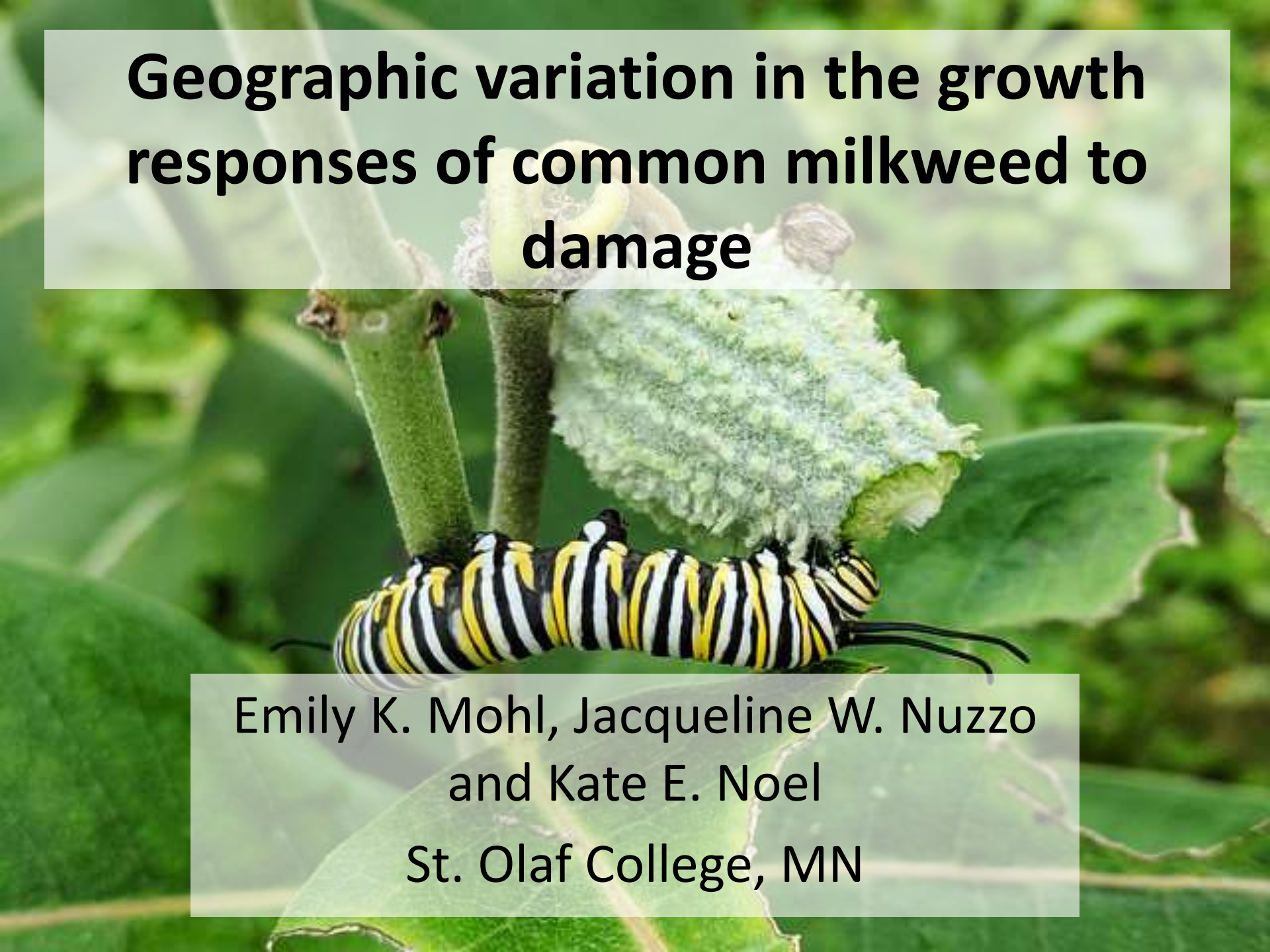
Geographic variation in the growth responses of common milkweed to damage



Emily K. Mohl, Jacqueline W. Nuzzo and Kate E. Noel

St. Olaf College, MN

Acknowledgements

Sara E. Scanga, Danielle E. Garneau, Patricia A. Saunders, Aimee Phillippi, Andrew C. McCall, Kaitlin Stack Whitney, Tracy B. Gartner

