



EREN

ECOLOGICAL RESEARCH AS EDUCATION NETWORK

EREN Virtual Community Event

Feb 3, 2023

2:30-4PM Eastern Time

Welcome!

Today's Agenda

- **Ice Breaker in Breakout Rooms** (random assignment) - 10 min
- **EREN Project Presentations** (n = 8, 4 minutes each max) - 30-40 min
 - **Classic EREN Projects** - Started before 2020, emerged from a research idea
 - **EREN-NEON Flexible Learning Projects** - Started in 2020 as a pandemic response, focused on flexible teaching in a research context and include NEON datasets
 - **EREN-NEON-EDDIE Projects** - Started in 2021, include collaborative data collection, large datasets, teaching modules inspired by EDDIE methods of teaching with big data
- **Project Breakout Rooms** - Follow up discussions of projects - 25-30 min
 - Choose your room and switch among them
- **EREN's New Initiatives** - 10 min
 - Invitation to develop an **EREN-NEON Flexible Learning Project** this spring
 - The **Macrosystems Ecology For All (MEFA) Network**
- **We're done!**

EREN Project Presentation Order

1. **Using Space and Time to Explore Phenology (EREN-NEON FLP)** - presented by Alisa Hove and Jennifer Rhode Ward
2. **EREN-NEON-EDDIE Vernal Pool (EREN-NEON-EDDIE)** - presented by Dave Steinberg
3. **PFFP (Classic EREN)** - presented by Rachel Collins
4. **Sapsucker Project (EREN-NEON FLP)** - presented by Sandra Cooke
5. **EREN Milkweed (Classic EREN)** - presented by Emily Mohl
6. **EREN Lichen (EREN-NEON FLP)** - presented by Mary Beth Kolozsvary
7. **EREN Turtle Pop 2.0 (Classic EREN)** - presented by Jennifer Purrenhage
8. **EREN Moss Pilot Project (EREN-NEON-EDDIE)** - presented by Denise Finney and Erin Bissell

Using Space and Time to Explore Phenology

Alisa Hove



Warren Wilson
COLLEGE



Jen Rhode Ward

Scientific Goals

- Examine changes in phenology (the timing of life history events) over geographic and temporal scales
- Make connections between phenological and abiotic data

Student Learning Outcomes - flexible!

- Formulate authentic research questions
- Practice field data collection
- Explore big data (*NEON*)
- Contribute to citizen science efforts (*Nature's Notebook*)
- Gain skills in quantitative reasoning (*R, Excel*)



Using Space and Time to Explore Phenology

Logistics can be adapted for majors/non-majors, upper/lower division, urban/rural campuses!

- Required
 - ability to download [National Phenology Network](#) data
 - ability to download [NEON](#) data
 - access to [Excel](#) or [RStudio](#) for data analysis
- Optional
 - access to the [Nature's Notebook app](#)
 - access to outdoor sites for data collection



Methods

- Create hypotheses relating phenological phenomena to abiotic data from NEON
- Collect local phenological data and / or get data from the National Phenology Network
- Download abiotic data from NEON
- Do regression analyses
- Report results (internally, and to other project participants)

Using Space and Time to Explore Phenology

Project Stage & Key Results

- Limited adoption beyond initial development team
- Created permanent phenology trails for trees on three campuses
- Curated long-term tree phenology datasets on three campuses

Next Steps

- Expand Project Participants

How to Join

- Visit [our project page!](#)
- Or email ahove@warren-wilson.edu & jrward@unca.edu



How do local and regional factors affect the spring phenology of pond-breeding amphibians and trees?



We hypothesize that:

1. Local factors are better predictors of phenology than regional ones.
2. Phenological asynchrony between plants and early spring-breeding amphibians will increase across time in proportion to the degree of environmental change.

 **VERNAL POOL
PHENOLOGY PROJECT**

The logo consists of four small squares in a 2x2 grid. The top-left square is brown, the top-right is light green, the bottom-left is dark green, and the bottom-right is orange. Each square contains a simple icon: a water drop, a leaf, a tree, and a frog respectively.

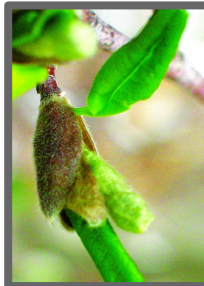
Mary Beth Kolozsvary (Siena)
Jennifer Purrenhage (UNH)
Dave Steinberg (UNH)
Thilina Surasinghe (Bridgewater St.)



  VERNAL POOL
  PHENOLOGY PROJECT

What do you need?

