FIELD STATIONS: A NATURAL ENVIRONMENT FOR RESEARCH, EDUCATION, AND OUTREACH

LARA ROKETENETZ, Director, UA Field Station; Past President of OBFS
CHELSEA MILLER, Assistant Professor, UA Department of Biology

The University of Akron Field Station

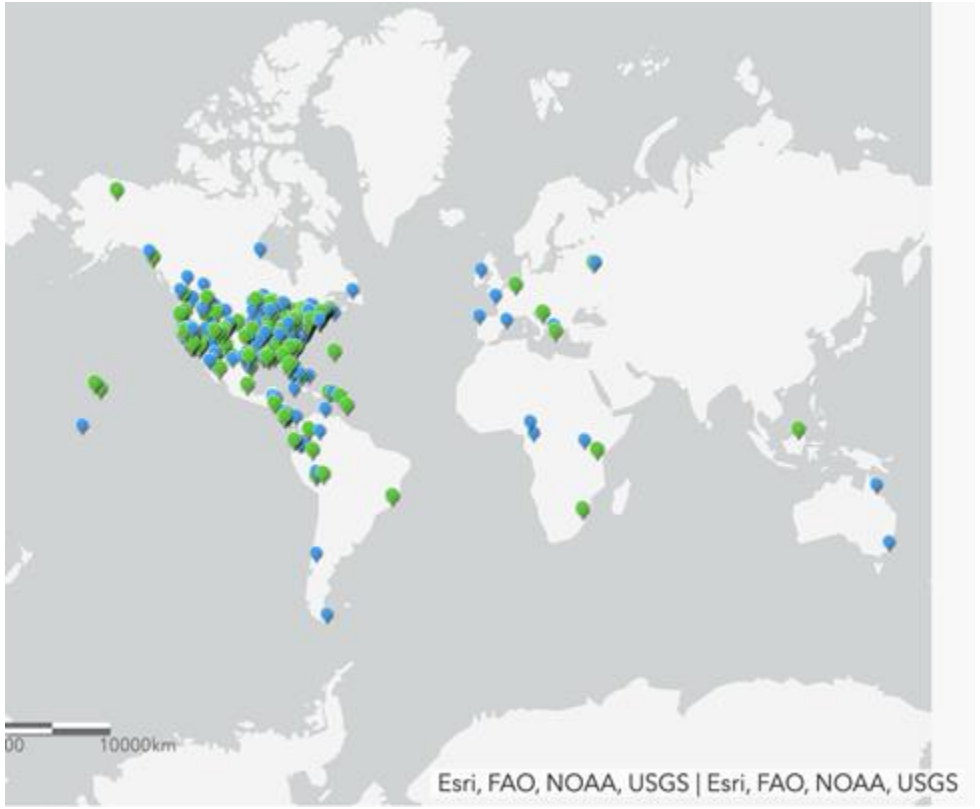
OBFS

WHAT IS A FIELD STATION?

- Any establishment that calls itself a field station and supports scientists conducting research on or near its premises (Struminger et al, 2018).
- Missions also typically include education and public engagement

https://www.obfs.org/

- **Mission**: Help member stations increase their effectiveness in supporting critical research, education, and outreach programs. We pursue this goal in a manner that maximizes diversity, inclusiveness, sustainability, and transparency.



Importance of Field Stations

Biological Field Stations: Research Legacies and Sites for Serendipity

Biological field stations are distributed throughout North America, capturing much of the ecological variability present at the continental scale and encompassing many unique habitats. In addition to their role in supporting research and education, field stations offer legacies of data, specimens, and accumulated knowledge. Such legacies often provide the only framework for documenting and understanding the nature and pace of ecosystem, regional, and global changes in environmental conditions; ecological processes; and biodiversity. Because of these legacies and because they serve as gathering places for a rich diversity of highly creative and motivated scientists, students, and citizens, biological field stations are frequently where serendipitous scientific discoveries take place. The inclusion of biological field stations in environmental observatories and research networks ensures that these places will continue to foster future serendipitous scientific discoveries.

Keywords: biological field stations, long-term research, research legacies, serendipity, socially relevant research

WILLIAM K. MICHENER, KEITH L. BILDSTEIN, ARTHUR McKEE, ROBERT R. PARMENTER, WILLIAM W. HARGROVE, DEEDRA McCLEARN, AND MARK STROMBERG

Science

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HOME > SCIENCE > VOL. 373, NO. 6551 > SAVE EARTH'S GLOBAL OBSERVATORIES

EDITORIAL

Save Earth's global observatories

GENE E. LIKENS AND DAVID L. WAGNER Authors Info & Affiliations

SCIENCE · 9 Jul 2021 · Vol 373, Issue 6551 · p. 135 · DOI: 10.1126/science.abk2615

BULLETIN
ECOLOGICAL SOCIETY OF AMERICA

Networks, Centers, Observatories, and Field Stations | Open Access

The Organization of Biological Field Stations at Fifty

Stacy A. McNulty, David White, Mary Hufty, Paul Foster

First published: 29 September 2017 | https://doi.org/10.1002/bes2.1349 | Citations: 4

Biological Field Stations: A Global Infrastructure for Research, Education, and Public Engagement

LAURA TYDECKS, VANESSA BREMERICH, ILONA JENTSCHKE, GENE E. LIKENS, AND KLEMENT TOCKNER

Biological field stations (BFS) constitute a global network for long-term environmental monitoring and research, education, and public information. On the basis of a comprehensive inventory, we identified 1268 contemporary BFS, located in 120 countries. BFS occur in all biomes and cover terrestrial, freshwater, and marine systems, with the majority situated in protected areas. We emphasize the pivotal role that BFS constitute as a strategic infrastructure of global relevance for environmental research and monitoring and discuss their future development.

Keywords: global change, biodiversity, environmental research, nature conservation, sustainability

OBFS/FSML Networks

Climate Research at FSMLs

JOURNAL ARTICLE

The Activities and Importance of International Field Stations

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Richard L. Wyman, Eugene Wallensky, Mark Baine

BioScience, Volume 59, Issue 7, July 2009, Pages 584–592,
https://doi.org/10.1525/bio.2009.59.7.9
Published: 01 July 2009

CURRICULUM AND INSTRUCTION ON CLIMATE LITERACY

Using Rich Context and Data Exploration to Improve Engagement with Climate Data and Data Literacy: Bringing a Field Station into the College Classroom

Amy L. Ellwein, Laurel M. Hartley, Sam Donovan & Ian Billick

Pages 578-586 | Received 13 May 2014, Accepted 10 Sep 2014, Published online: 14 Jun 2018

Cite this article https://doi.org/10.5408/13-034 Check for updates

1 January 2016

The University of Kansas Field Station: A Platform for Studying Ecological and Hydrological Aspects of Climate Change

W. Dean Kettle

Author Affiliations +

Transactions of the Kansas Academy of Science, 119(1):12-20 (2016). https://doi.org/10.1660/062.119.0104

Chapter

Field Stations for a Future Climate

Architectures of Environmental Care

By Daniel Jacobs, Brittany Utting

Book Architectures of Care

Edition	1st Edition
First Published	2023
Imprint	Routledge
Pages	21

Climate Research at LTERs

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BioScience, Volume 62, Issue 4, April 2012, Pages 377–389,
https://doi.org/10.1525/bio.2012.62.4.9
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BioScience, Volume 72, Issue 9, September 2022, Pages 871–888,
https://doi.org/10.1093/biosci/biac006
Published: 16 August 2022

JOURNAL ARTICLE

Cross-Site Comparisons of Dryland Ecosystem Response to Climate Change in the US Long-Term Ecological Research Network

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https://doi.org/10.1093/biosci/biac076
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OBFS Programs

https://obfs.org/join-obfs/

- List-serv
- Station Exchange Program
  - International Groupings
- Congressional Visit Days
- Mini-grants
- Awards/Recognition
- Annual Conference

- https://www.obfs.org/join-obfs/listserv/
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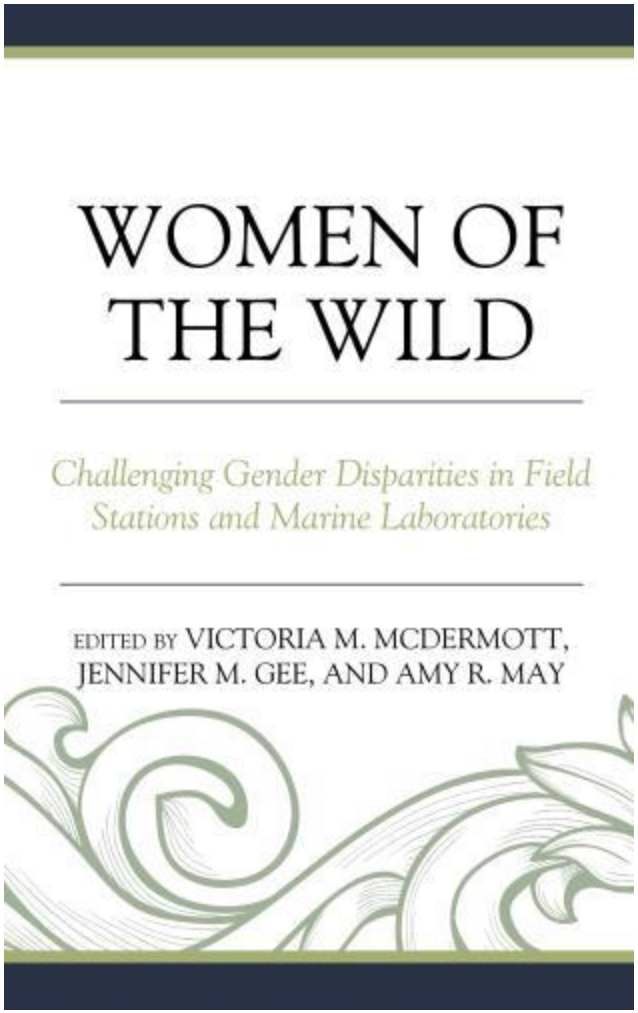
HERE 1475 FT
ABOVE
THE OCEAN
THE MIGHTY
MISSISSIPPI
BEGINS
TO FLOW
ON ITS
WINDING WAY
2552 MILES
TO THE
GULF OF
MEXICO



S9 ENVISIONING A DIVERSE, INCLUSIVE & SAFE FUTURE FOR FIELD BIOLOGY

Beyond A Vision for The Future: Tangible Steps To Engage Diverse Participants in Inclusive Field Experiences
Robin M Verble and others

Integrative and Comparative Biology, Volume 63, Issue 1, July 2023, Pages 59–65, https://doi.org/10.1093/icb/icad063

Abstract ▾ View article

Critically Assessing Undergraduate Field Experiences: Understanding Conceptualizations and Opportunities for Building Inclusive Programs
Nia Morales and Darryl Reano

Integrative and Comparative Biology, Volume 63, Issue 1, July 2023, Pages 66–78, https://doi.org/10.1093/icb/icad008

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Fieldwork and LGBTQ+ Identities: Queering the Outdoors
Maryam Kamran and Kelsey Jennings

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Shayle B Matsuda

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Equipment Repositories for Accessibility: A Model for Improving Access in Field Science
Amy-Charlotte Devitz

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EDITOR'S CHOICE

Remaining safe conducting Field work While Black (FWB), and Tips for PIs, Universities, and Employers of Black Individuals
Alex Troutman

Integrative and Comparative Biology, Volume 63, Issue 1, July 2023, Pages 108–113, https://doi.org/10.1093/icb/icad062

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Deficits in Accessibility across Field Research Stations for Scientists with Disabilities and/or Chronic Illness, and Proposed Solutions
Elizabeth N Rudzki and Kevin D Kohl

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Knowing Your Field Community: Elevating the Human Dimension in Ecological Research and Teaching
Gillian Bowser and Carmen R Cid