Madeline Q. Johnson, Zoua Lor, Sydney C. Povilaitis

Plant Responses to Herbivory

Resistance

Avoidance Strategies

Escape

Defence

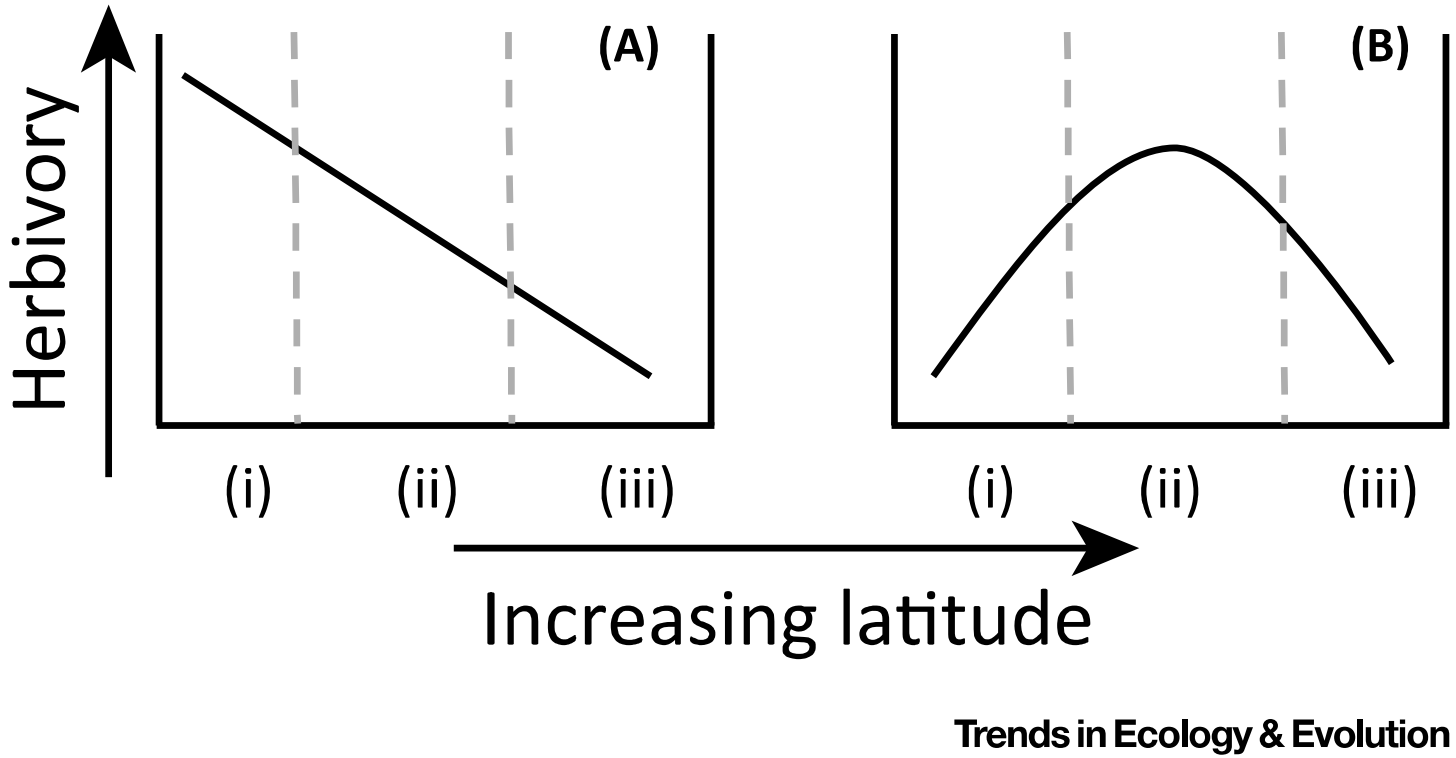
Tolerance Strategies

(Include compensatory growth)

K. Nagarjun.
https://www.flickr.com/photos/nagarjun/28168006107

- Rosenthal and Kotanen 1994 *Nature*

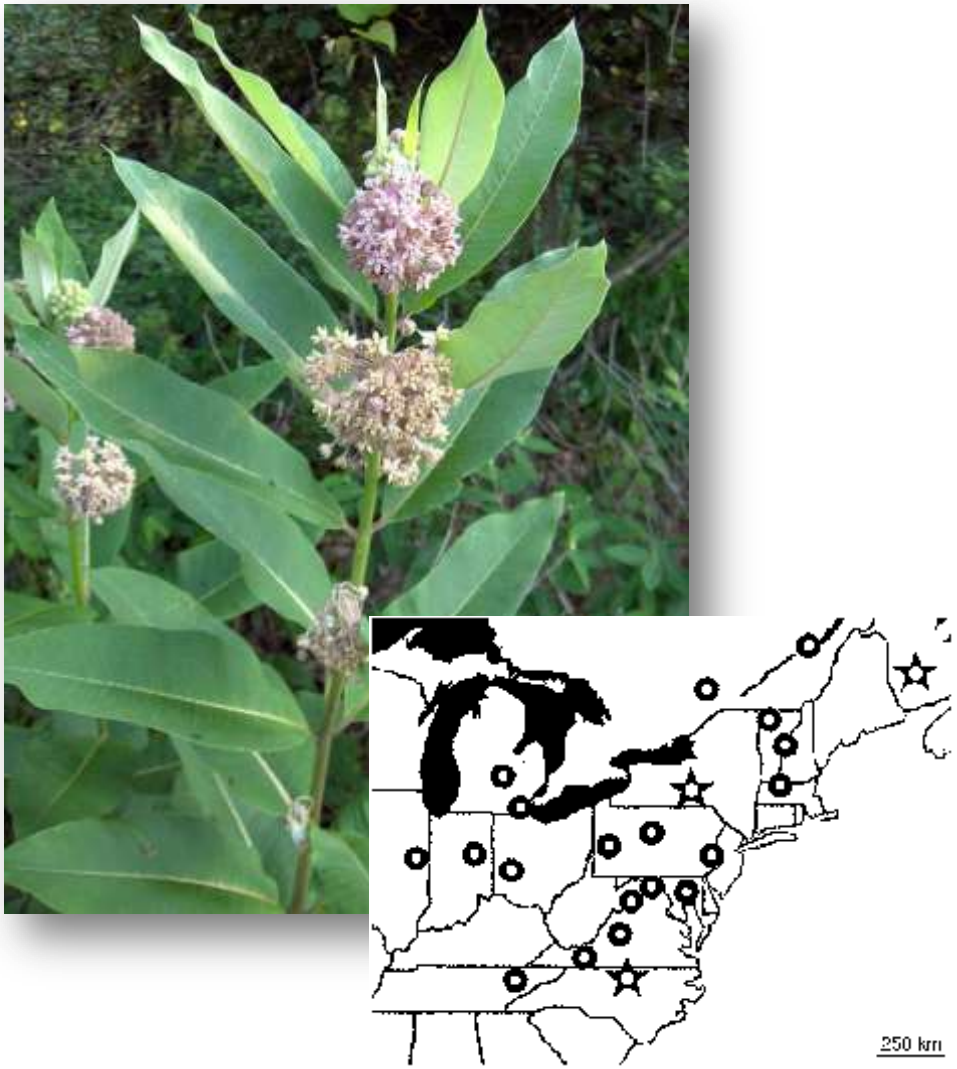
Latitudinal Herbivory-Defense Hypothesis