- A 'pool' (forested, fishless, <math><0.2\text{ ha}</math>)
- ~600-700 USD worth of equipment
- Ability to complete twice weekly surveys for 6 weeks for *at least* 1 year
- Willingness to share data





**WE WANT YOU
FOR THE VPPP**

Email for info/protocols:
eren.vppp@gmail.com



  **VERNAL POOL**
  **PHENOLOGY PROJECT**

Spring 2022: Pilot 1.0

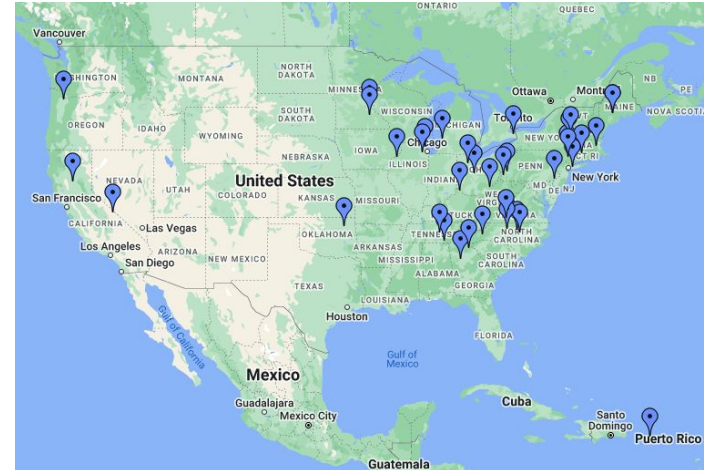
Spring 2023: Pilot 2.0 + Accepting New
Participants

2024 – 27/8: Active + Accepting New
Participants

Permanent Forest Plot Project (PFPP)

Scientific Goals

Establish permanent research plots
addressing questions within sites or across
sites/ecoregions about
tree biomass, carbon accumulation, invasive
species, species composition, succession....



Student Learning Outcomes

- Learn forest measurement techniques and tree species identification
- Gain practice with data analysis and display
- Use results to address questions central to forest ecology



Permanent Forest Plot Project (PFPP)

Logistics

- Having access to forested land to house one or more permanent forest plots
- Forested plots are 400 M² and are marked with corner stakes.
- All trees > 5 cm DBH (diameter at 1.37 M from the ground) have a permanent numbered tag and identified to species

Materials Available

- Extensive protocols, datasheets, potential research questions, tips
- Instructor resources
- Forest Species Composition Activity - 100% classroom-based need computer access



Permanent Forest Plot Project (PFPP)

Project Stage

- **PFPP 1.0 (2012-2022) | Co-PIs: Karen Kuers and Erin Lindquist - CLOSED**
 - Submit existing data from PFPP 1.0, to Karen Kuers kkuers@sewanee.edu
 - Published dataset is in the works
- **PFPP 2.0 (2023 – Present) | Co-PIs: Jason Kilgore, Rachel Collins, & Ben Dolan**
 - **Recruiting new participants**
 - New protocols expect by Summer 2023 to include standardized data entry, disaggregated data for independent data publishing.
 - Researchers can follow the current protocol (PFPP 1.06) for now
- **Four Other Projects Using PFPP Protocols**

Join Us

PFPP is for forest novices and forest experts



Foraging sapsucker tree use across landscapes

Sandra Cooke, Department of Natural Sciences, Greensboro College, Greensboro, NC

Background: Sapsuckers (*Sphyrapicus* spp.) are North American woodpeckers that primarily feed on tree sap. Feeding leaves behind holes called **sap wells** that ~40 other species use to forage in the tree. So, sapsuckers are considered **keystone species**.

Questions: Across different eco-climatic domains, does **sap well presence and abundance** vary with:

- Urbanization?
- Tree size?
- Tree species?
- Tree native status?
- Cardinal direction?
- Distributions of sap-well-using species (e.g., rufous hummingbird)?

Image from <https://en.wikipedia.org/wiki/Sapsucker>



Project Logistics & Methods

- Site attributes
 - Eco-climatic region
 - Location (GPS or nearby intersection)
 - Urbanization level (Bortle scale)
- Tree attributes
 - DBH (cm)
 - Species
 - Native vs. non-native
 - Bark type
 - Disease presence
 - Signs of additional woodpecker activity
 - Sap wells presence/ absence
- Sap well attributes (if present)
 - Location (lower trunk, upper trunk, limbs)
 - Estimated quantity at each location
 - Texture/ condition (distinct holes, fused furrows)
 - Orientation preference (e.g., N, S, E, W, none)

In a nutshell,
observe a bunch of
nearby trees, see if
they have sap wells,
and record them!

