Nutrient enrichment alters blue carbon pools and processes

Thomas J. Mozdzer, Don Barber, Melissa McCormick, Joshua Caplan, Caitlin Bauer, Emily Geoghegan, Francine Leech, , Camila Silva, & Paige Weber

Salt marshes are globally important C pools

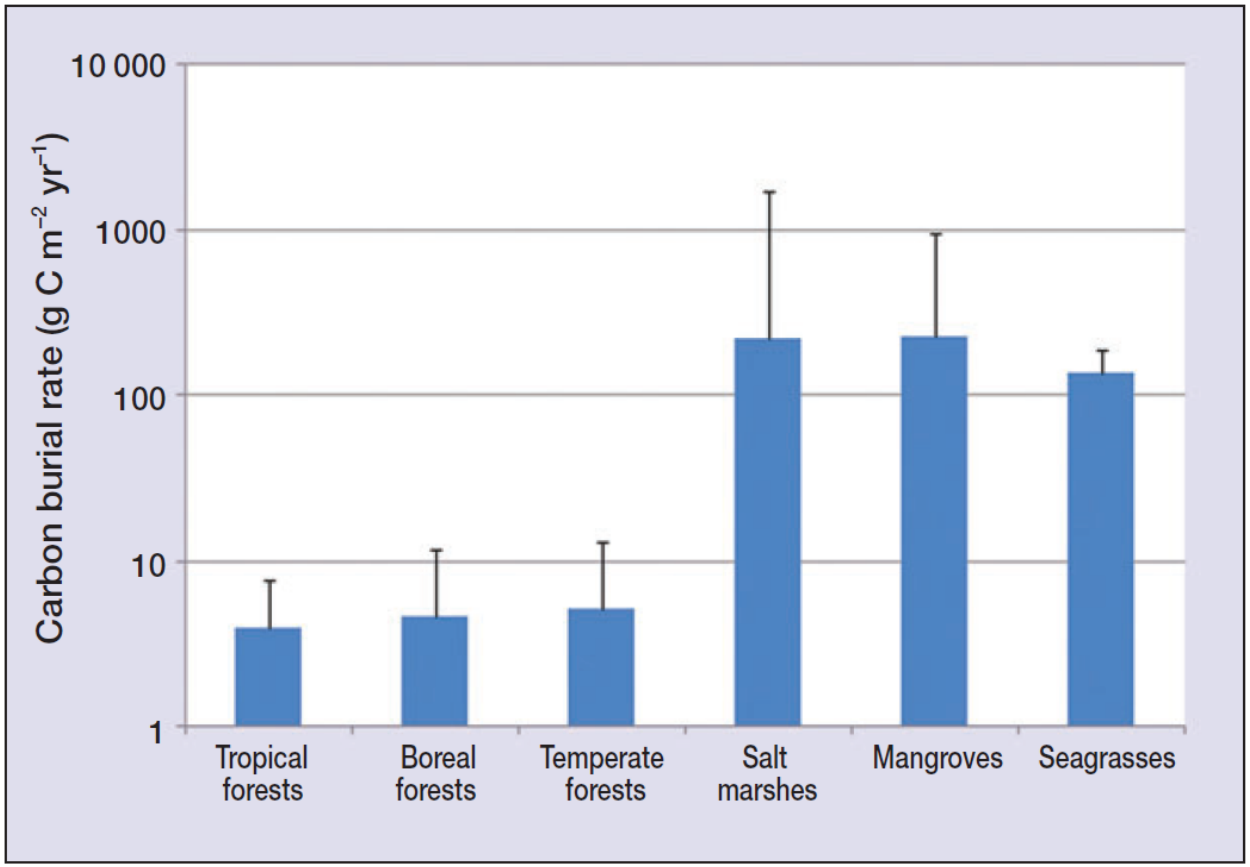
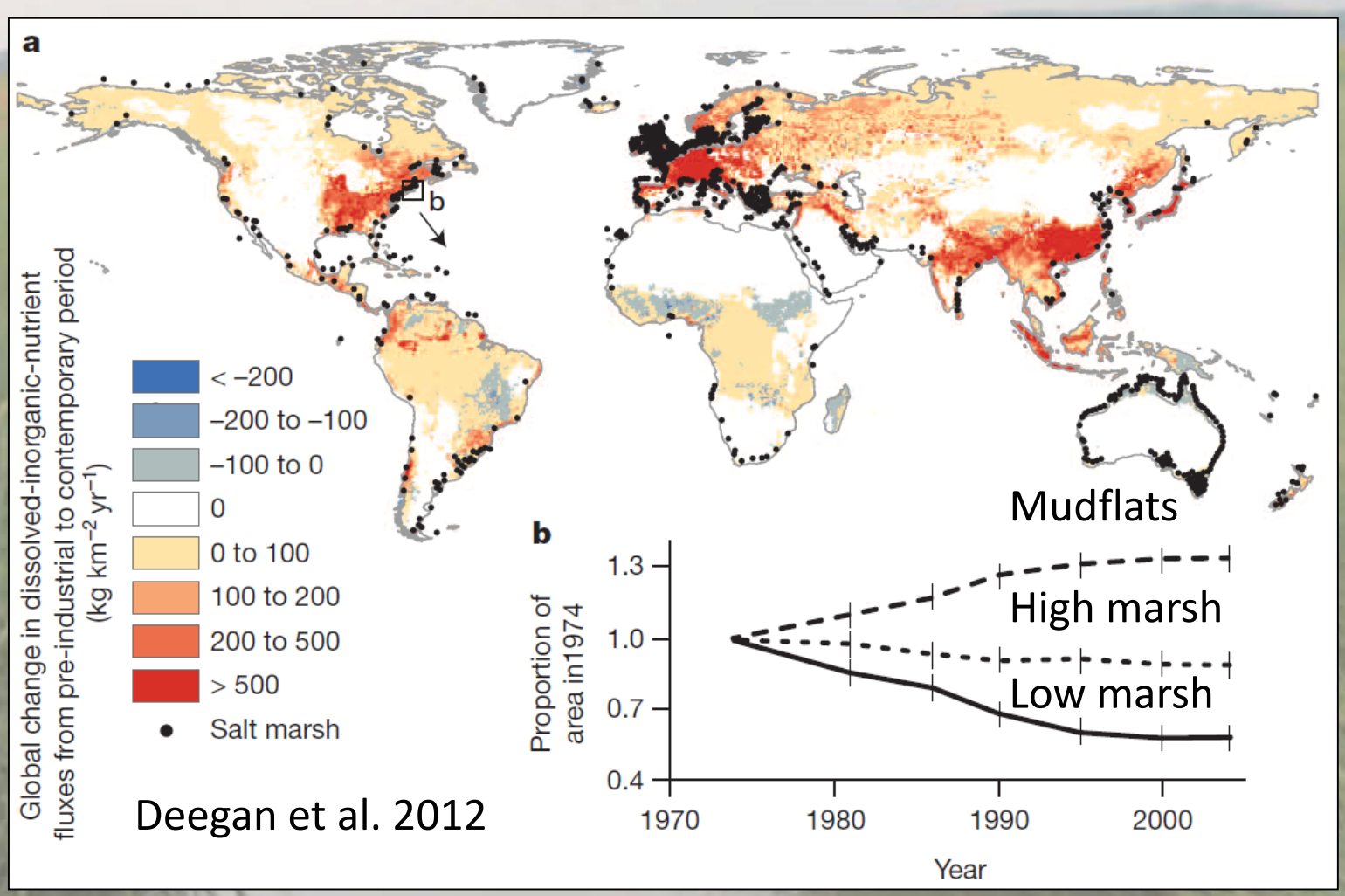
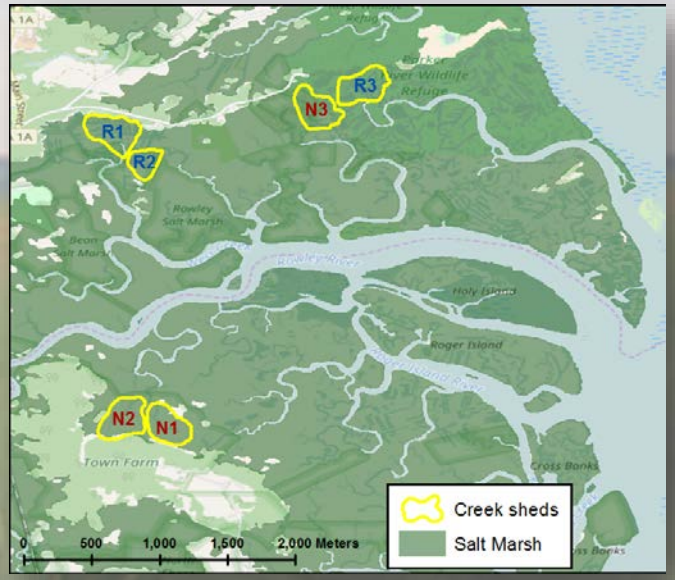