Integrative and Comparative Biology, Volume 63, Issue 1, July 2023, Pages 128–135, https://doi.org/10.1093/icb/icad036

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IDEA+ and OBFS: Using Transdisciplinary Strategies to Create More Inclusive Spaces
Victoria McDermott and others

Integrative and Comparative Biology, Volume 63, Issue 1, July 2023, Pages 136–144, https://doi.org/10.1093/icb/icad025

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Best Practices to Promote Field Science Safety
Kristen Yarincik and others

Integrative and Comparative Biology, Volume 63, Issue 1, July 2023, Pages 145–161, https://doi.org/10.1093/icb/icad014

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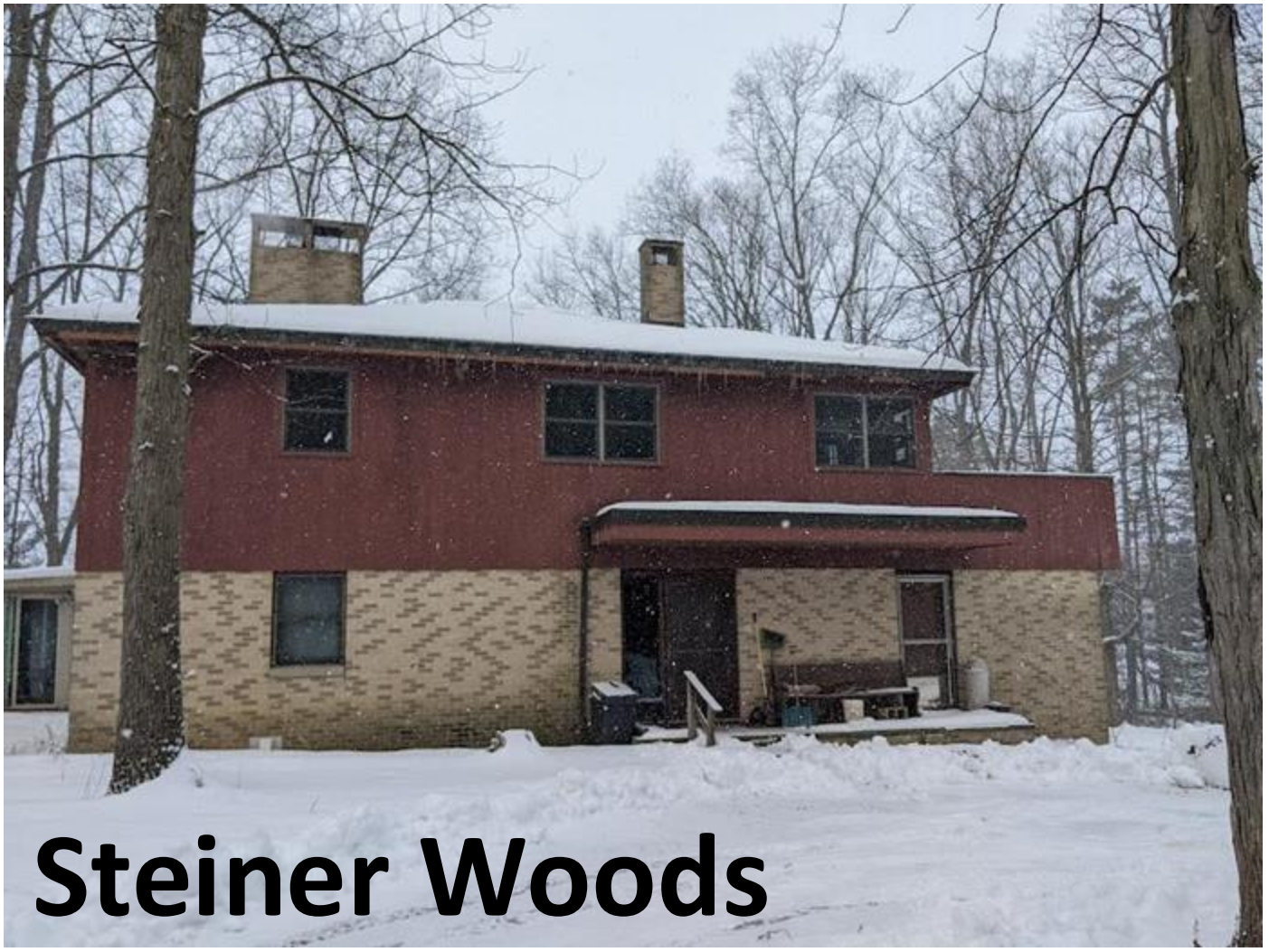
The University of Akron Field Station at Bath Nature Preserve is a living laboratory for the advancement of knowledge through ecological research, education, and stewardship of the natural world.

- Provide a center for long-term environmental research emphasizing habitat restoration and ecology
- Interact with the local community in promoting environmental awareness
- Support the education programs of primarily urban universities and local schools (K-12)

https://www.facebook.com/UAFieldStation

https://www.instagram.com/uakron_fieldstation/

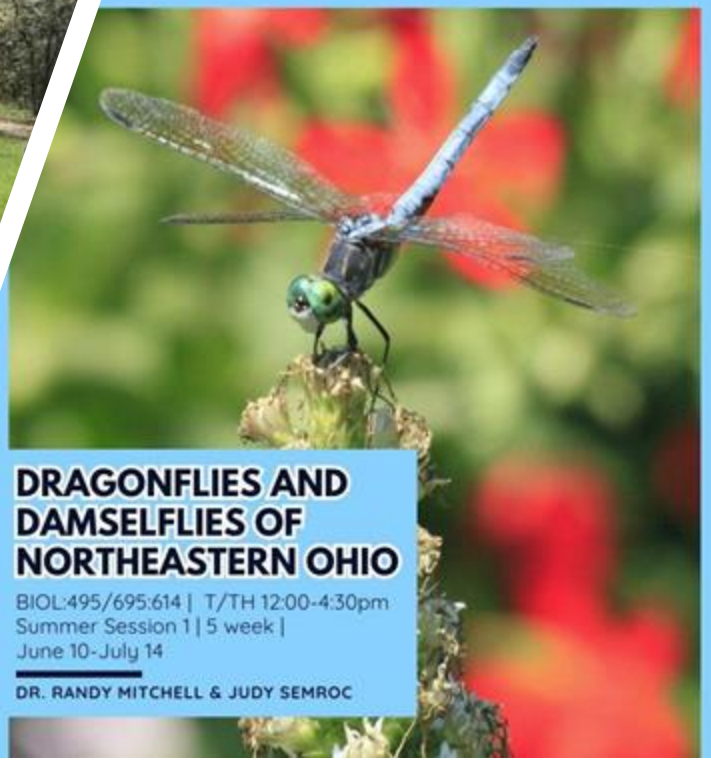
Bath Nature Preserve


Steiner Woods

Panzner Wetlands Wildlife Preserve

Undergraduate Education

- Environmental Education
- Environmental Ethics
- Vertebrate Zoology
- Wetland Ecology
- Entomology
- Restoration Ecology
- Field Ecology



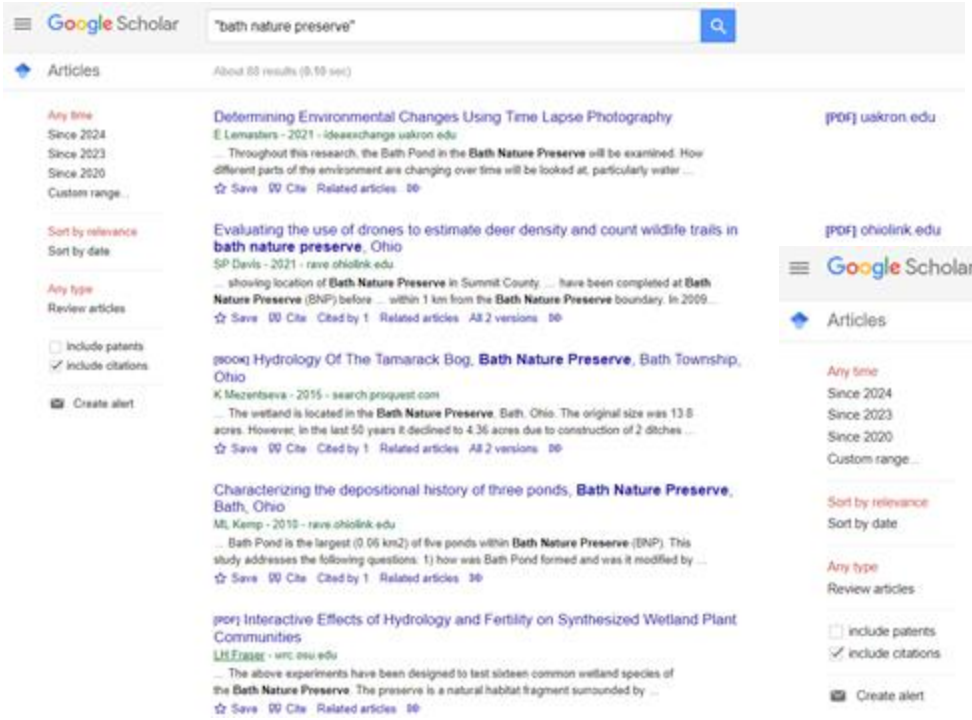
DRAGONFLIES AND DAMSELFLIES OF NORTHEASTERN OHIO

BIOL:495/695:614 | T/TH 12:00-4:30pm
Summer Session 1 | 5 week |
June 10-July 14

DR. RANDY MITCHELL & JUDY SEMROC

FIELD COURSES TO MAINE(‘23/’25) AND VIRGINIA(‘24)

Research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E Lemasters - 2021 - ideaexchange.uakron.edu
... Throughout this research, the Bath Pond in the Bath Nature Preserve will be examined. How different parts of the environment are changing over time will be looked at, particularly water ...
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... The wetland is located in the Bath Nature Preserve, Bath, Ohio. The original size was 13.8 acres. However, in the last 50 years it declined to 4.36 acres due to construction of 2 ditches ...
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LH Fraser - wrc.osu.edu
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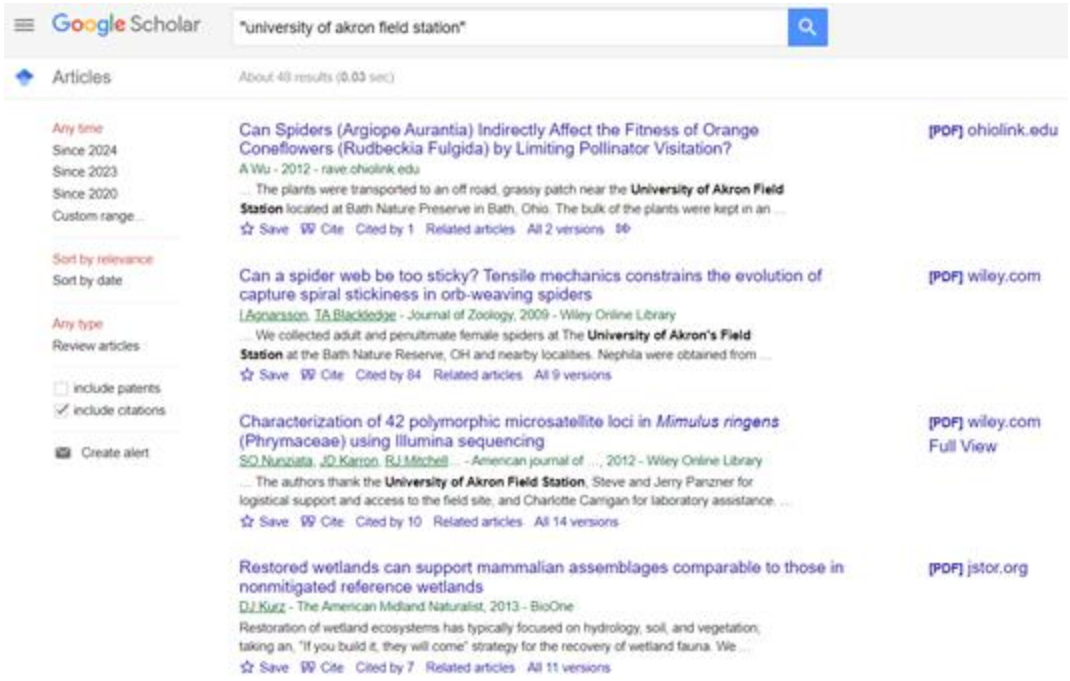
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A Wu - 2012 - rave.ohiolink.edu
... The plants were transported to an off road, grassy patch near the University of Akron Field Station located at Bath Nature Preserve in Bath, Ohio. The bulk of the plants were kept in an ...
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... The authors thank the University of Akron Field Station, Steve and Jerry Panzner for logistical support and access to the field site, and Charlotte Carrigan for laboratory assistance. ...
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Restored wetlands can support mammalian assemblages comparable to those in nonmitigated reference wetlands
DJ Kurz - The American Midland Naturalist, 2013 - BioOne
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Akron Beacon Journal

OHSAA sets NIL referendum vote date to determine if Ohio high s

LOCAL

University of Akron students on the trail of Steiner Woods salamanders

Staff Writer Akron Beacon Journal

April 10, 2014, 11:00 a.m. ET

BATH TWP.: Sometimes the simplest solution can help in a monumental task.