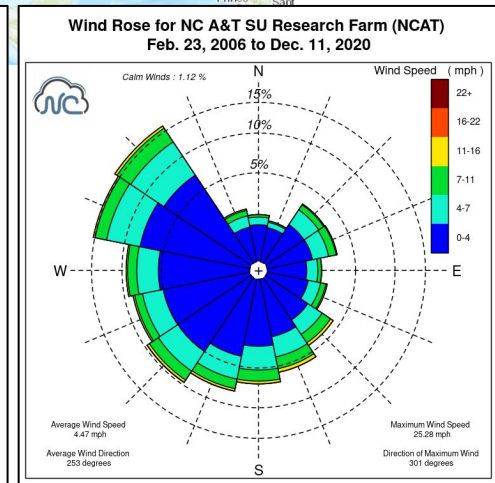
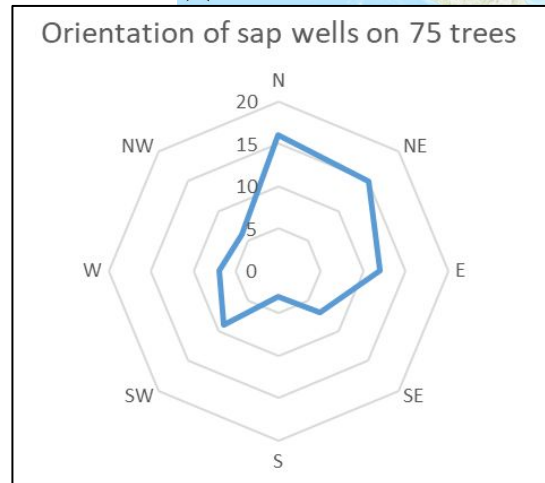
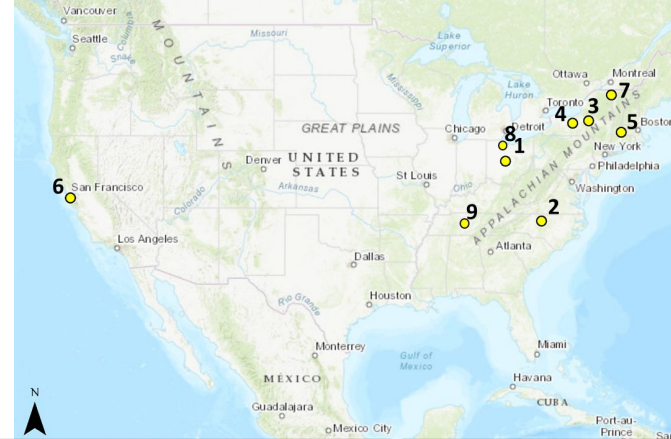


Preliminary Participation Results & Metadata

As of January 31, 2023:

- 9 institutions have “signed on”
- 5 have collected data
- 4 have contributed data
- Almost 600 total observations contributed
- 255 trees with sap wells
- ~100 tree species identified
- Appears to be more sap wells in more urban/ developed areas compared to wooded areas?
- Cardinal direction of sap wells may be non-random

Visit [here](#) to join, or google “EREN sapsucker”



Milkweed Adaptation

Overarching Question: Does it matter where milkweeds come from for restoration?

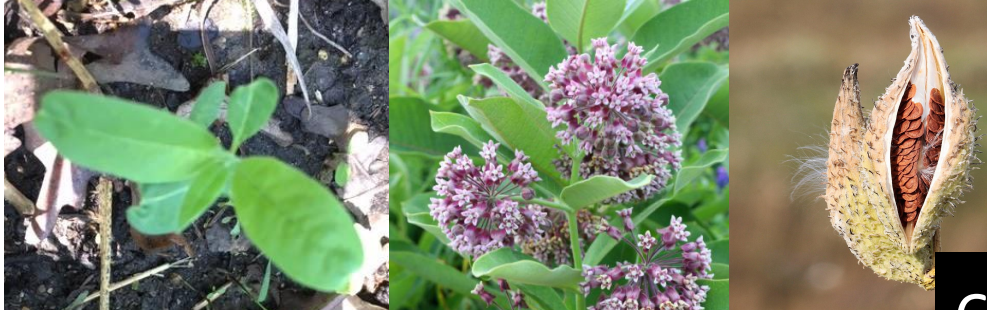
Current Question: How does milkweed phenology affect its interactions with pollinators and herbivores?



Courtney
Celley USFWS

Milkweed Adaptation

Pick a season



Observe plant phenology and interactions with herbivores/pollinators over space or time.

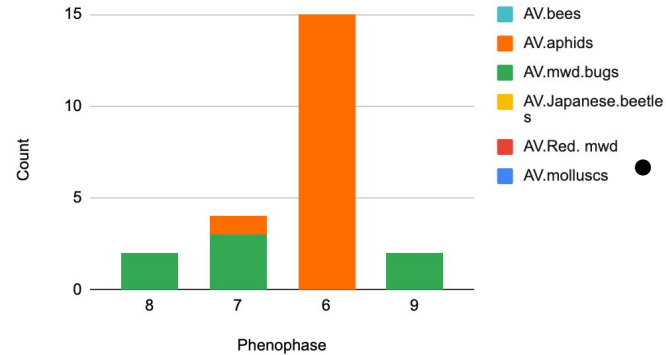
Or: Conduct a bioassay experiment in the spring



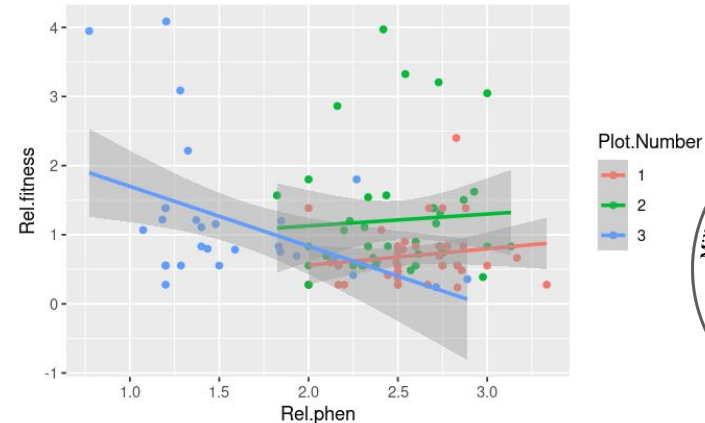
Contribute to the Milkweed Adaptation Study!

