learning outcomes and assessment.

- The PFPP has an online database that allows sharing of data from multiple sites.

- Ecological questions that can be explored with this long-term project include:
    - Carbon sequestration patterns over time and in forests of different types
    - Urbanization effects on forest communities
    - Invasive plant and insect effects on forests
    - Exploration of edge effects

Permanent Forest Plot Project

Lead Scientists: Dr. Erin Lindquist, Meredith College and
Dr. Karen Kuers, Sewanee: The University of the South


KAPPA
KARAOKE
2007

Teaching with the EREN PFPP: Start with carbon in NPP (biomass)

- Carbon sequestration = storage of carbon in living or dead biological tissue
- Trees have great potential for carbon sequestration because they are
  - Large organisms that capture a lot of carbon
  - Long-lived so that the carbon is not quickly released by decomposition
  - Have many durable tissues that contain carbon

How is NPP measured in the field?

- Clip plants at their base, dry, and weigh.
- Multiply weight by 0.45 to 0.50 to get carbon content.
- Student question: What are the drawbacks to this method?

Allometric equations

- Theory – different dimensions of an individual are statistically related (or correlated, although the relationship is not necessarily linear).
- An allometric equation describes the relationship between these dimensions and allows prediction of one dimension from the other.
- For trees – diameter at breast height (1.3 to 1.4 m) can be used to predict biomass.
- Student question: how would you make an allometric equation relating dbh and biomass in trees?

How to make and use an allometric equation

- Harvest a sample of trees of varying sizes.
- Measure diameters.
- Weigh trees to relate weight to diameter.
- Explore the mathematical relationship between weight and diameter and express as an equation.
- Apply equation to living trees – measure diameter and use this to predict biomass.