For more than 15 years now, ordinary household buckets have been the key to an extensive research project — the study of the spotted salamander in the Windhover Pond area of Steiner Woods in Bath Township.

MOLECULAR ECOLOGY

Population structure of spotted salamanders (*Ambystoma maculatum*) in a fragmented landscape

J. L. PURRENHAGE, P. H. NIEWIAROWSKI, F. B.-G. MOORE

First published: 14 January 2009 | https://doi.org/10.1111/j.1365-294X.2008.04024.x | Citations: 65

Jennifer L. Purrenhage, Fax: +1 513-529-6900; E-mail: purrenjl@muohio.edu

Terrestrial Habitat Use by Radio-Implanted Spotted Salamanders (Ambystoma maculatum)

Nussbaum, Ashley Lynn

Permalink: http://rave.ohiolink.edu/etdc/view?acc_num=akron1134688691

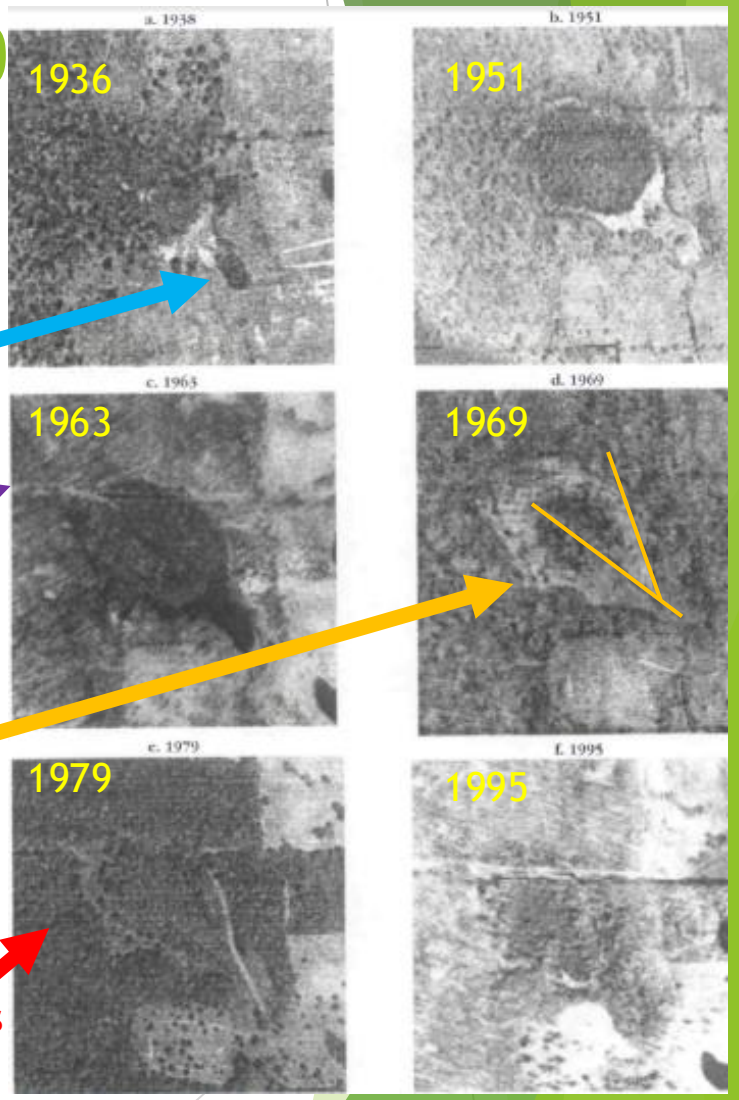
Randy Mitchell
Ira Sasowsky
University of Akron

Jean Marie Hartman
Rutgers University

Bath Nature Preserve's Tamarack "Bog" restoration

Bog evaluation by UA in 2000

- Since 1936, wetland area shrank f**rom 13 to 5 acres**
- Bath Township began implementing a restoration plan in 2012-2013



The Ecological Lens

How do **plants** and **insects** (organisms that are central to ecosystem functioning) respond to rapid and sometimes unpredictable environmental shifts, such as those caused by climate change and urbanization?


Monochamus titillator

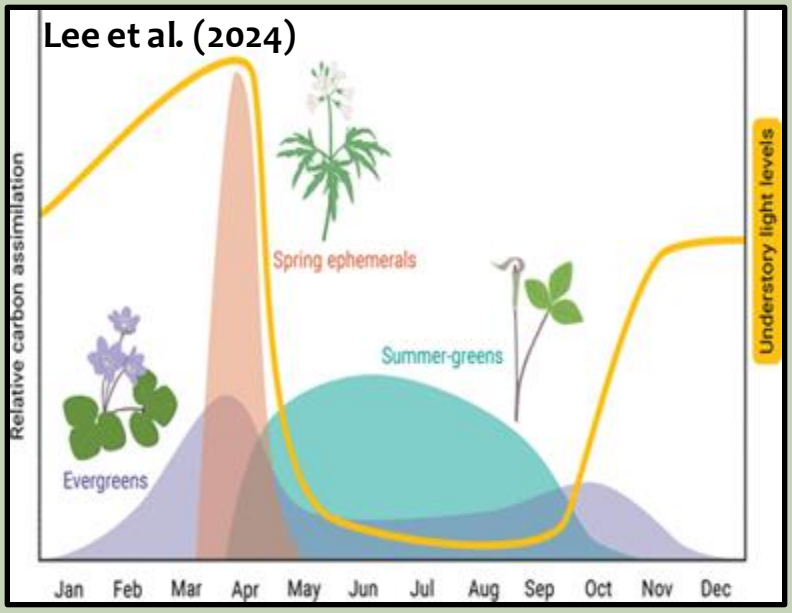

Trillium nivale

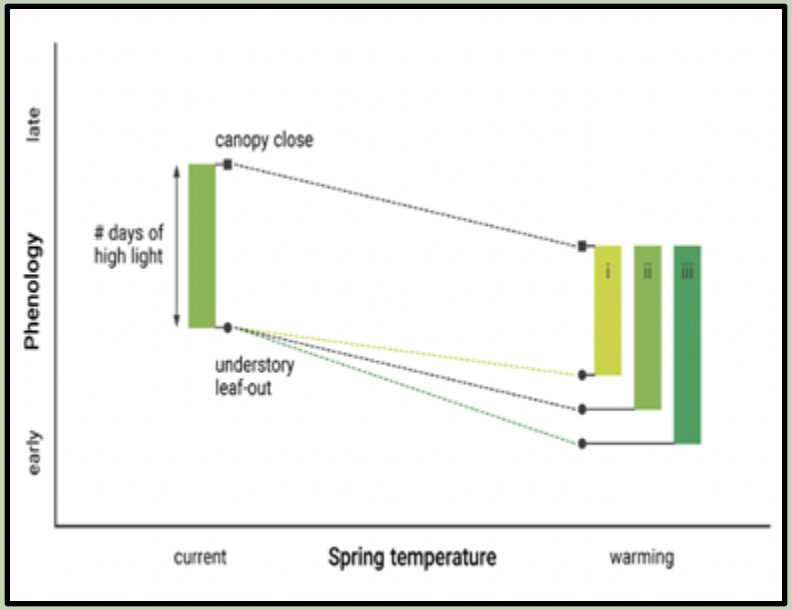
Spring ephemerals & weather extremes

- **Timing** and **duration** of plant life-cycle events (emergence, flowering, fruiting, senescence) drive ecosystem structure and species interactions
- **Spring ephemerals:**
  - Spring wildflowers
  - Forest understory
  - Above-ground lifecycle: narrow window between last frost and canopy closure → max light and soil resources
  - High C assimilation rate over a short time-period:
    - High spring irradiance before canopy closure = 39–100% of species-level annual carbon assimilation (Heberling et al., 2019)

Yellow trout lily (*Erythronium Americanum*)

Spring ephemerals & weather extremes





- If flowering/fruiting shifts in response to climate change but canopy leaf-out doesn't, ***plants may lose access to light, mutualists, or dispersers, reducing fitness***
  - ❖ Spring ephemerals are particularly vulnerable to climate-induced phenological mismatch (Heberling et al., 2019)
- **Short-term anomalies matter**:
  - ❖ Outsized effects on developmental timing
  - ❖ Understanding responses to anomalous weather helps reveal the plasticity and sensitivity of plants to rapid fluctuations, not just gradual change

Spring ephemerals & weather extremes

Dr. Katie Stuble, Community Ecologist at the Holden Arboretum

Holden Arboretum

Do warmer than average days result in truncated phenophase durations for spring flowering herbs?

H_1: Higher deviance scores for mean daily temperature will be related to truncated durations of spring wildflower phenophases.

Community Science at Public Gardens

Emily Lewis attempting to identify an early spring flower using iNaturalist (credit: Maris Hollowell, 2023).

Katie Stuble training a group of volunteers at HFG (2023).