Figure 5. *Mean long-term rates of C sequestration (g C m^{-2} yr^{-1}) in soils in terrestrial forests and sediments in vegetated coastal ecosystems. Error bars indicate maximum rates of accumulation. Note the logarithmic scale of the y axis. Data sources are included in Tables 1 and 2.*

What role do nutrients play blue carbon pools and processes?



TIDE - a long-term NITRATE enrichment experiment



Plum Island Ecosystem LTER site

Unfertilized

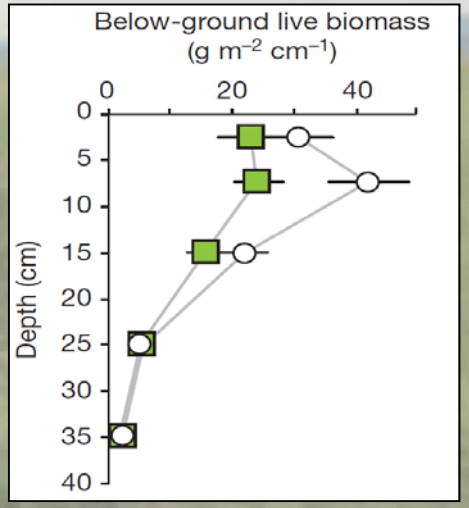
Eutrophic

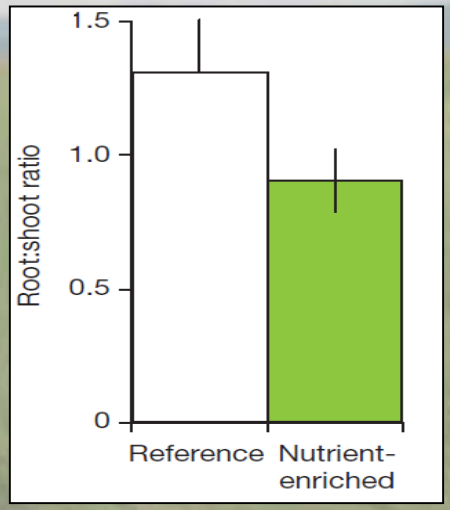
Deegan et al. 2007, 2012

Fracturing was associated with changes in biomass allocation & ecosystem processes

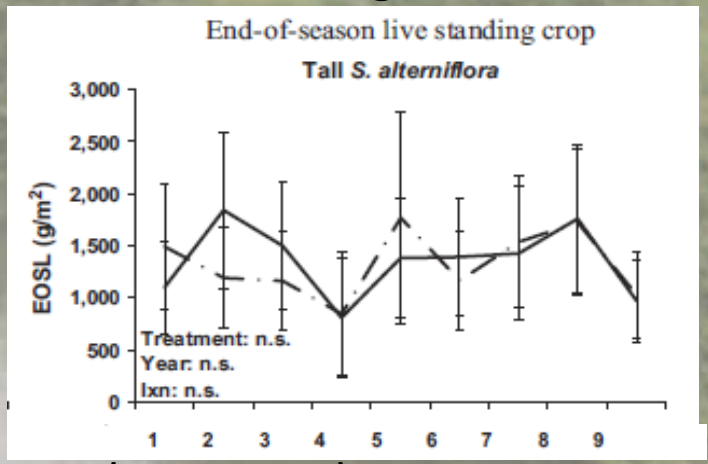
- ↓ belowground
- ↓ Root:Shoot
- ↑ litter respiration