- Anstett et al. 2016

Common Milkweed

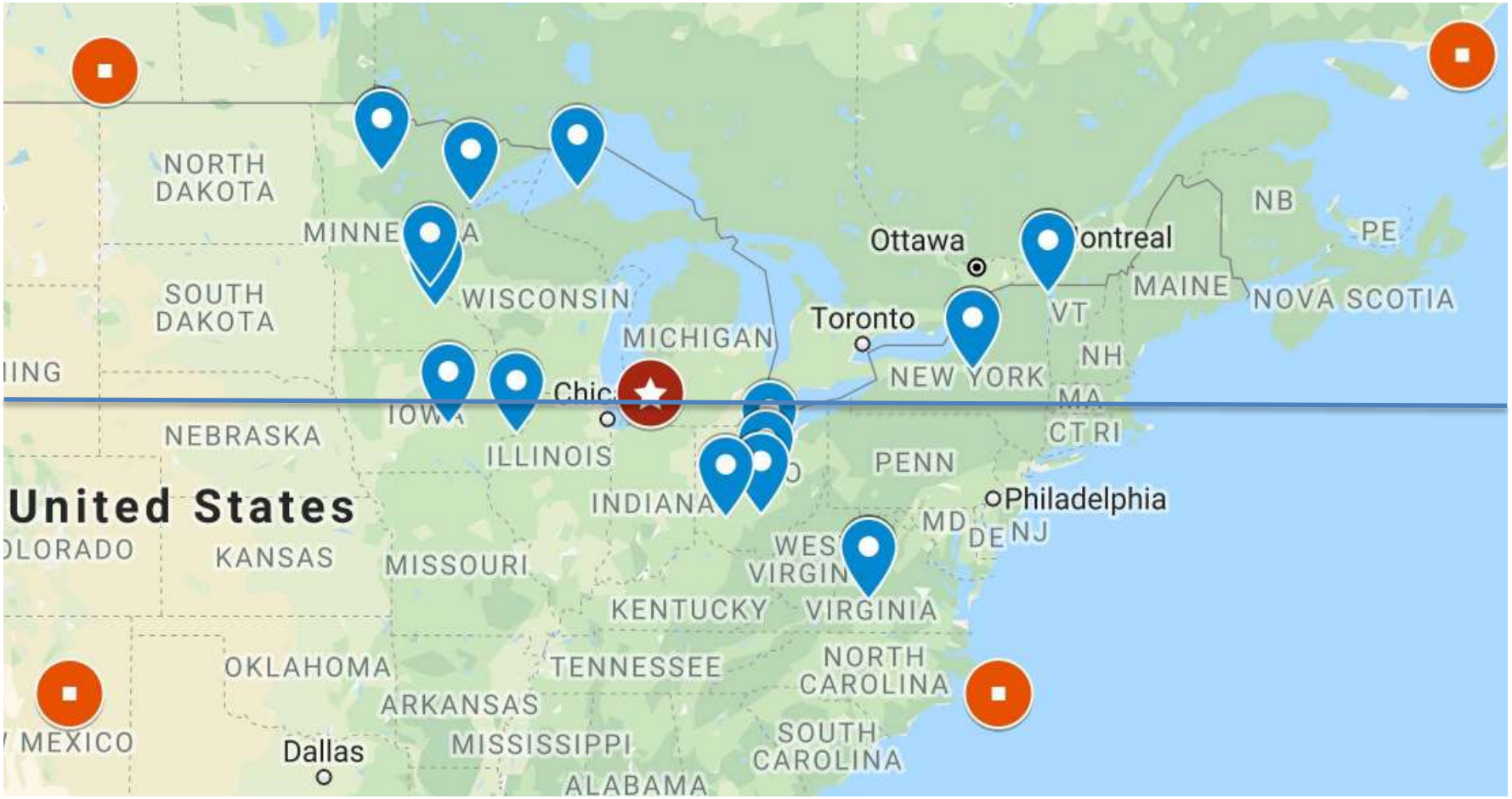
- Perennial weedy herb with wide geographic range
- Important food source for monarch butterflies
- Clines in growth and defense: northern populations more defended, more root-investing, and slower growing (Woods et al. 2012)



Hypotheses

- Greater compensation in the south, where growth rate is reported to be faster
- Greater compensation in the north, where root:shoot ratios are reported to be higher and phenology is earlier
- Greater compensation at range center, where herbivory is reported to be highest

Distribution of Sites



EREN
ECOLOGICAL RESEARCH AS EDUCATION NETWORK

Range marked in red: Bhowmik 1994

Methods

Treatments x 14 sites x 8 blocks

Control 1 Control 2 Damage

Methods

Treatments x 14 sites x 8 blocks

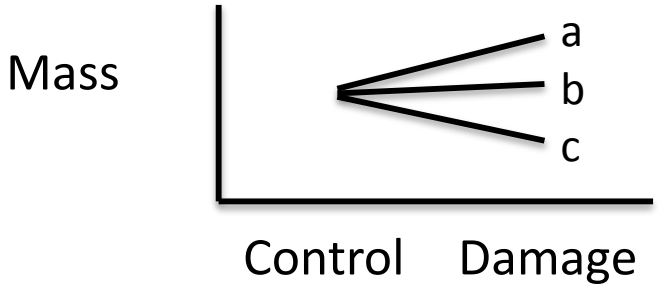
Control 1 Control 2 Damage

Measurements

- Total mass
- Root:shoot ratio
- Relative leaf area growth rate
- Stem investment