Holden Arboretum

budburst
A project of the Chicago Botanic Garden

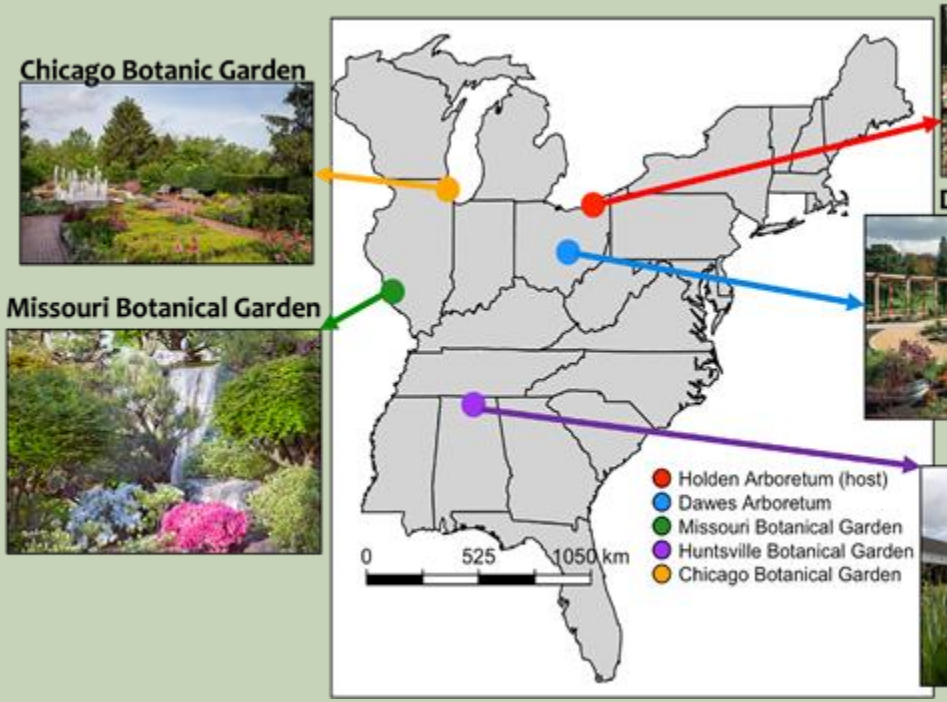
iNaturalist

(iNaturalist, 2024; Budburst, 2024)

(Fuccillo et al., 2015; Gallinat et al., 2021)

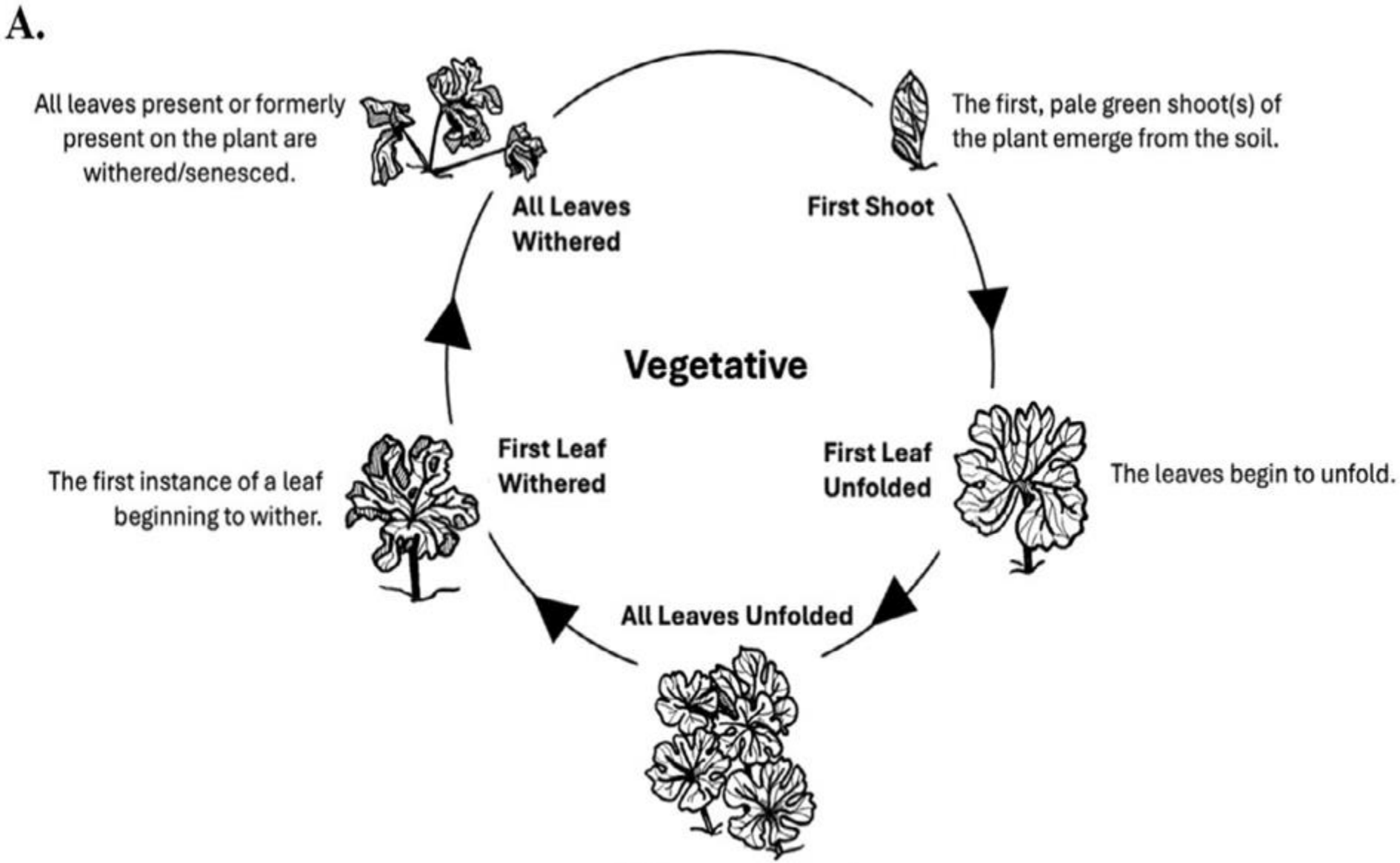
Spring ephemerals & weather extremes

Do warmer than average days result in truncated phenophase durations for spring flowering herbs?



- 14 plant species
- 5 botanical gardens
- 4 states (OH, IL, MO, AL)
  - 198 plants
  - Monitored Mar–Oct 2023
- >30 community science volunteers
- 2x/week observations
- 16 phenophases (flowering, fruiting, vegetative) tracked with a standardized, publicly-available app (Budburst)
  - 14,256 observation events
    - ~72 observations/ plant

Phenophases



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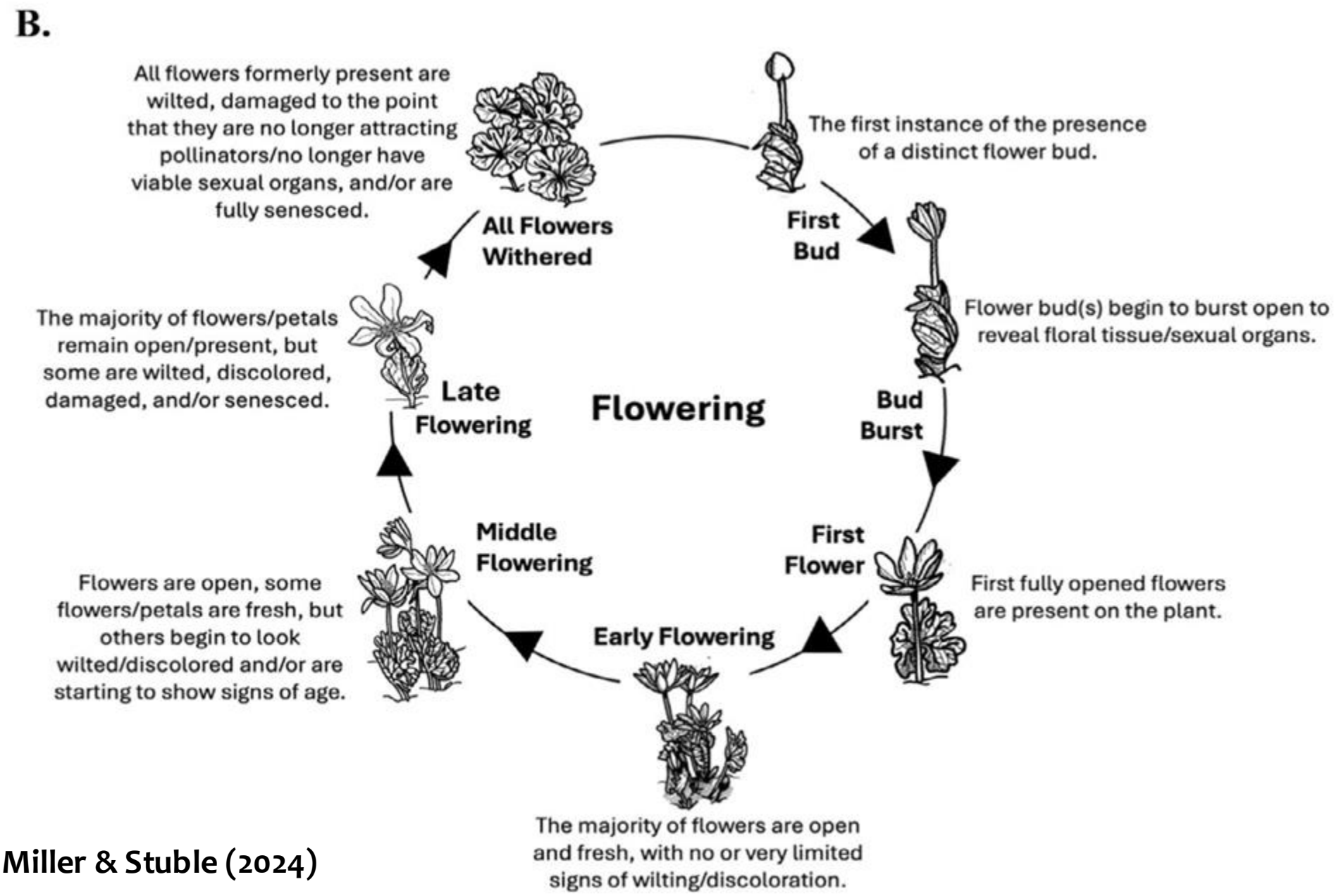
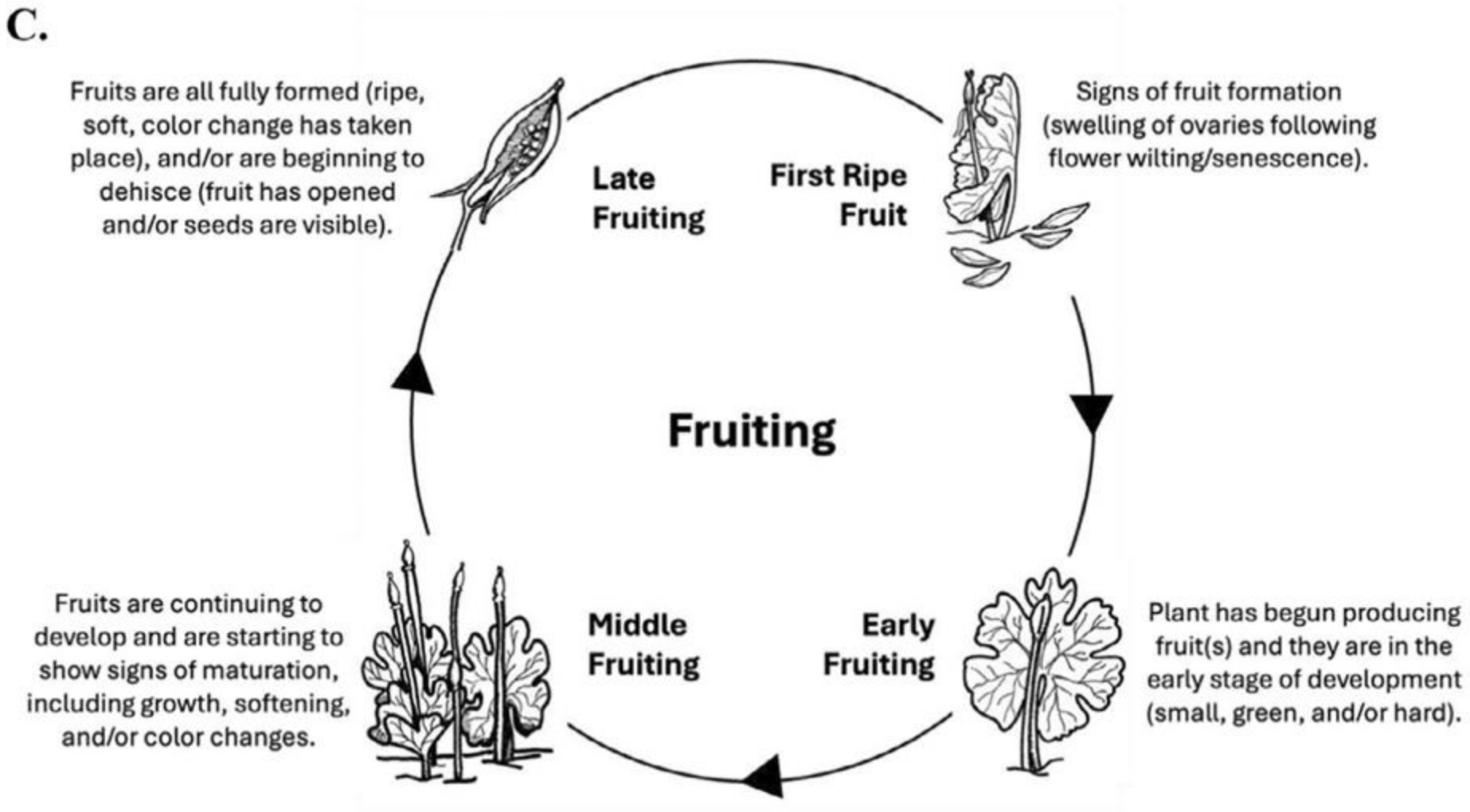
Phenophases