1. Check out the Phenology Project at marenweb.com
2. Join our [Mailing List](#).
3. You can participate at any time, but stay tuned for summer workshops.
4. Contact Emily: mohl@stolaf.edu

Plot/Time 1



- Analyze the data you collect for simple or complex patterns.
- Contribute to a larger dataset to discover geographic trends.



Lichens in Diverse Landscapes

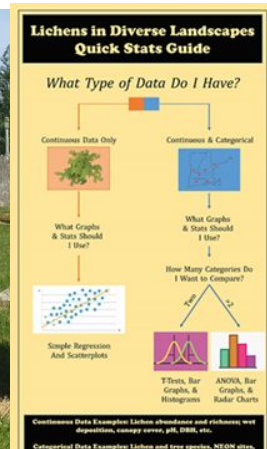


Modules:

1. Spatial Analysis of Biological & Environmental Data
2. Lichens in YOUR Landscape
3. Data Analysis for NEON & Local Field Data

Project Leaders:

Danielle Garneau (SUNY-Plattsburgh),
Matthew Heard (Belmont University),
Mary Beth Kolozsvary (Siena College)



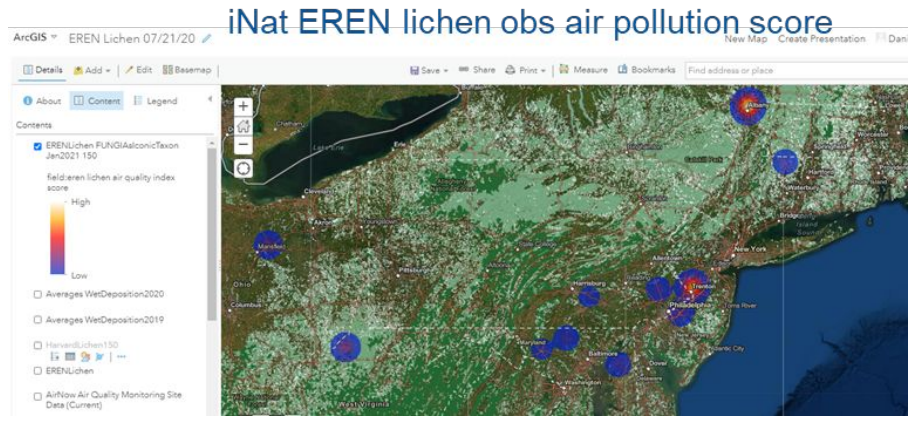
Spatial Analysis - biological & environmental data

- NEON site-level lichen cover
- NEON wet deposition pollutants
- GIS datasets - air quality, land cover type, forest cover
- iNaturalist EREN lichen observations



Stats

Totals	Most Observations	Most Species	Most Observed Species
923 Observations »	owensds 23 observations	owensds 7 species	Common Greenshield Lichen 24 observations
56 Species »	katoerikun 20 observations	katoerikun 5 species	American Sweetgum 7 observations
204 People »	predini 17 observations	nvilla 5 species	Candleflame Lichen 7 observations
	ibikarisingh 10 observations	huntergarrett 3 species	Mustard Lichen 7 observations
	nwlbon47 15 observations	emilyrammeyer 3 species	Red Maple 5 observations



NEON wet deposition nitrate & iNat EREN lichen obs



Field-based Module

Instructor/Student Guide

- Flexible templates, detailed protocols
- Focus analysis on your own site or across multiple sites (*iNaturalist*: EREN Lichen)

Variables to explore

- Percent lichen
- Lichen air quality index
- Tree - species, diameter, canopy cover, aspect, bark pH

<https://erenweb.org/all-projects/lichens-in-diverse-landscapes/>



Lichen Type	Air Quality	Air Quality Score
No lichens present	very poor	1
Crustose only	poor	3
Foliose present, but no fruticose	moderate to good	6
Fruticose present	good	9
<i>Lobaria pulmonaria</i> or <i>Teloschistes exilis</i> present; fruticose lichens, very sensitive to pollution	very high	10