- No change in ANPP with N





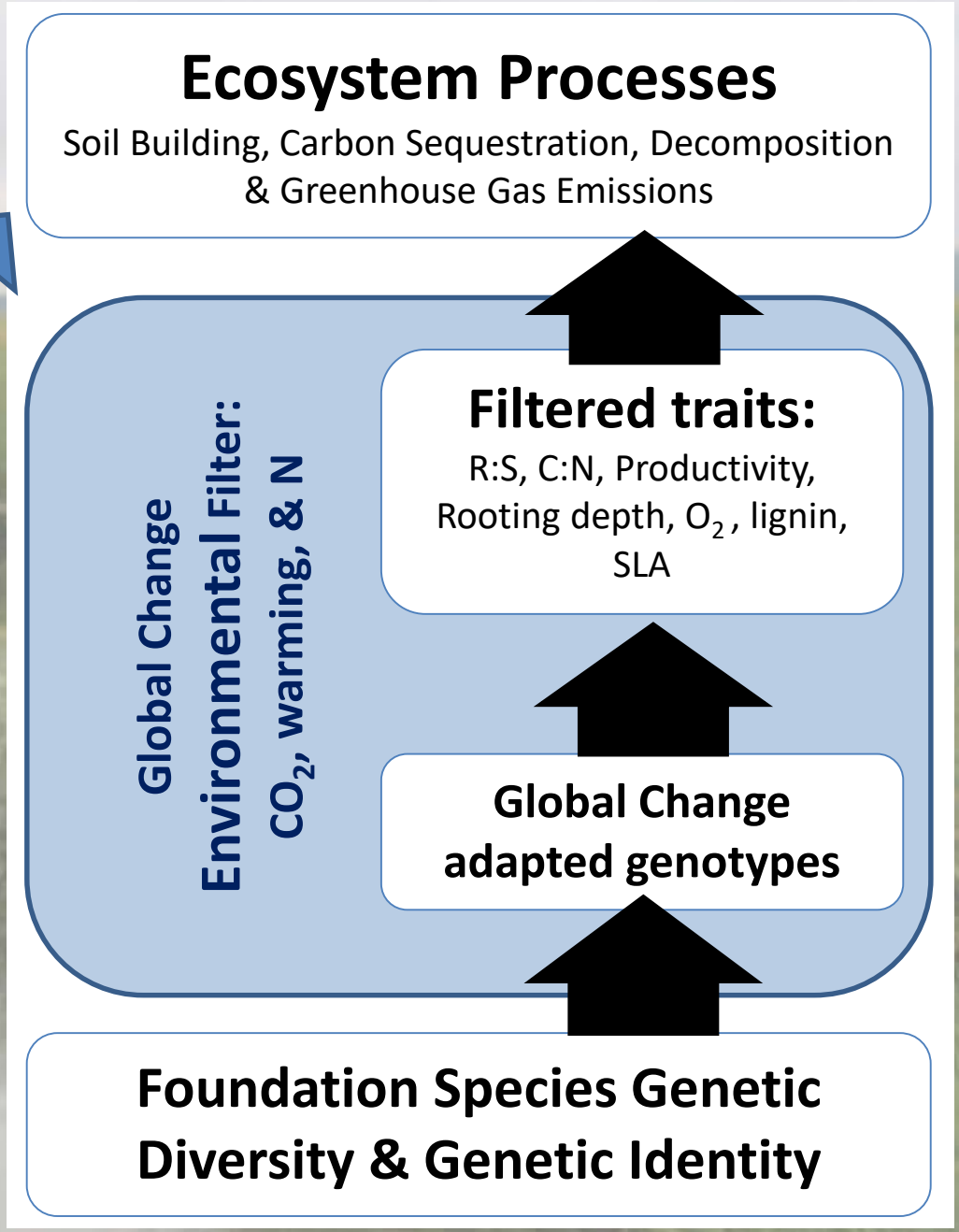
Deegan et al. 2012