Miller & Stuble (2024)

Phenophases

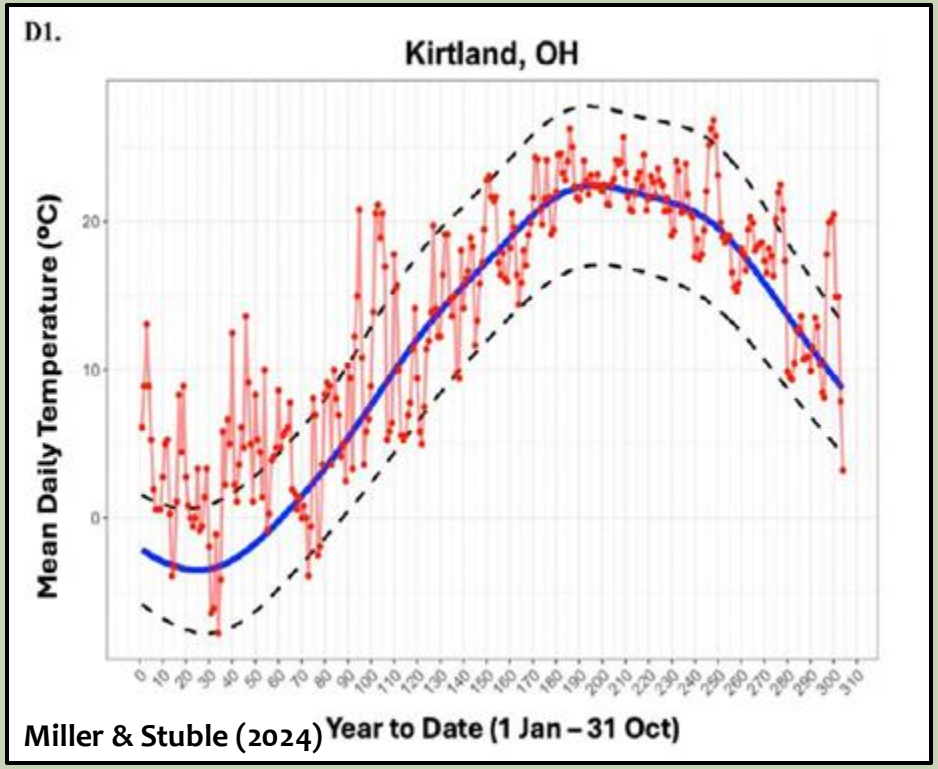


Miller & Stuble (2024)

Spring ephemerals & weather extremes

Do warmer than average days result in truncated phenophase durations for spring flowering herbs?

- Average of ~19 weeks per site with temps significantly above/below 30-yr normals
- Most deviations were warmer, rather than cooler



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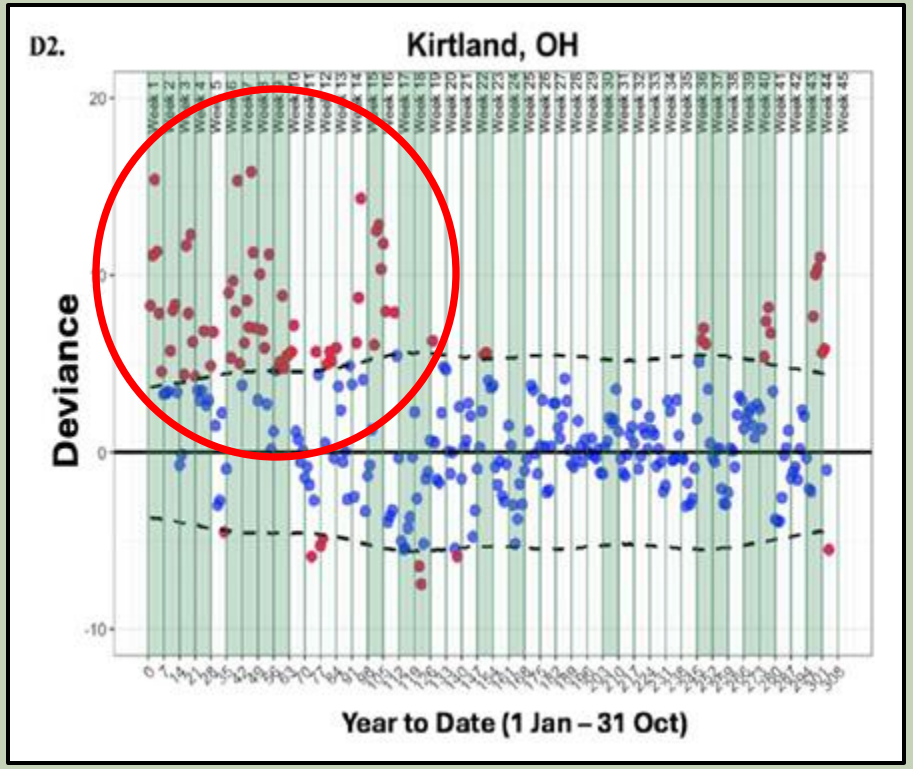
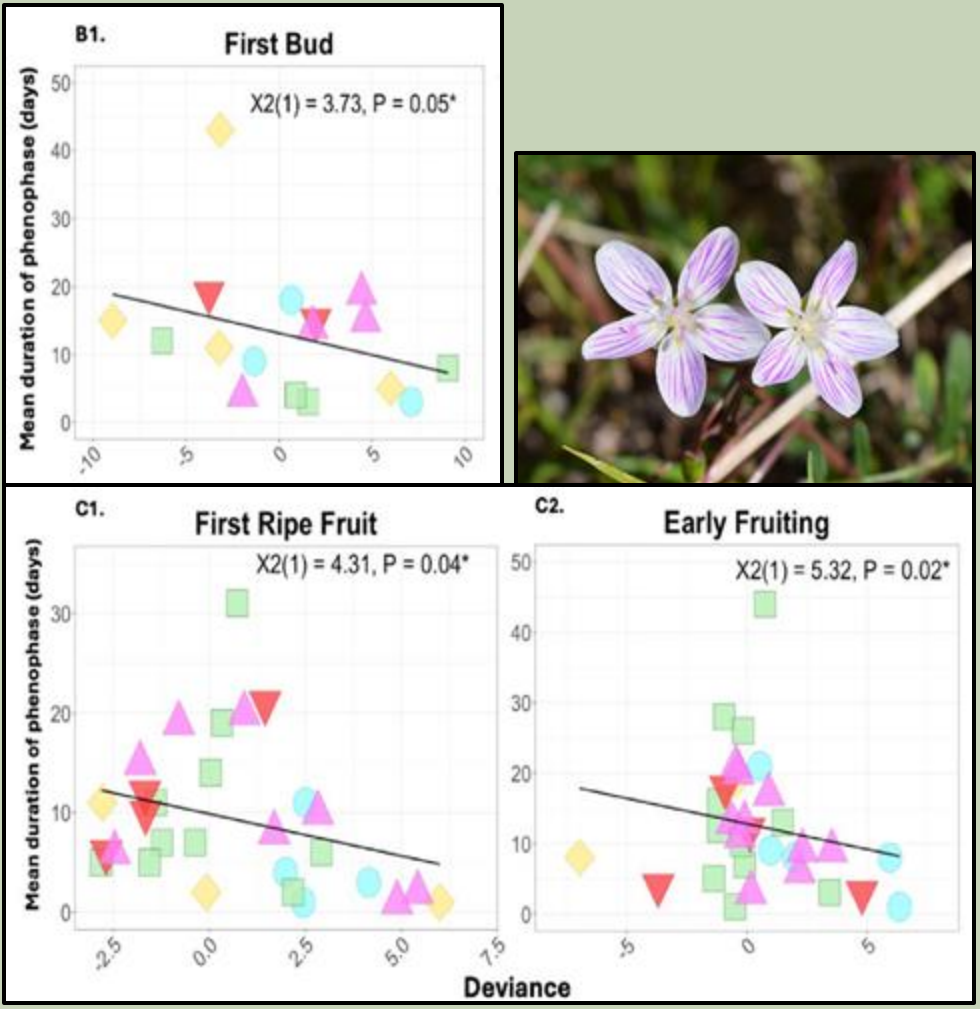


Spring ephemerals & weather extremes

Do warmer than average days result in truncated phenophase durations for spring flowering herbs? – Yes.

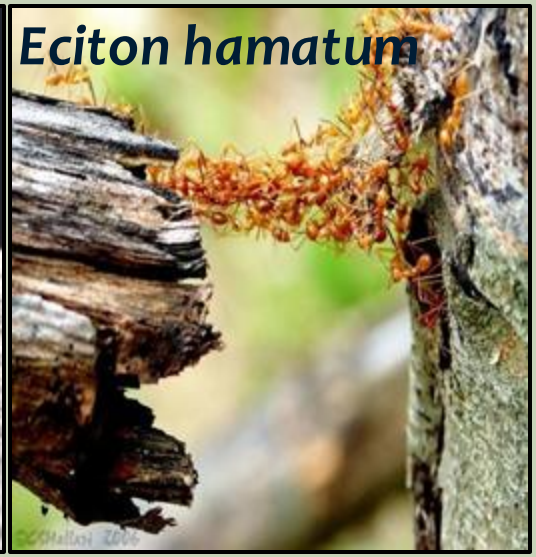


Key result:

- Warmer-than-average days → shorter durations of early reproductive phenophases (“First Bud,” “First Ripe Fruit,” “Early Fruiting”)
  - Also, significant differences *among* species in phenophase lengths, but no single pattern
- Shortened phenophases may reduce reproductive success, alter plant–pollinator timing, and ripple through ecosystems
- **More questions…**
  - Intended as a “de facto common garden” to disentangle **phenotypic plasticity vs. local adaptation** in phenology, but limited by garden records

Miller & Stuble (2024)

Why ants?



- Fascinating organisms; powerful ecological players
- Ecosystem engineers (nutrient cycling, soil turnover, seed dispersal)
- Sensitive to microclimate → sentinels of environmental change
    - Present on every continent
    - Have enormous global biomass
    - Unique eusocial lifestyles
    - Engage in important interactions with many other species

Why ants?