Methods

Treatments x 14 sites x 8 blocks

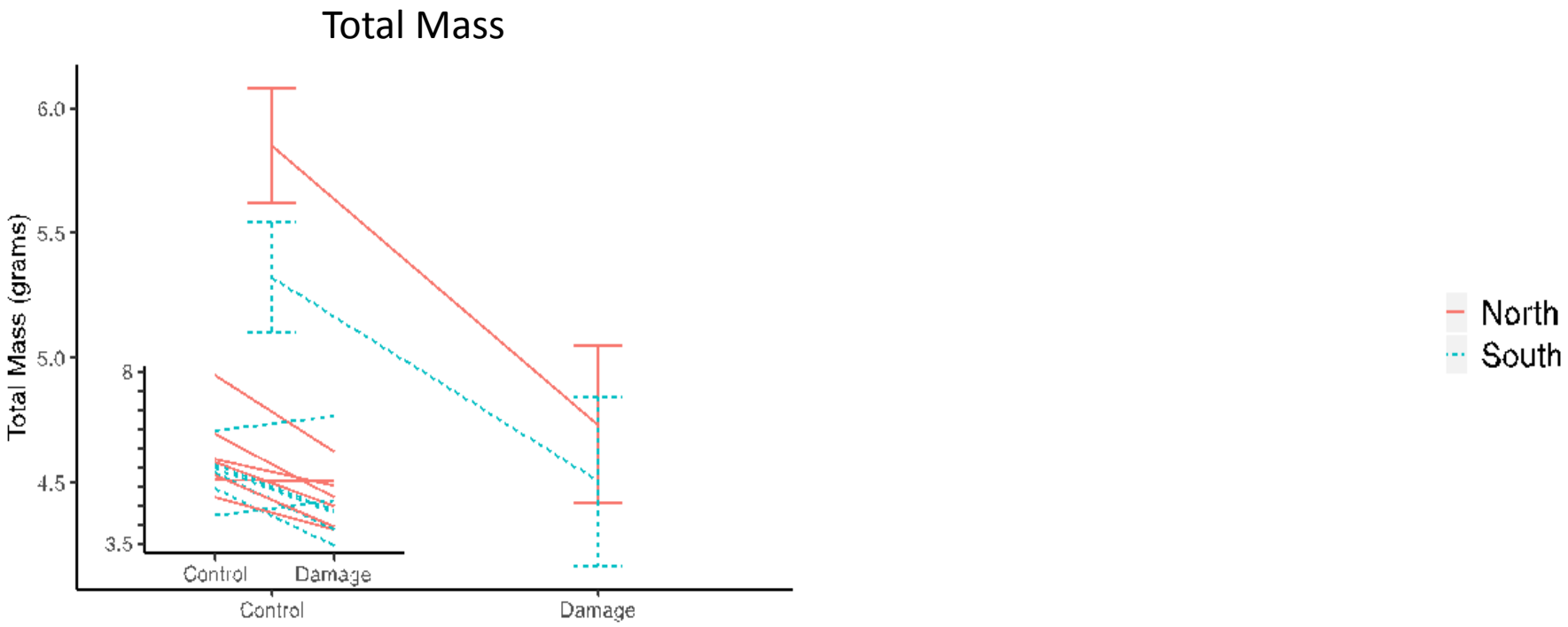


Measurements

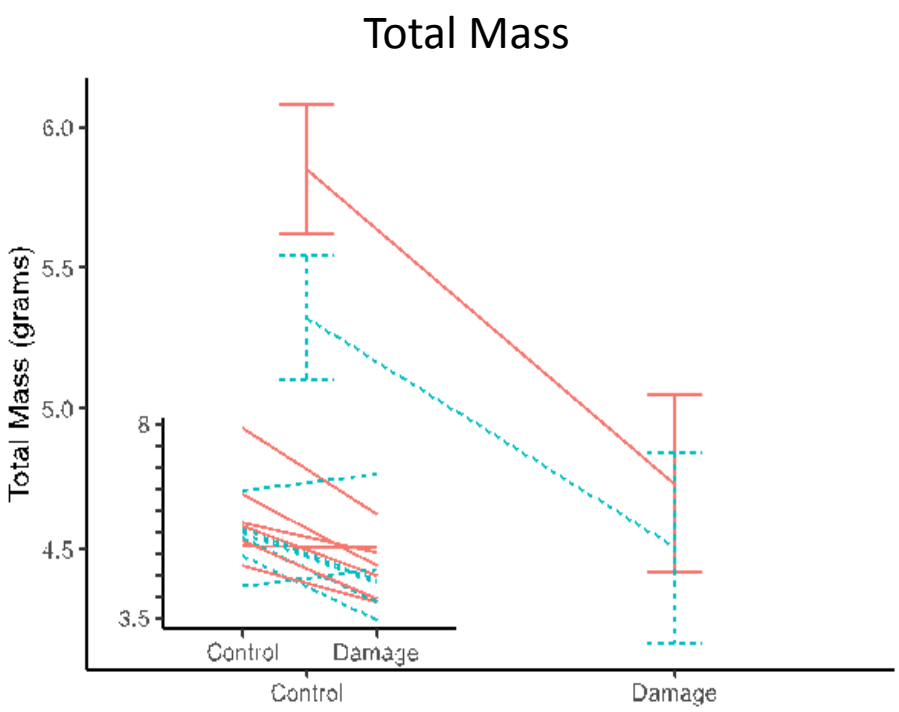
- Total mass
- Root:shoot ratio
- Relative leaf area growth rate
- Stem investment