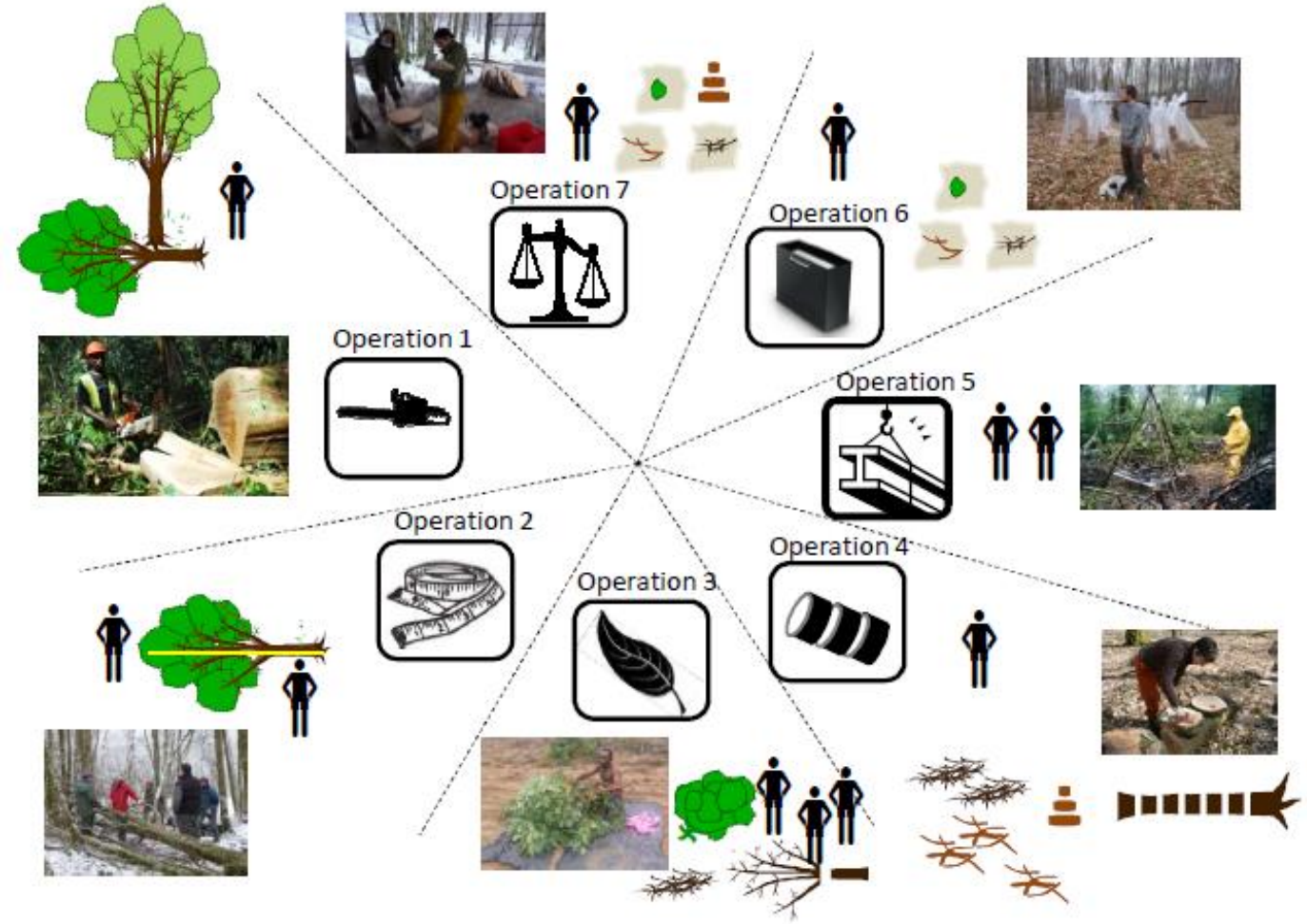

Figure 3.2 – *Organization of a biomass measurement site with 7 different operations. Operation 1, site preparation and felling of the trees (photo: L. Saint-André); operation 2, measurement of felled trees: stem profile, marking for cross-cutting (photo: M. Rivoire); operation 3, stripping of leaves and limbing (photo: R. D'Annunzio and M. Rivoire); operation 4, cross-cutting into logs and disks (photo: C. Nys); operation 5, weighing of logs and brushwood (photo: J.-F. Picard); operation 6, sampling of branches (photo: M. Rivoire); operation 7, sample weighing area (photo: M. Rivoire).*

PHOTO 3.4 – *Biomass campaign in a eucalyptus plantation in Congo. On the left, stripping leaves onto a tarpaulin (photo: R. D'Annunzio). On the right, operations completed for a tree, with bags in the weighing area containing leaves, logs and brushwood (photo: L. Saint-André).*

PHOTO 3.5 – *Left, biomass campaign in Ghana in a teak high forest: measurement of branching (photo: S. Adu-Bredu). Right, biomass campaign in France in a high forest coppice: stem profile measurements (photo: M. Rivoire).*

PHOTO 3.7 – *Biomass campaign in an oak grove. Left, disks taken and placed in large bags for transfer to the samples weighing area; middle, samples weighing area; right, digger used to weigh logs (photos: C. Nys).*

PHOTO 3.8 – *Laboratory measurements: (A) debarking, (B) weighing the wood, (C) weighing the bark (photos: L. Saint-André), (D) oven-drying samples, (E) regular weighing to constant weight (photos: M. Henry).*

The PFPP Database

- Accessed via the EREN website at http://erenweb.org/data/c-storage/
- Contact Drs. Lindquist and Kuers via e-mail for access to the database.

Data Analysis Examples: Exploring Different Scales

- Example 1 from Dr. Erin Lindquist – dbh data from one plot is used to explore tree growth across years.
- Example 2 from Dr. Karen Kuers – dbh data from six plots is used to explore carbon sequestration patterns across a landscape.
- Example 3 from Drs. Laurie Anderson and Jose-Luis Machado – dbh data from the entire dataset is used to explore carbon sequestration in relation to large-scale precipitation and temperature patterns.