Email: eren.lichen@gmail.com

EREN Turtle Pop



Initiated by Dave Bowne, 2011

Conservation Biology



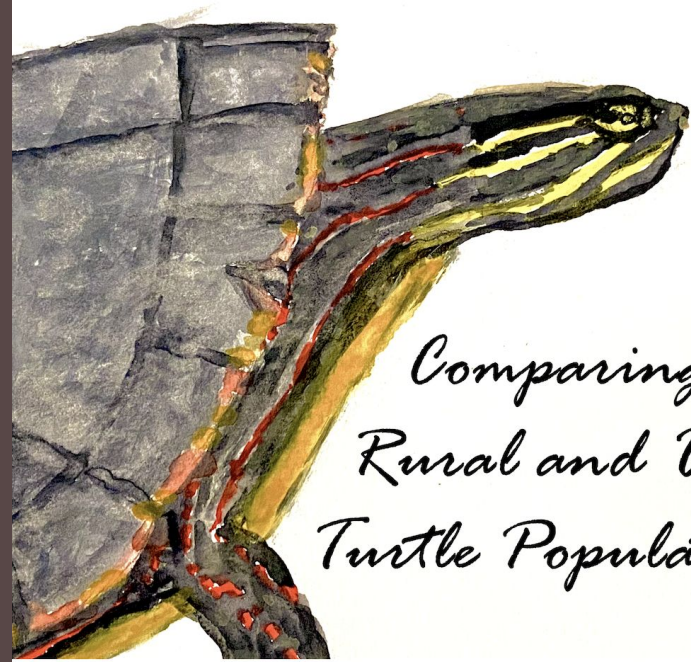
Contributed Paper

Effects of urbanization on the population structure of freshwater turtles across the United States

David R. Bowne ^{1*}, Bradley J. Cosentino ², Laurel J. Anderson,³ Christopher P. Bloch,⁴ Sandra Cooke,⁵ Patrick W. Crumrine,⁶ Jason Dallas,^{7,25} Alexandra Doran,^{1,26} Jerald J. Dosch,⁸ Daniel L. Druckenbrod,⁷ Richard D. Durtsche,⁹ Danielle Garneau,¹⁰ Kristen S. Genet,¹¹ Todd S. Fredericksen,¹² Peter A. Kish,¹³ Mary Beth Kolozsvary,¹⁴ Frank T. Kuserk,¹⁵ Erin S. Lindquist,¹⁶ Carol Mankiewicz,¹⁷ James G. March,¹⁸ Timothy J. Muir,¹⁹ K. Greg Murray,²⁰ Madeline N. Santulli,¹⁴ Frank J. Sicignano,^{14,21} Peter D. Smallwood,²² Rebecca A. Urban,²³ Kathy Winnett-Murray,²⁰ and Craig R. Zimmermann²⁴

TurtlePop 1.0 found:

A significant positive relationship between proportions of mature female painted turtles (*C. picta*) and urbanization



*Comparing
Rural and Urban
Turtle Populations*



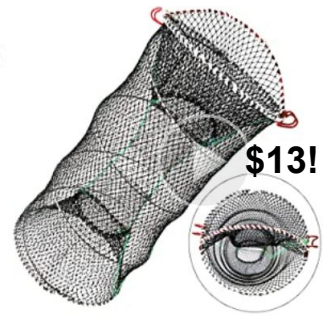
EREN Turtle Pop
Project 2.0

Allyson Degrassi (SU)
Jennifer Purrenhage (UNH)
Dave Steinberg (UNH)



**Great
potential
for side
projects/
offshoots!**

  EREN Turtle Pop
  Project 2.0



- Paired-ponds design to test these hypotheses:

Turtle populations occupying 'rural' and 'urban' ponds will differ significantly in ...

- abundance
- sex ratio (prop. of adult females)
- stage/size structure

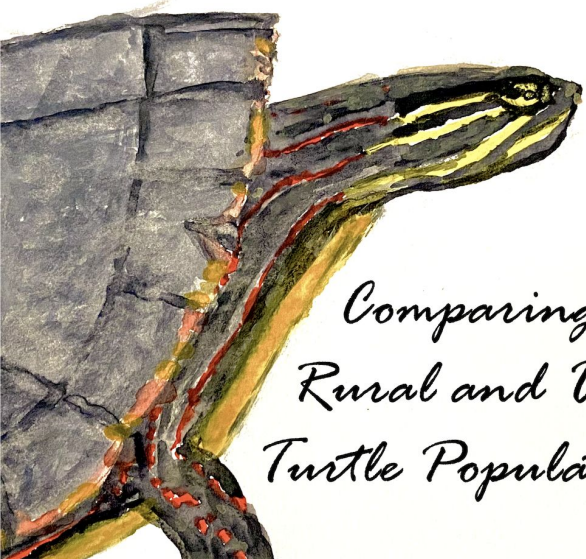
- Methods, Equipment, Commitment

1 pond w/ painted turtles, 10 traps, calipers, file, waders, bait (≥ 1 year)