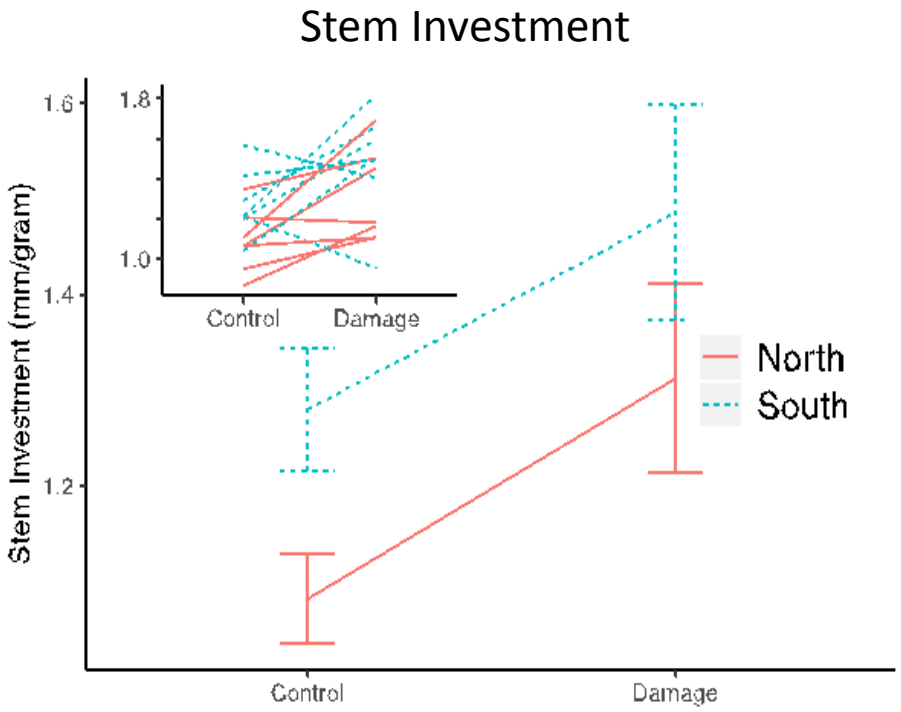
RESPONSES to DAMAGE=
mean (Dam) - mean (Control)

