

The Ecological Research as Education Network's (EREN) Collaborative Model: The Permanent Forest Plot Project (PFPP)



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Introduction to EREN

- EREN is a group of more than **300** faculty from over **200** Primarily Undergraduate Institutions (PUIs) in the US, Canada, and other international localities. Faculty collaborate on multiple site faculty-student research projects to answer regional to continental-scale ecological questions.
- Faculty strive to maximize student engagement in science and assess student learning outcomes focused on scale-dependent ecological processes, collaborative research skills, and data management.
- Faculty-student research is incorporated into courses and undergraduate research projects. Data generated by the faculty and students are shared among the participating institutions for class activities and research publications.

Table 1: Past* and Current EREN Collaborative Research Projects

EREN Research Project	Lead Scientist(s) and Institution
Stream Temperature Project* (RBAST)	Jeffrey Simmons, Mount St. Mary's University (MD)
Permanent Forest Plot Project (PFPP)	Karen Kuers, Sewanee: The University of the South (TN) Erin Lindquist, Meredith College (NC)
TurtlePop	David Bowne, Elizabethtown College (PA)
Decomposition of Aquatic and Terrestrial Invasive Species (DATIS)	Tracy Gartner, Carthage College (WI) Carolyn Thomas, Ferrum College (VA)
EREN Worm Project	Tim McCay, Colgate University (NY)
Emerald Ash Borer Project	Ben Dolan, University of Findlay (OH) Jason Kilgore, Washington and Jefferson College (PA)
Bird-Window Collision Project	Steve Hager, Augustana College (IL) Bradley Cosentino, Hobart and William Smith Colleges (NY)
Oak Mast Project	Harmony Dagleish, College of William and Mary (VA) Michael Steele, Wilkes University (PA)
Milkweed Adaptation Project	Emily Mohl, St. Olaf College (MN)



Figure 1. Students at EREN institutions participating in the Turtle Pop (A) and Worm Project (B)

Permanent Forest Plot Project (PFPP)

- Open to all EREN member faculty and students
- Provides a detailed, common protocol to collect site, plot, tree, and small stem data for 20 x 20 m forest plots
- Maintains an online database available to all users. Currently (10 Jan 2016) there are:
 - 225 individual database users at 41 institutions
 - 209 plots at 45 sites among 16 ecoregion divisions
 - Diversity of plot types (Table 2)
- Promotes multi-site collaboration (for both faculty and students)
- Addresses landscape and regional scale questions

Table 2: Number and type of 20 x 20m plots with tree data (dbh ≥ 2.5 cm) entered in PFPP online database. (10 Jan 2016)

Plot Type	Number of plots
Urban plots	69
Edge (≥ 30 m from forest edge)	39
Floodplain	22
Disturbance: Invasives	89
Disturbance: Wind	25
Disturbance: Insect	25
Disturbance: Logging	45

Research Questions

- Main research questions relate to: (1) carbon accumulation, (2) effects of invasive plant (e.g., garlic mustard) and animal (e.g., emerald ash borer) species, (3) and disturbance within and across multiple scales and ecoregions.
- Faculty and students can test their own questions using the shared database such as:
 - How does length of growing period determine aboveground tree biomass (Figure 2A)?
 - How does precipitation influence tree species richness (Figure 2B)?
 - How do forest edges varying in type, size, and location impact the tree community?

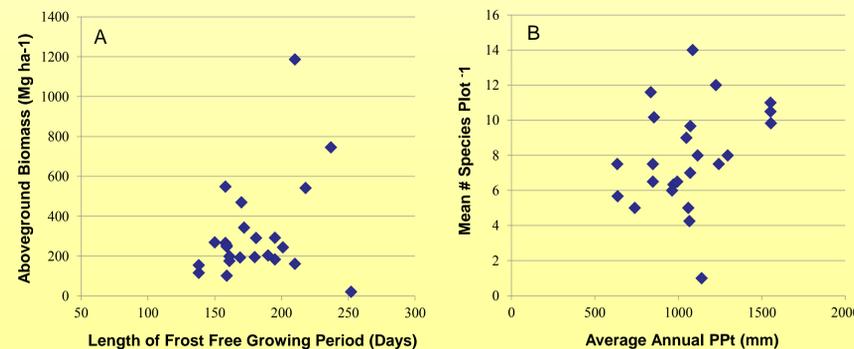
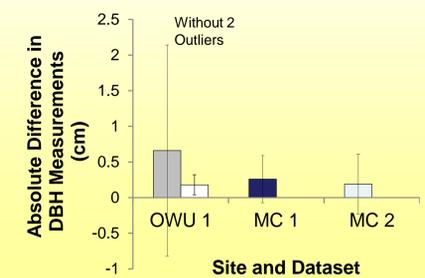


Figure 2A,B: Example of potential ecological trends students and faculty can investigate utilizing the online PFPP database (Fig 2A: $R^2=0.10$, $p=0.14$; Fig 2B: $R^2=0.10$, $p=0.12$). Plot database accessed in July 2014.

PFPP Quality Control and Assurance

- Student measurements are reviewed by a faculty member before they are entered in the database. Repeat measurements are encouraged for at least 10% of stems.
- A quality control variable is entered in the database with each plot upload.
- We performed repeat student diameter measurements of a subset of trees at two institutions (Figure 3) and found that any recorded growth below 0.2 cm may be due to error.

Figure 3. Absolute differences (cm; mean ± stdev) between the first and second measurements for three student collected datasets: OWU 1 (n = 20), MC 2 (n = 62), and MC 3 (n = 68). Two outliers were removed from OWU 1.



PFPP Future Goals

- Increase the quantity (number, type) and publication quality of plot data available on the database to perform multi-site comparisons
- Increase the number of sites with multiple-year plot data to investigate forest changes over temporal scales
- Develop faculty-led projects focused on particular research questions for publication
- Support faculty in developing and sharing new curricular resources which utilize the database in classrooms
- Assess the effectiveness of incorporating the PFPP curriculum and research into undergraduate classes for faculty and student outcomes

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