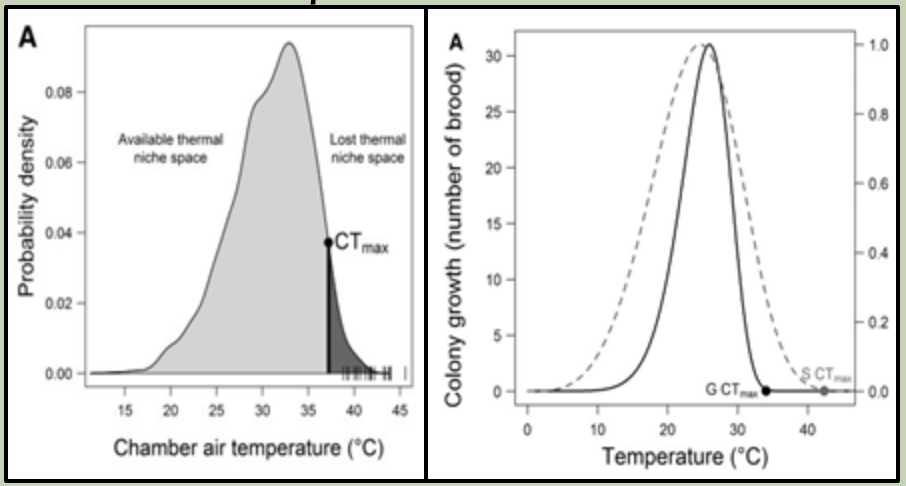
- **Long-term personal connection:**
  - Ant seed dispersal shapes plant communities
  - I tested the efficacy of **myrmecochory** for rare and common spring ephemeral plants in the genus *Trillium*
  - I found that rare Trilliums experienced significantly poorer quality seed dispersal by ants →
    - Likely due to ants' preference for the seeds of widespread species

Myrmecochores: plants with seeds dispersed by ants

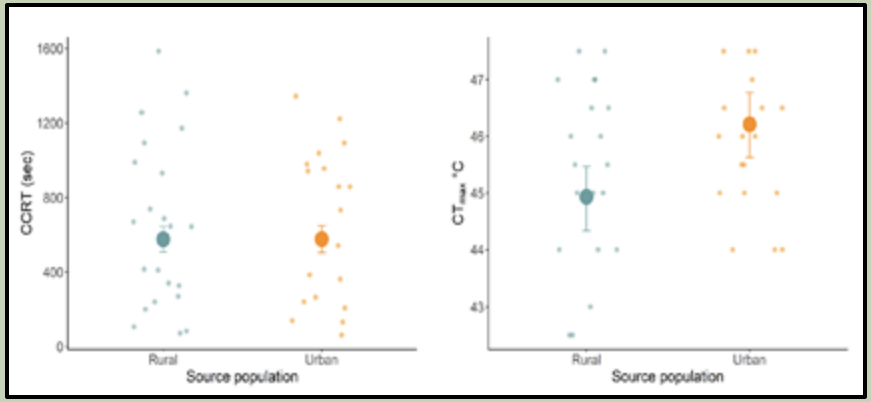
Adaptation affects ant responses to environmental change…

Acorn ant (*Temnothorax curvispinosus*

- ***Among* species:**
  - Thermal tolerance predicts ant species abundance under warming, but fitness outcomes differ depending on metric (survival vs. colony growth)
  - Ants like the acorn ant (*Temnothorax curvispinosus)* can survive higher temps than they can grow/reproduce at → Do populations persist via plastic responses, or evolve new tolerances?
- **And *within* species:**
  - Urban acorn ants show evolutionary increases in heat tolerance, but maintain comparable cold tolerance under overwintering conditions



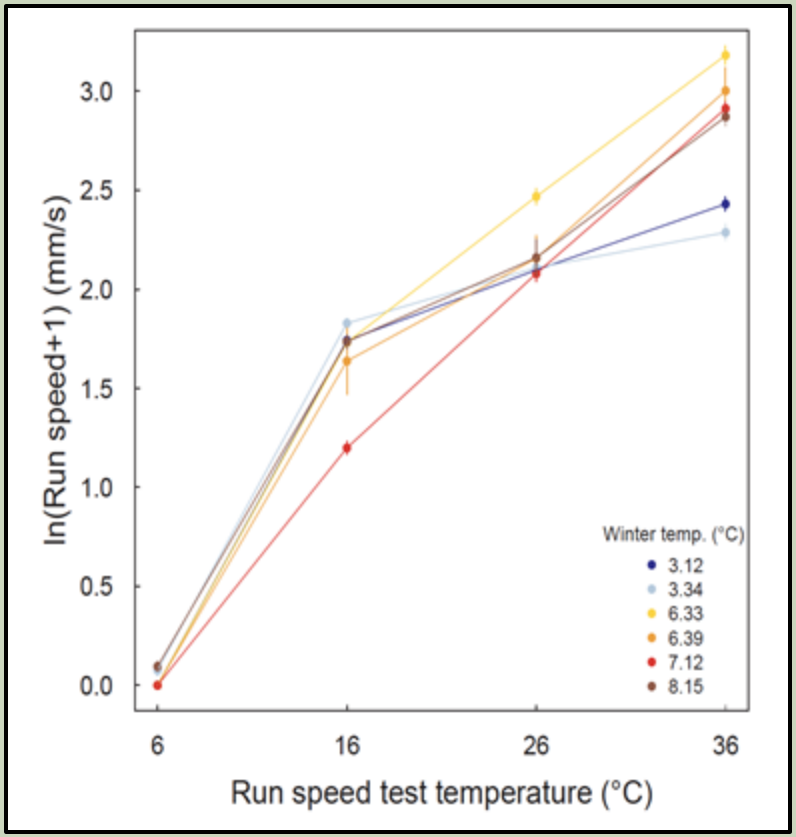
(Diamond et al., 2013)



(Prileson et al., 2023)

…and so does plasticity!

- Experimental winter warming primes ants for warmer spring activity →
  - Ants acclimated to warmer winters ran faster at high temps (26–36 °C), showing strong phenotypic plasticity in performance

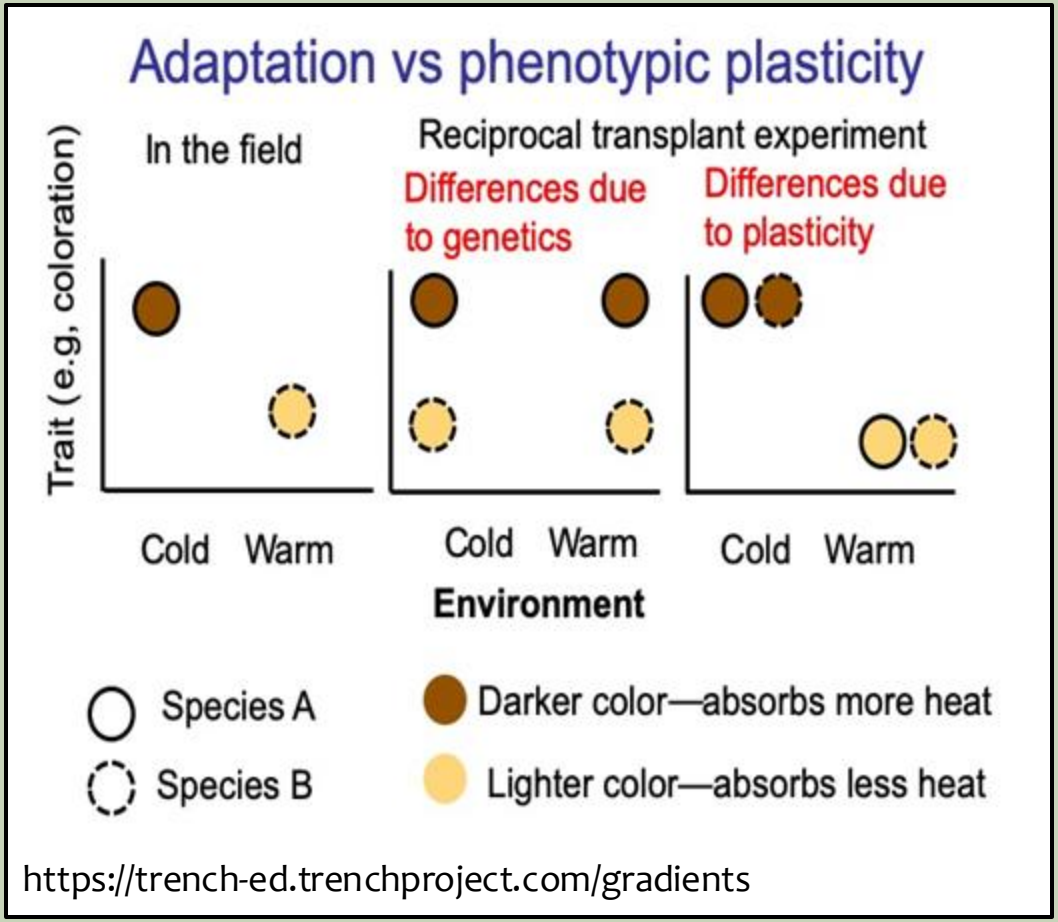


(MacLean et al., 2017)

Acorn ant (*Temnothorax curvispinosus*)

Antwi

- Literature not only demonstrate that ants are adapting—
- Also highlights tension between **plastic physiological shifts** (short-term, reversible) and **local adaptation** (genetic divergence between urban vs. rural populations)
- Understanding ant responses to climate change:
  - ***When*** and ***to what extent*** do species rely on phenotypic plasticity vs. local adaptation?
  - How does **seasonal context** (summer vs. winter) shifts that balance?



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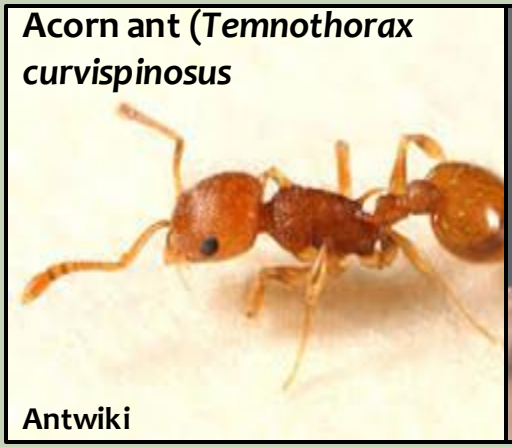


Acorn ant (*Temnothorax curvispinosus*

Antwiki

Odorous house ant (*Tapinoma sessile*)

Antwiki

Winnow ant (*Aphaenogaster rudis*)

Antwiki

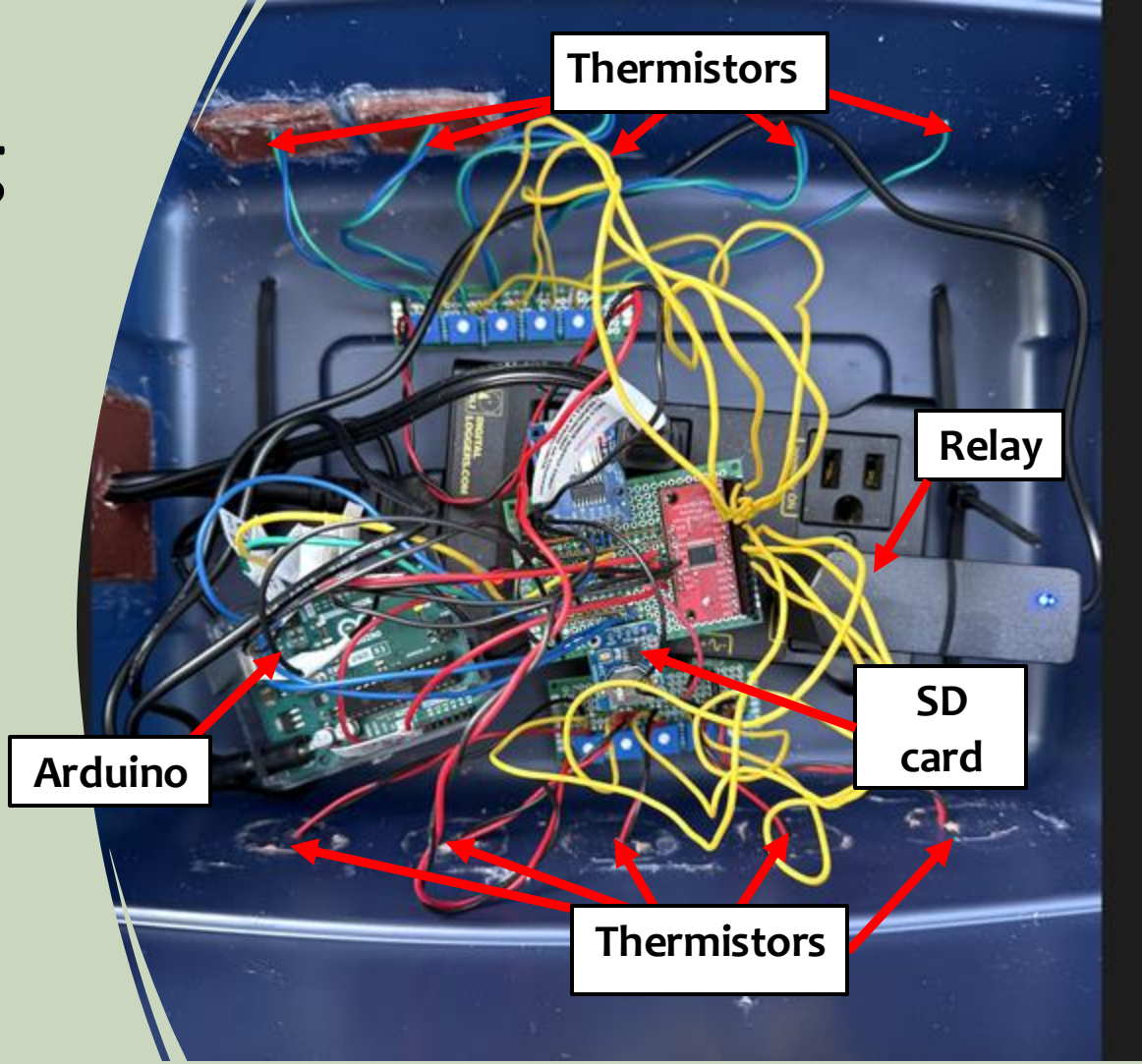
How does forest ant overwintering change under experimental warming?