Effect of Damage by Region

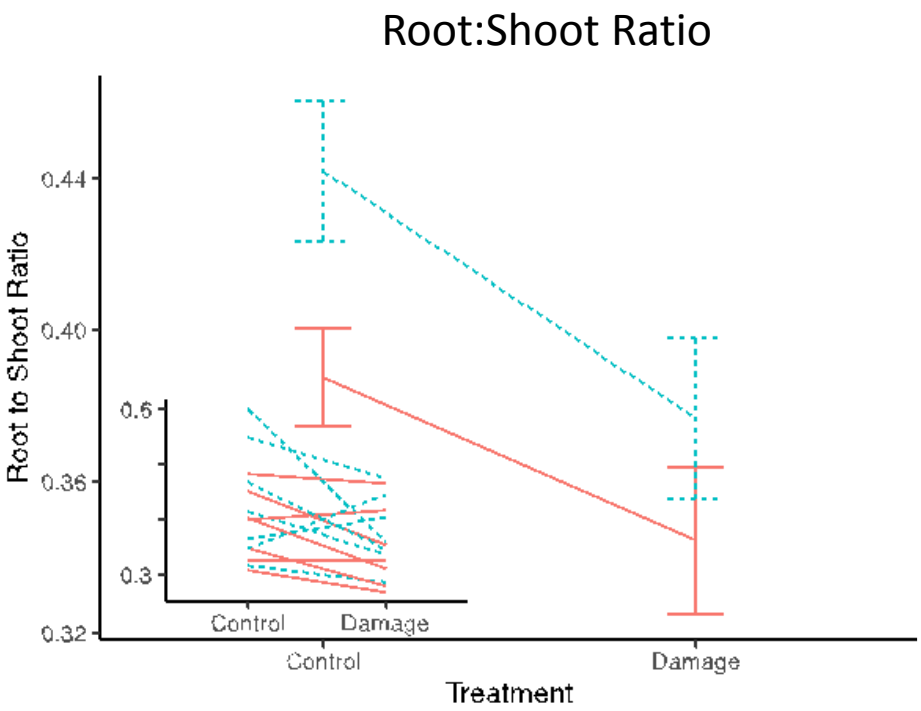


Effect of Damage by Region



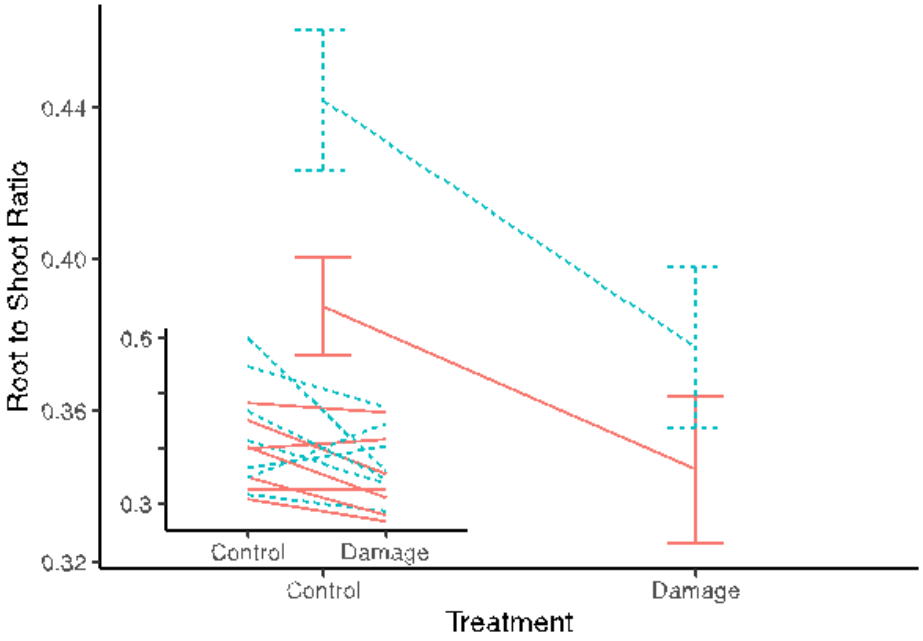


Effect of Damage by Region

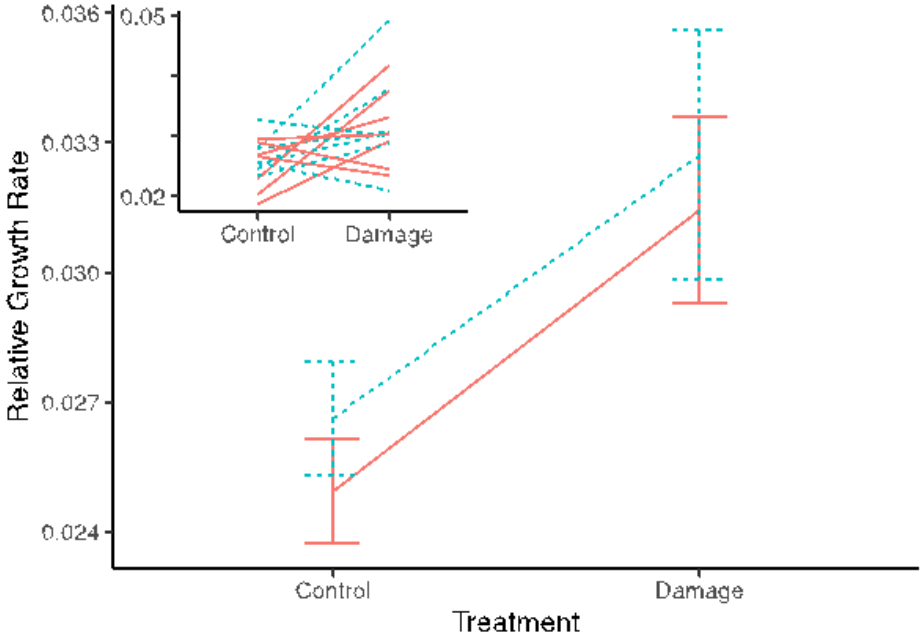


Effect of Damage by Region

Root:Shoot Ratio

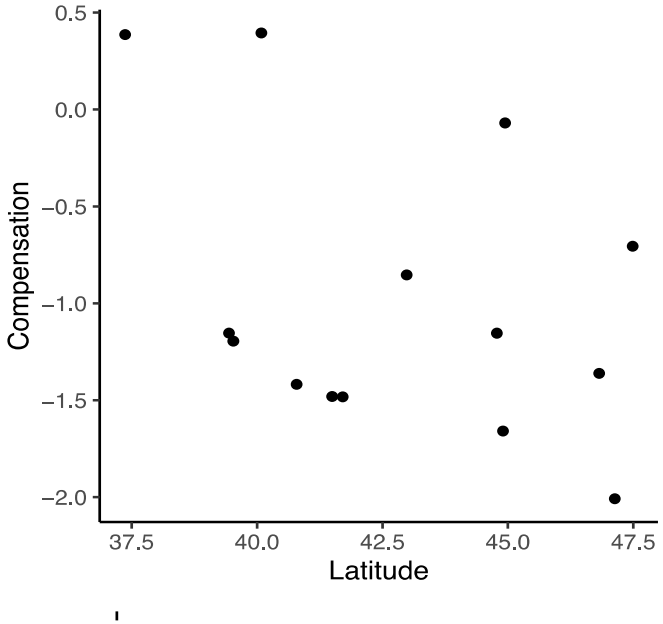


Relative Growth Rate



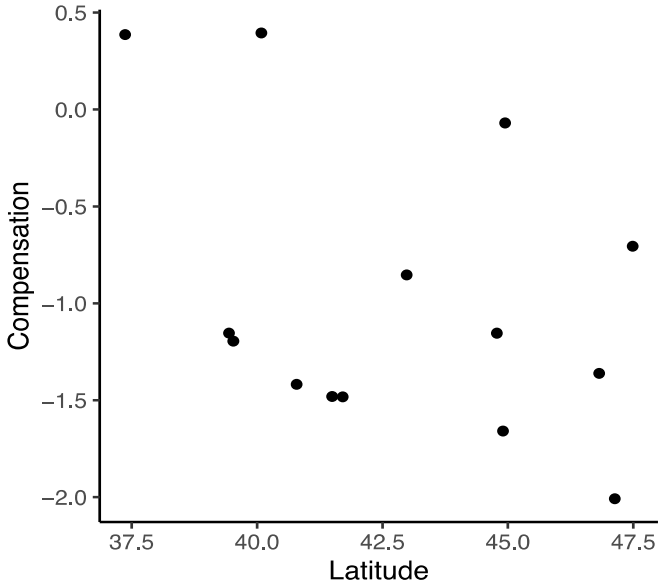
- Although all traits display site level variation, there are common responses to damage
- Regional differences exist for all traits except Relative Growth Rate
- No interactions between region and damage; no evidence for geographic patterns in compensatory or other growth responses to damage

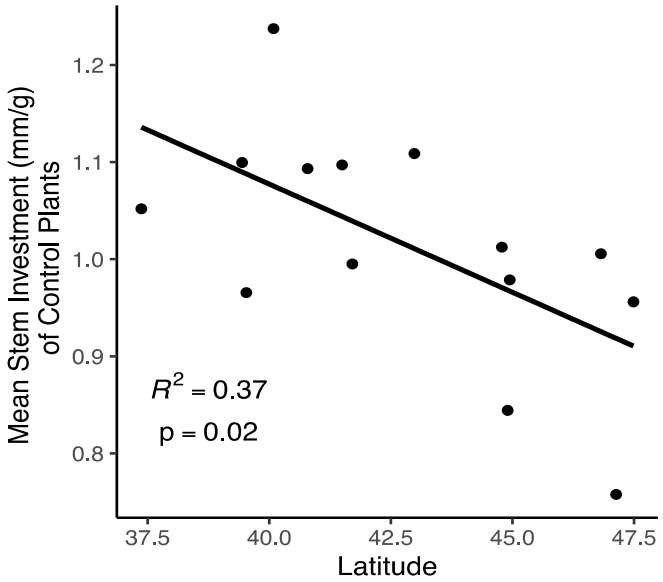
Latitudinal Trends



- No evidence for latitudinal clines in compensation or any other responses to damage