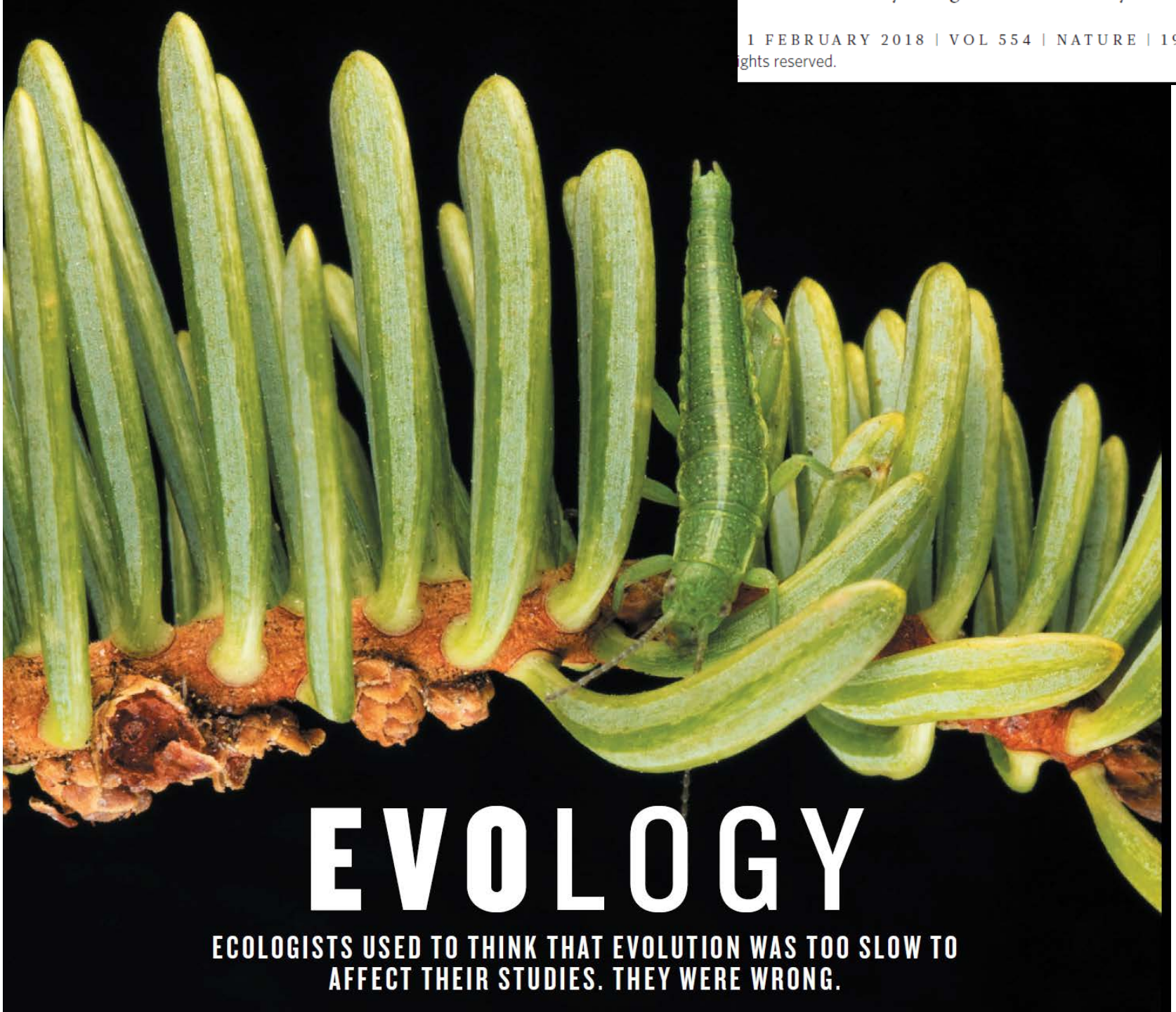


Johnson et al. 2016

What is the role of genetic diversity in ecosystem science?