1. How do **urbanization + winter climate change** shape ant overwintering survival and activity?
2. Is colony response driven by **phenotypic plasticity** or **local adaptation**?

- Focal taxa: acorn ants (*Temnothorax curvispinosus*), plus comparisons with other surface-nesting forest ant species, like those in genera *Aphaenogaster, Lasius,* and *Tapinoma.*
- Why acorn ants (and those that share life history)?
  - Above-ground nests in acorns = ***highly exposed to freeze–thaw and warming pulses***

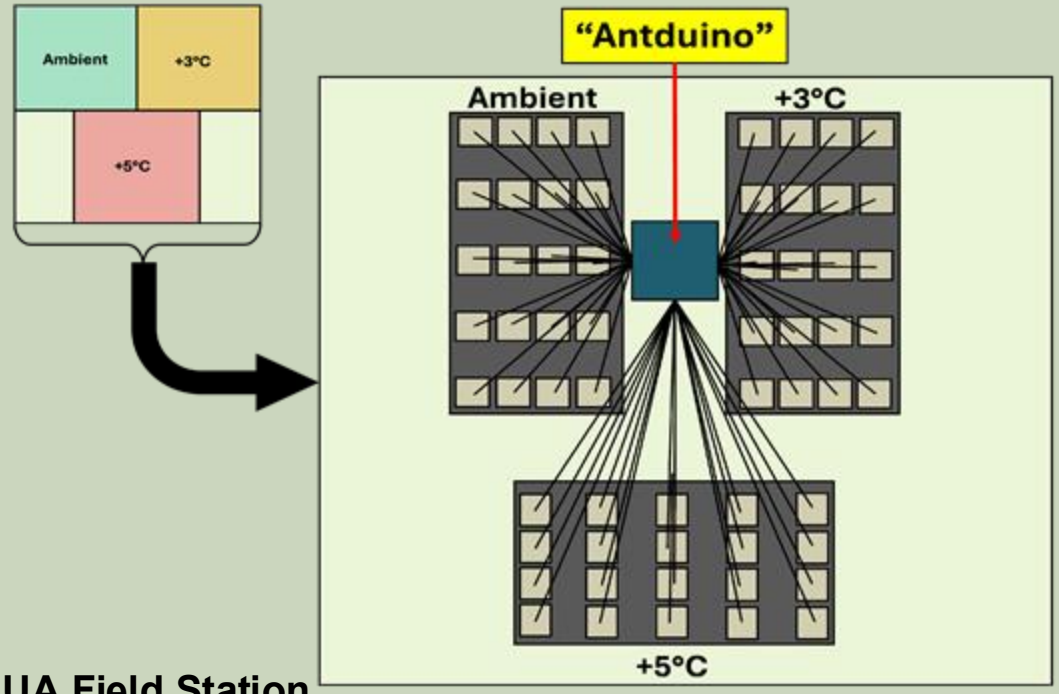
How does forest ant overwintering change under experimental warming?

- **Antduino chambers**: custom-designed Arduino-based warming systems (+3 °C, +5 °C)

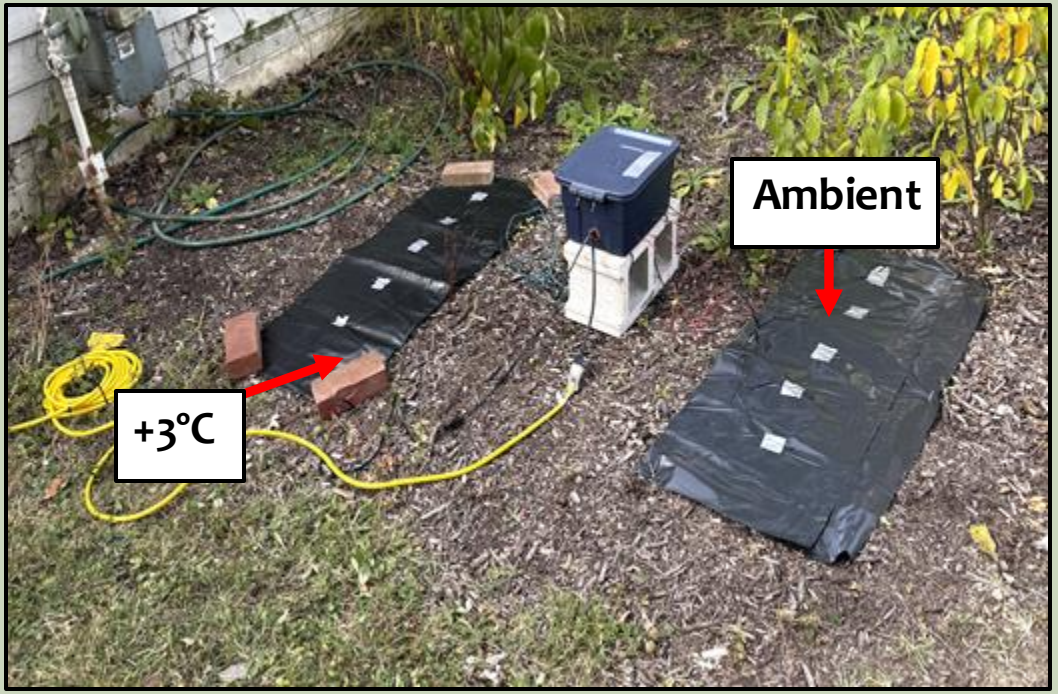


How does forest ant overwintering change under experimental warming?

- **Treatments:** simulated winter warming via soil-warming open-air "chambers"
  - Arduino tracks the temperature of the ambient and heated mats using thermistors
  - Turns heat mat on/off to ensure heat mat stays +3ºC warmer than ambient

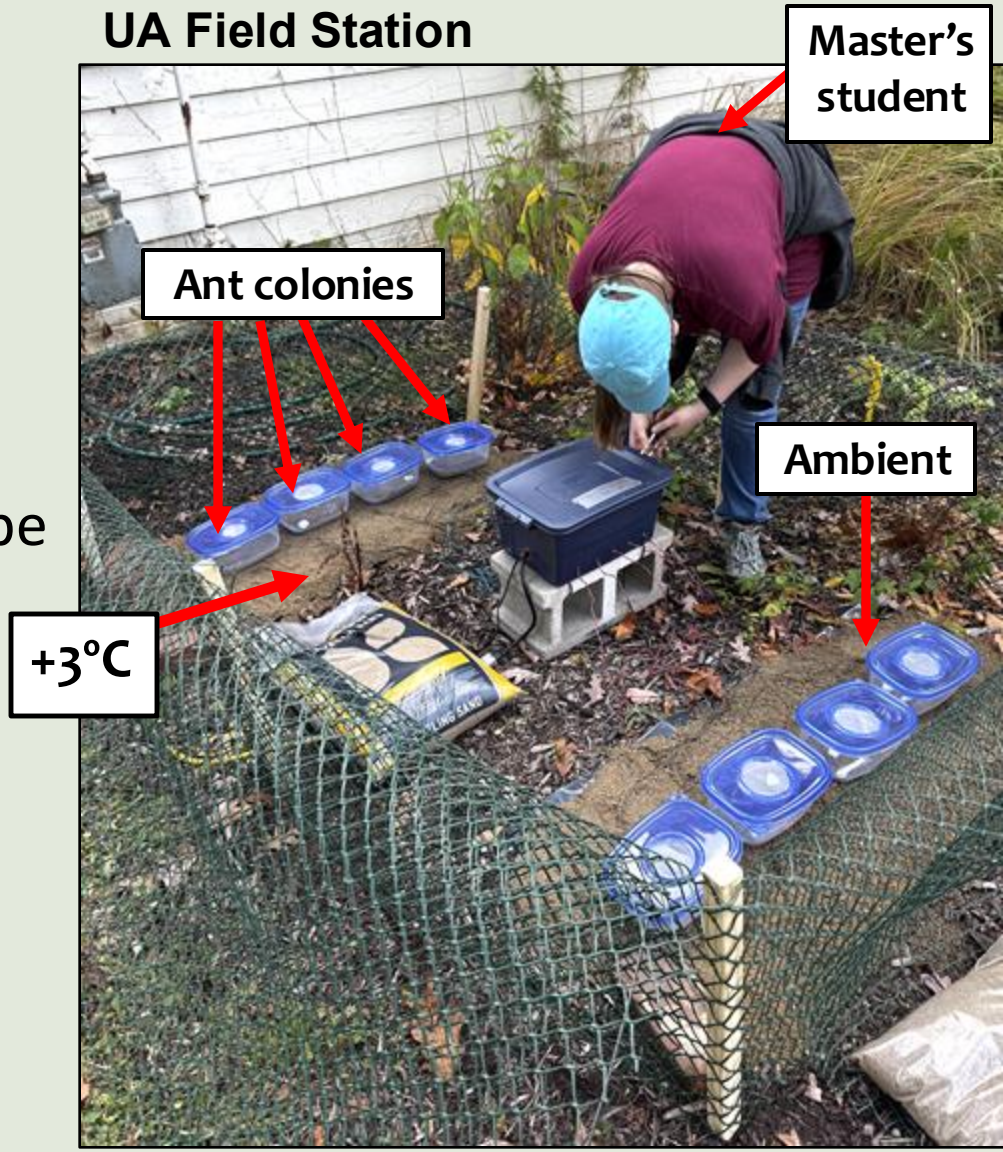


UA Field Station

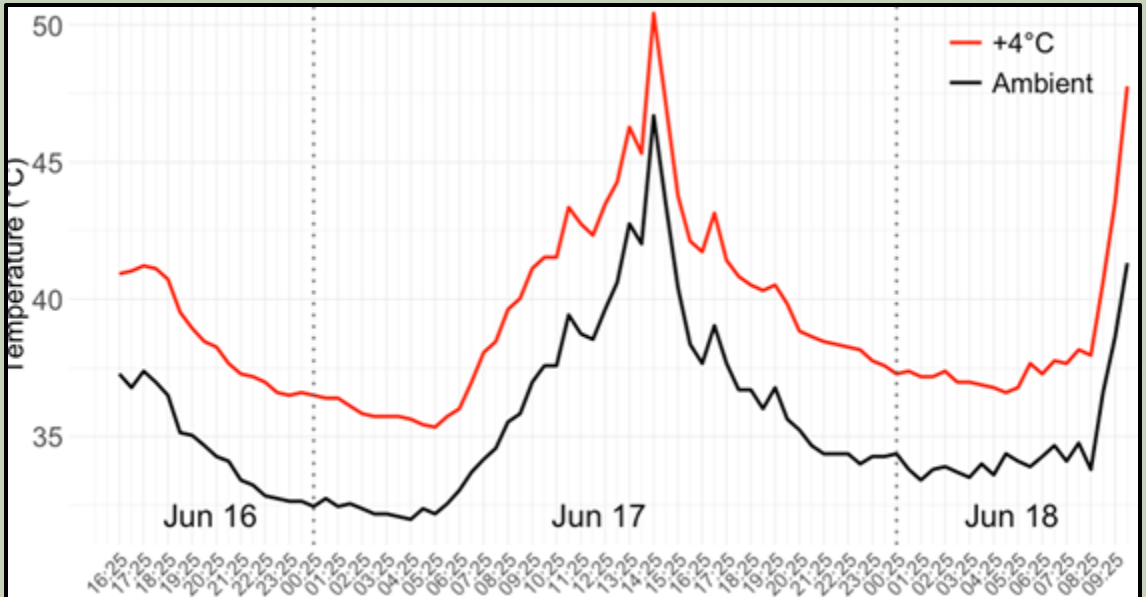


How does forest ant overwintering change under experimental warming?