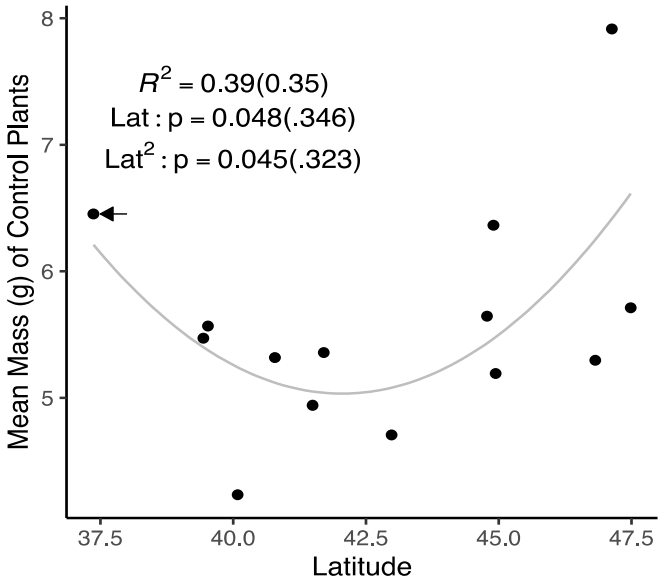
Latitudinal Trends

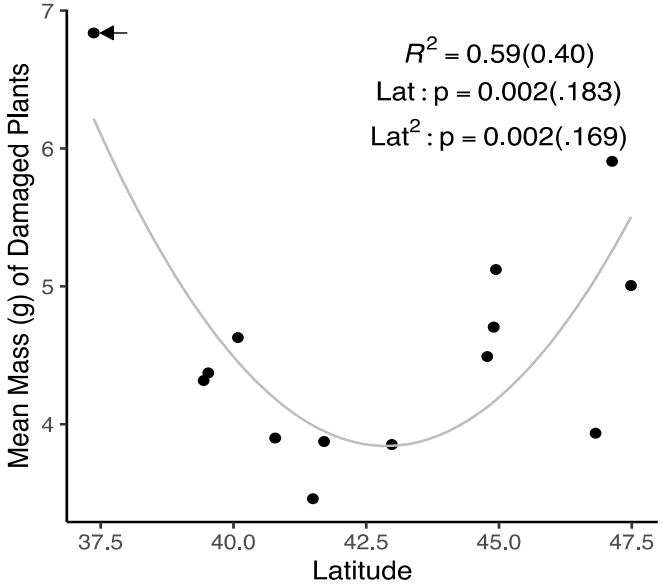


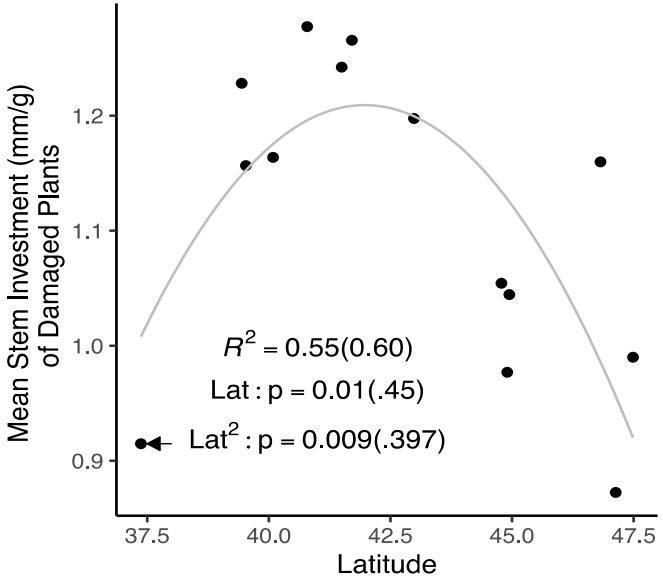


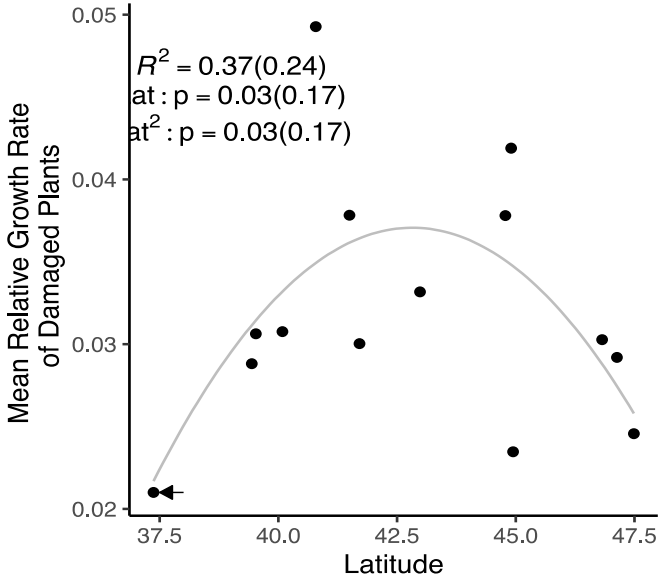
- No evidence for latitudinal clines in compensation or any other responses to damage
- Evidence for a cline with greater stem investment in control plants from the south