Most research presented at the symposium has focused here, which ignores evolutionary processes

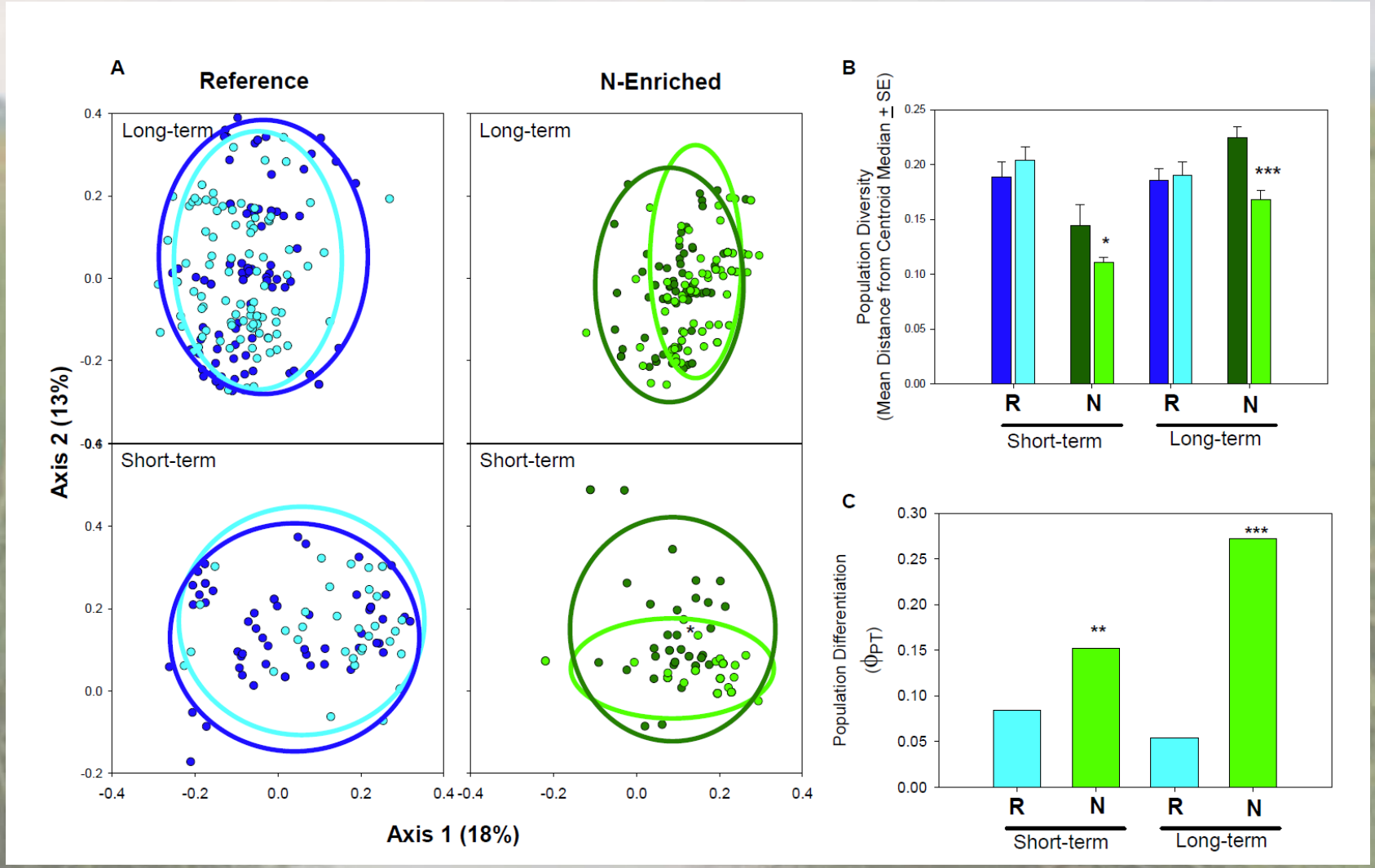




EVOLOGY

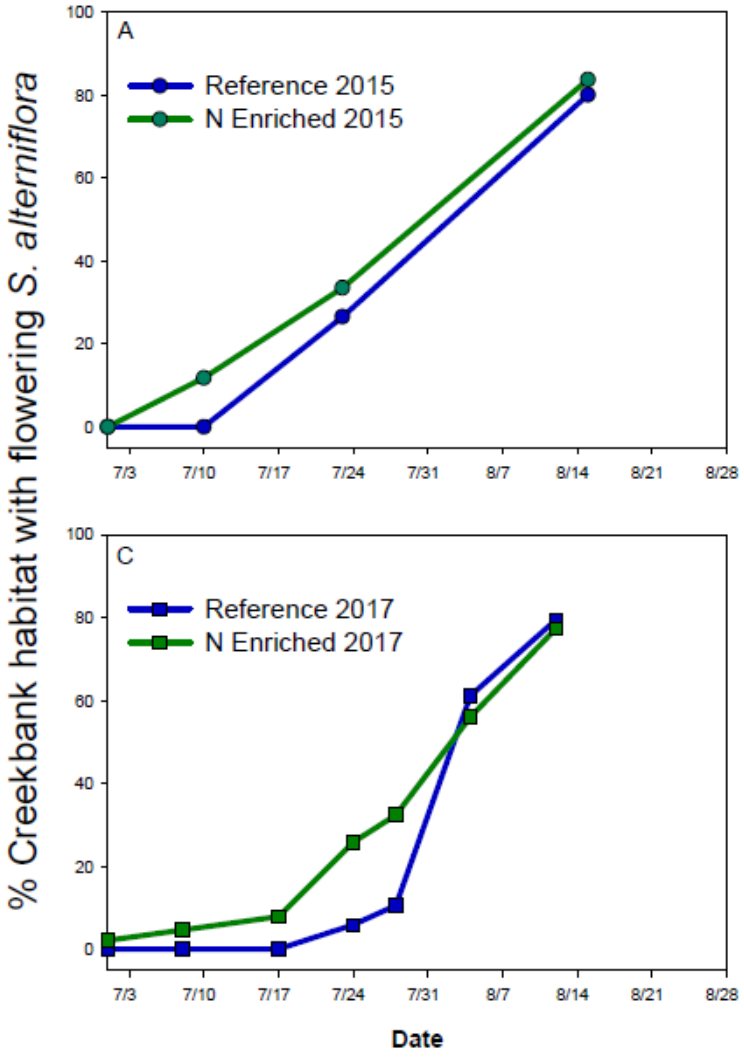