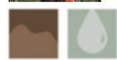
- Undergrad Teaching, Research

Join TurtlePop 2.0! Email for info/protocols: EREN.turtles@gmail.com

erenweb.org/active-projects/turtlepop-2-0/



*Comparing
Rural and Urban
Turtle Populations*



EREN Turtle Pop



Project 2.0

2022: Pilot Season

2023: Accepting New Participants

2026: Phase-1 Analysis



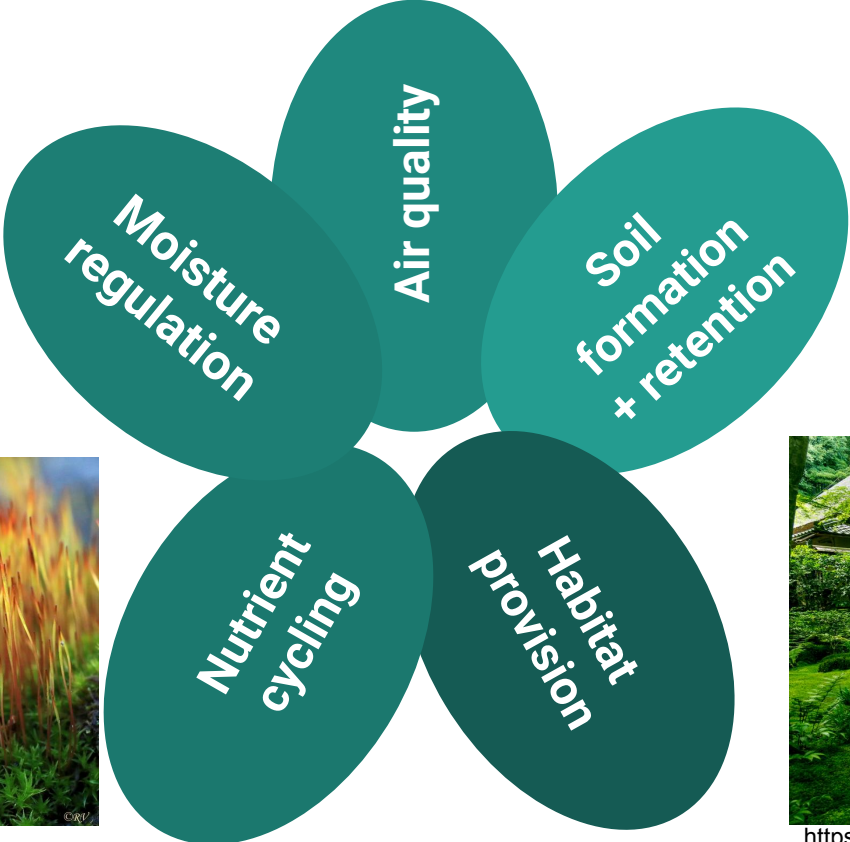
Of Moss and Men: Moss Phenology in Built Environments



<https://inaturalist-open-data.s3.amazonaws.com/photos/254418436/large.jpg>



<https://inaturalist-open-data.s3.amazonaws.com/photos/254435934/large.jpeg>



<https://static.inaturalist.org/photos/254397283/large.jpg>



https://www.plantsnap.com/wp-content/uploads/2020/12/shutterstock_661683910.jpg

What factors influence moss phenology and reproductive traits?



Magill, Robert. (2010). Moss Diversity: new look at old numbers. *Phytotaxa*. 9. 167-174.

- Continental scale
- Local scale: built versus natural environments

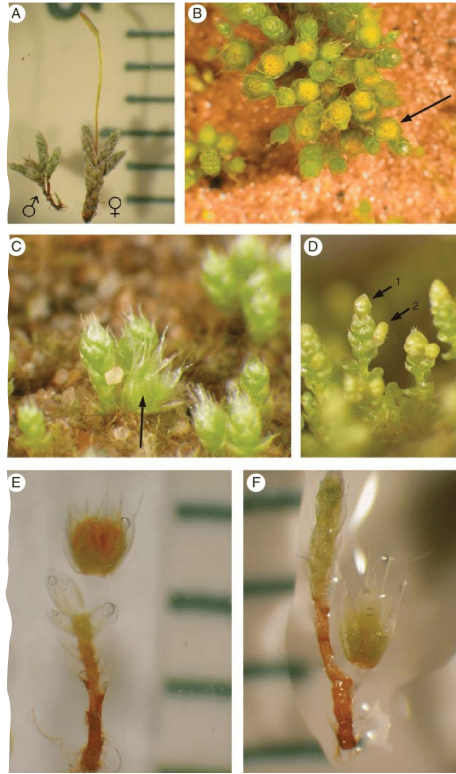


Photograph of *Bryum argenteum* growing in a sidewalk (a), and a closeup of *B. argenteum* shoots (b). Photographs from Digital Atlas of Mosses produced by northernforestatlas.org.

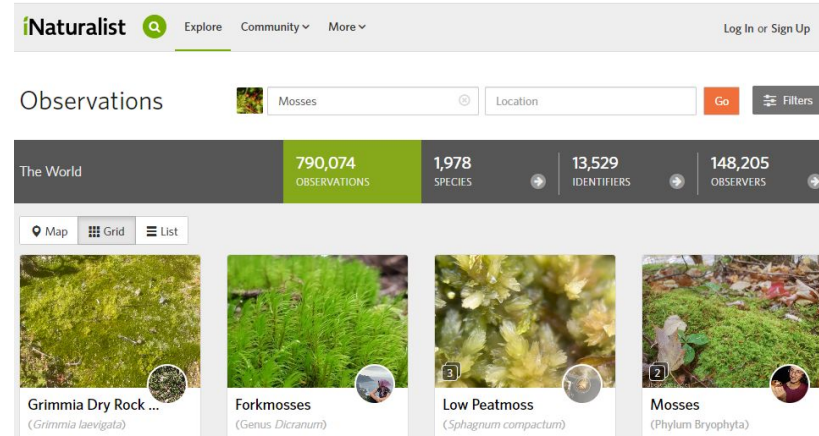
Approaches



Field observations of sporophyte presence, abundance, and height



Laboratory observations of gametangia



Analysis of sporophyte presence/absence in iNaturalist observations

Why join EREN-Moss?