Non-Linear Latitudinal Trends







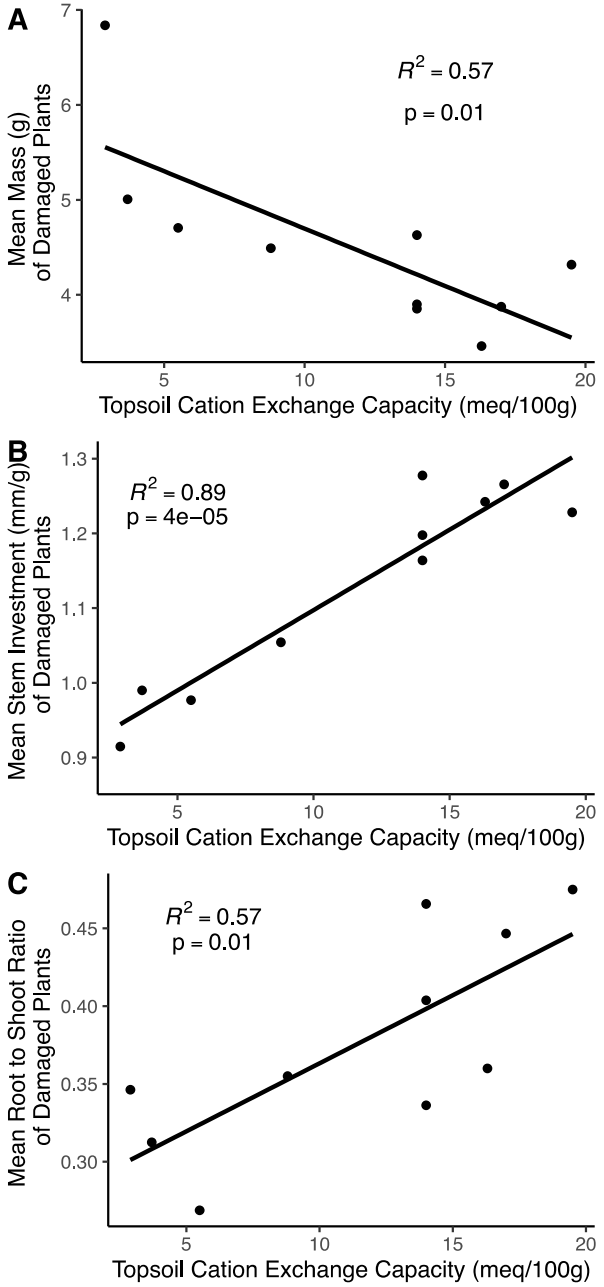


- All driven by a single low-latitude site
- No evidence that distance from range center predicts traits or responses

Soil Characteristics Predict Traits when Damaged

Site Traits Explored

- Cation Exchange Capacity
- Available Water Content
- Soil pH
- Soil Organic Matter
- Longitude
- Long Term Precipitation
- Elevation
- Frost Free Days
- Growing Degree Days in year prior to seed collection



Conclusions

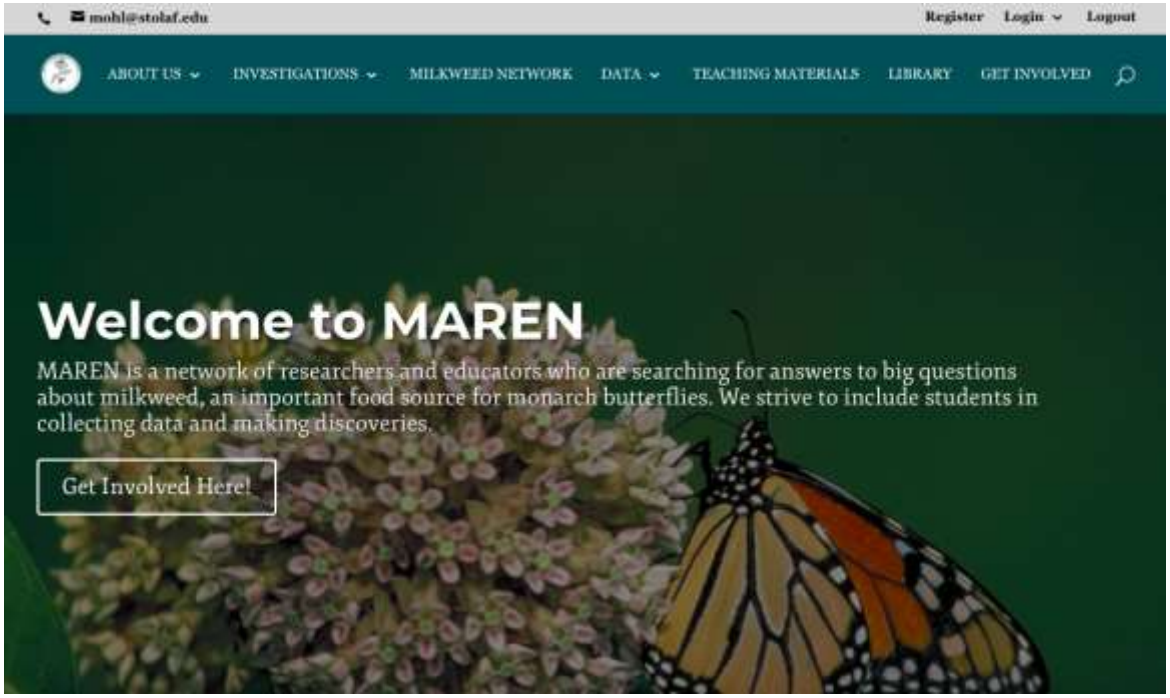
- Common suite of growth responses to damage include increased growth rate, increased stem investment, and reduced root:shoot ratio.
- Latitude was not a linear predictor of traits when damaged. Patterns we observed did not align with previous reports.
- Soil characteristics were the strongest predictors of traits when damaged.

Next Steps

- Investigate geographic variation in herbivory
- Test for local adaptation, especially to soil conditions

Learn more or get involved with the Milkweed Adaptation Research and Education Network:

marenweb.com



Thank You

- St. Olaf CURI
- Seed Contributors

Abby Kula
Adam Zorn
Aimee Phillippi
Al Wachutka
Alissa Naymark
Amber Gremmels
Amy Allin
Andy McCall
Ashley Rea
Brad Cosentino
Caren Hudak
Charles McClaugherty
Danielle Garneau
Dave Dziengel
David Abazs
Denice Robertson
Jason Haupt
John Styrsky
Julie Beston
Kaitlin Stack Whitney
Ken Lidle
Kendra Cipollini
Kevin Geedey
Kirk Larsen
Lisa Hooper
Liz Koziol
M. Caitlin Fisher-Reid
Mark Studer
Kari Erickson
Michael Weinstein
Natasha Capell
Patti Dugan-Henriksen
Patty Saunders
Pauline Corzilius
Rachel Sanders
Rebecca Hutchison
Sara Scanga
Tracy Gartner
Travis Hall

Effect of Herbivory: 2016