- **Reciprocal transplants:** colonies with **urban** vs. **rural origins** will be deployed across **urban, intermediate, rural sites (TBD)**
- **Data (to be) collected:** colony survival, foraging activity, nest choice, phenology (entering dormancy, etc.), behavior
- **Variables:**
  - Ant species
  - Colony origin
  - Warming treatment



How does forest ant overwintering change under experimental warming?



Where we are now:

- First chamber deployed at **UA Field Station**!
  - Rural
- Second chamber to be deployed at UA main campus
  - urban
- Pilot data collection underway

How does forest ant overwintering change under experimental warming?

What's next:

- Deploy full set of warming chambers across 9 sites (urban → rural)
- Launch reciprocal transplant experiments with many colonies
- Collect **multi-season** and **multi-year** data on overwintering, survival, and phenology
- Integrate results with broader frameworks on **urban climate adaptation and phenological plasticity**

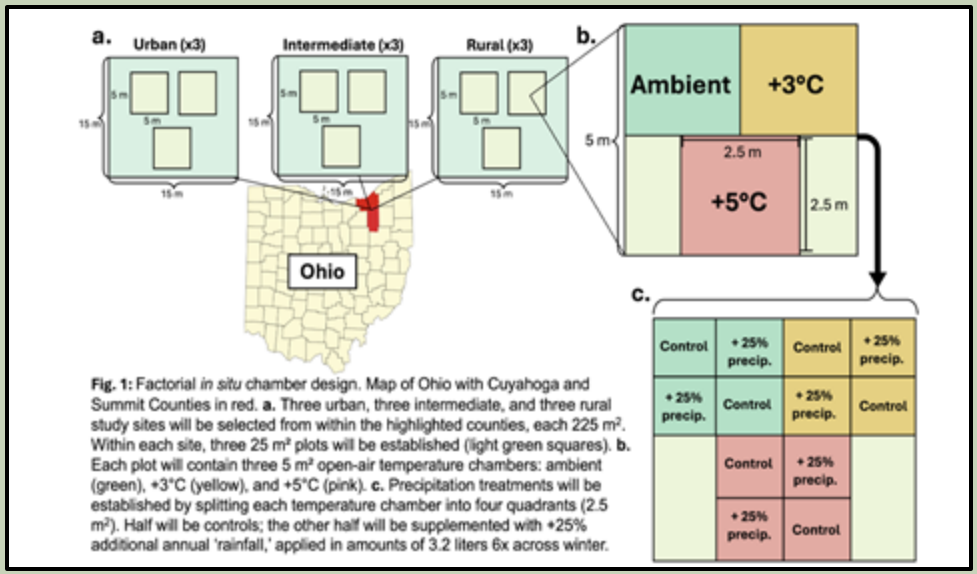


Fig. 1: Factorial *in situ* chamber design. Map of Ohio with Cuyahoga and Summit Counties in red. **a.** Three urban, three intermediate, and three rural study sites will be selected from within the highlighted counties, each 225 m². Within each site, three 25 m² plots will be established (light green squares). **b.** Each plot will contain three 5 m² open-air temperature chambers: ambient (green), +3°C (yellow), and +5°C (pink). **c.** Precipitation treatments will be established by splitting each temperature chamber into four quadrants (2.5 m²). Half will be controls; the other half will be supplemented with +25% additional annual 'rainfall,' applied in amounts of 3.2 liters 6x across winter.

Overarching goal: predict resilience/vulnerability of forest ant communities under climate + urbanization pressures

Why it matters

- Climate change and other global change drivers are transforming ecological systems
- Studying responses **across scales** and **taxa** helps predict resilience
- **Ants** can provide insights into ecosystem functioning under global change
- **Field stations** and other non-academic institutions can be key players in facilitating important climate change research at a low cost
- And critically, field stations enable us to train the next generation of scientists beyond the classroom

Grant no. 2109482

In-classroom visits

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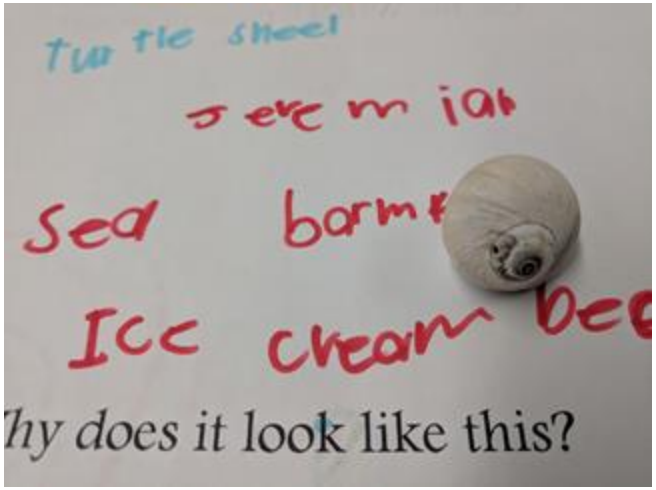
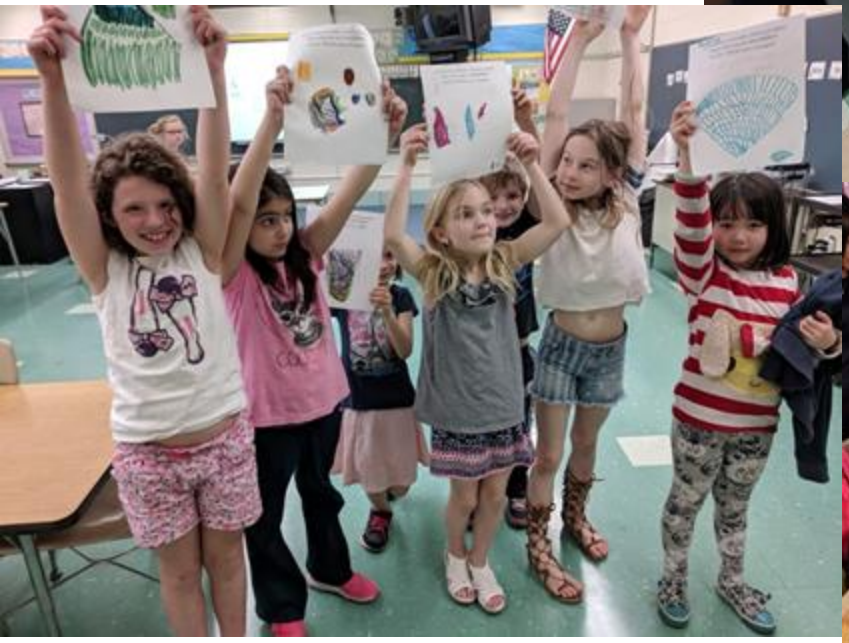


SITKA SOUND
SCIENCE CENTER



Name: Caellum Date:

COMPARE

The lines in this wing look like veins

OBSERVE

Draw what you see.

PREDICT

I think the lines in this wing are used for pumping blood

tha or vanes that pumpi blud.


University of Akron Field Station ~ Biomimicry worksheet

Draw what you see MAGNIFIED!

Use the WHOLE piece of paper!

Coral

In-classroom visits

HOME | NEWSROOM | ARTICLES

LOST EINSTEINS: THE US MAY HAVE MISSED OUT ON MILLIONS OF INVENTORS

WEALTHY CHILDREN ARE 10 TIMES MORE LIKELY TO BE INVENTORS.

By Rebecca Linke | February 16, 2018

Graphics: Mimi Phan

WHY IT MATTERS

Innovation has slowed in the U.S., stymying economic growth. To get back on track, the U.S. needs more low-income children, women, and minorities to become inventors — but that won't be easy.

THE EQUALITY OF OPPORTUNITY PROJECT

Who Becomes an Inventor in America? The Importance of Exposure to Innovation

Executive Summary

Alex Bell, Raj Chetty, Xavier Jaravel, Neviana Petkova, and John Van Reenen

Innovation is widely viewed as the engine of economic growth. As a result, many policies have been proposed to spur innovation, ranging from tax cuts to investments in STEM (science, technology, engineering, and math) education. Unfortunately, the effectiveness of such policies is unclear because we know relatively little about the factors that induce people to become inventors. Who are America's most successful inventors and what can we learn from their experiences in designing policies to stimulate innovation?

Science News *from research organizations*

Diversity boosts innovation in US companies, study finds

Date: January 9, 2018

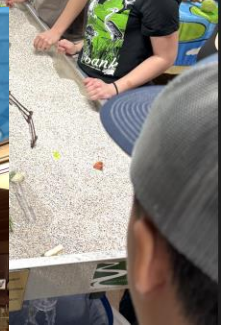
Source: North Carolina State University

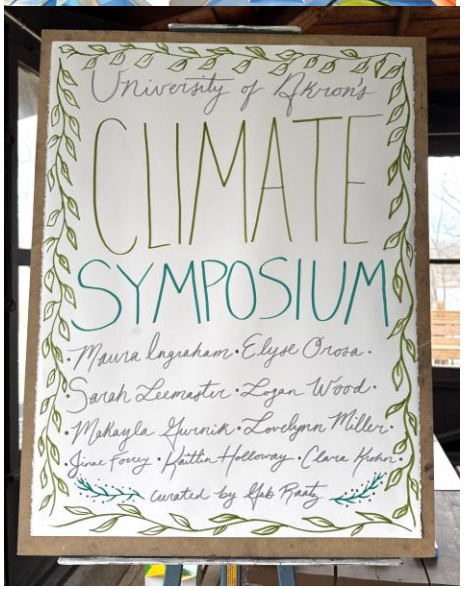
Summary: A recent study finds that taking steps to foster diversity makes a company more innovative, in terms of product innovations, patents created and citations on patents -- meaning the relevant innovations are also used to develop new technologies.

AWARD-WINNING PROGRAMS

- Educator of the Year – Cleveland Museum of Natural History; Summit Soil and Water Conservation District; Akron Garden Club; Cuyahoga County Soil and Water Conservation District;
- Human Diversity Award – OBFS
- University of Akron Achievement Award – Diversity
- Buchtel College of Arts and Sciences – Dean's Above and Beyond Award
- Buchtel College of Arts and Sciences – Community Outreach
- University of Akron Achievement Award – Community Outreach

UA Annual Climate Symposium at UAFS





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- 815-901-6801