Basic moss knowledge gaps

The “bryology gap” in teaching

Flexible

Accessible

EREN's Evolution

The EREN Classic Projects are awesome but...

- They were born before **NEON and other large datasets** were easy to access.
- They were born as **macrosystems ecology** emerged as a discipline.
- They do not emphasize **teaching data science** skills.
- Many faculty who use EREN projects do not **use the full EREN datasets or teach in a multi-site context** (Anderson et al. 2020).
- There was not a strong focus on **Diversity, Equity, Inclusion, and Justice (DEIJ)**.
- Our new grants aspire to evolve EREN to include these new elements.



EREN is now actively partnering with NEON!

EREN-NEON Flexible Learning Projects - Create One This Spring!

We want to help you develop projects that combine

- Student data collection from multiple sites in the context of authentic research questions (EREN's classic focus)
- Opportunities to learn data science skills
- Existing NEON data resources
- Flexible learning format (in class or online, possible data collection at student's location)

Support and logistics

- \$1000 stipend for the project development team, paid when project resources are complete and ready for posting.
- Laurie Anderson and Tim McCay provide regular meetings and facilitate conversations with NEON as needed.
- Funding will expire in June 2023 so please contact us at erenteam@gmail.com by March 10, 2023 to let us know of your interest!

EREN is now exploring **macrosystems ecology** – what is it?

Macrosystems ecology is the study of diverse ecological phenomena at the scale of regions to continents and their interactions with phenomena at other scales (Heffernan et al. 2014).

Example: The Amazon rainforest macrosystem showcases interactions across scales (Figure from Heffernan et al. 2014).

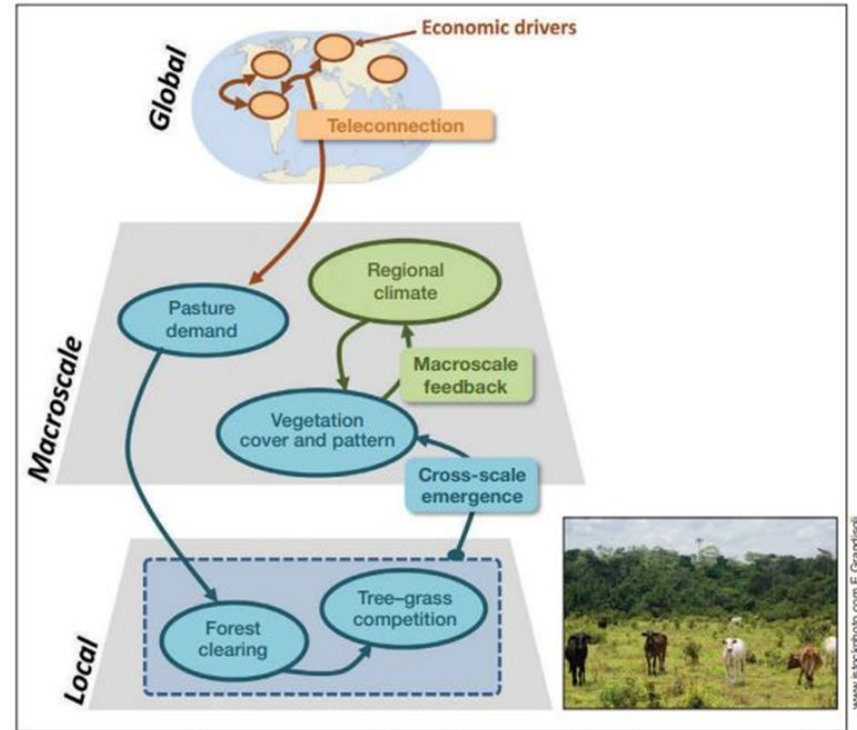


Figure 5. Some key interactions within and across scales in the Amazon rainforest macrosystem that include a macroscale feedback, cross-scale emergence, and a teleconnection (see text for details). The image shows cattle grazing on land that has been deforested.

Could your project be macrosystems ecology?
Take this project personality quiz!

- Are you investigating a process that works at a **regional to continental scale**?
- Are you measuring **phenomena at different scales**?
- Are you interested in **feedbacks and interactions across scales**?
- Are you interested in connections among **geophysical, biological, and socio-cultural processes**?

If you answered “yes” to all, you might be doing macrosystems ecology!

Why should EREN branch into macrosystems ecology?

What are the benefits? What are the challenges?

Benefits

- Important emerging area
- Many environmental problems have macrosystems dimensions.
- Great potential for collaboration
- Large datasets allow research and teaching without a field site.
- Rich opportunities to teach students data science

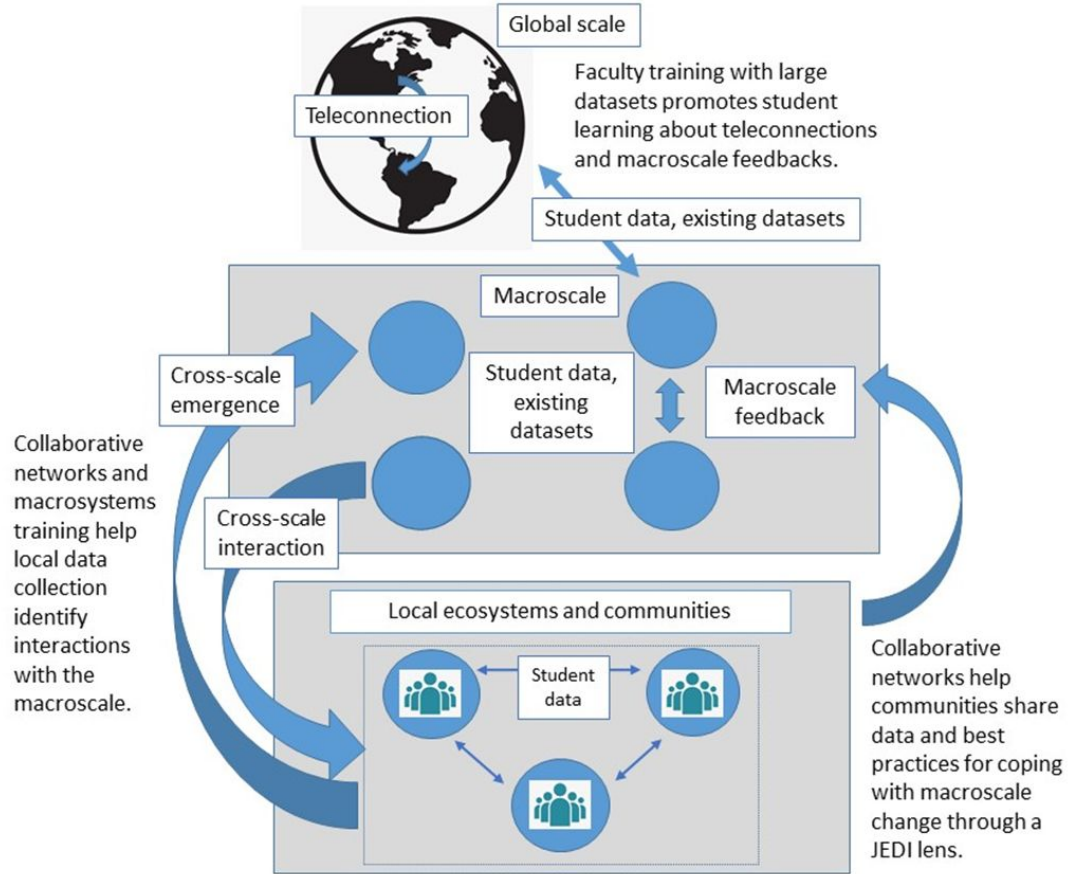
Challenges

- Many ecologists are trained as single site researchers.
- Understanding and measuring cross-scale connections is hard.
- Working with large datasets may require faculty training.
- Student quantitative skills are **extremely** variable.
- Spatially bigger collaborative projects may require extra management time.



The **Macrosystems Ecology For All (MEFA) Network** will support faculty from **ALL backgrounds** in developing **collaborative macrosystems ecology projects** for research and teaching with a focus on **diversity, equity, inclusion and justice**.

NSF funding runs 2022-2027!





Network Goals

Goal 1. Expand faculty training

Under-resourced faculty will be trained in macrosystems principles, data science, and existing environmental datasets.

Goal 2. Create a DEIJ-focused network

The MEFA RCN will be accessible and inclusive for scientists and students from all backgrounds.

Goal 3. Enable collaborative macrosystems research

The MEFA RCN will support collaborative, cross-institution projects that are scientifically compelling, DEIJ-centered, and address macrosystems concepts.

Goal 4. Educate through research

The MEFA RCN will create models for teaching undergraduates macrosystems ecology and data science through engagement in authentic research projects.



How to get involved with MEFA

- **Save the dates for our virtual kickoff events**
 - **Introduction to Macrosystems Ecology** - Friday, March 3, 10AM-11:30AM Eastern
 - **Introduction to Macrosystems Datasets** - Tuesday, April 4, 10AM-11:30AM Eastern
- **Join EREN and look for announcements in the EREN email listserv and newsletter on how to join MEFA (it's free, just like EREN)**
- **Reassurance: EREN will continue alongside MEFA!**
 - EREN is the parent organization, MEFA is a spin-off from EREN!



EREN

ECOLOGICAL RESEARCH AS EDUCATION NETWORK

Thank you for joining us today!

We so appreciate your ongoing collaboration with EREN and look forward to working with you in MEFA too!