ECOLOGISTS USED TO THINK THAT EVOLUTION WAS TOO SLOW TO AFFECT THEIR STUDIES. THEY WERE WRONG.

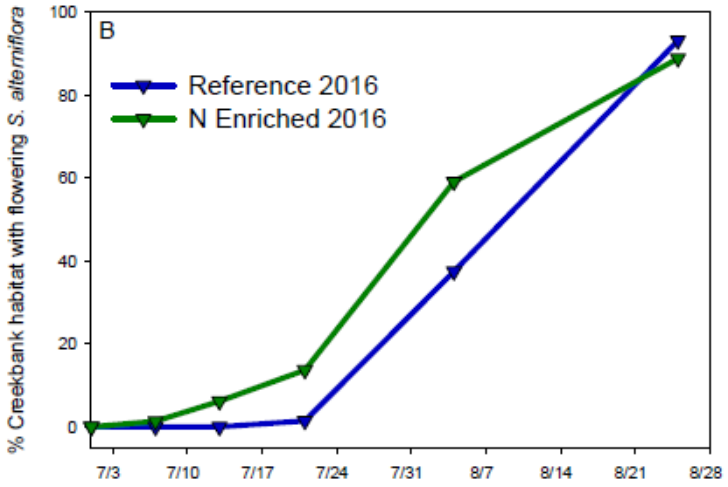
Spartina genetic diversity decreased with N enrichment in as little as 3 years

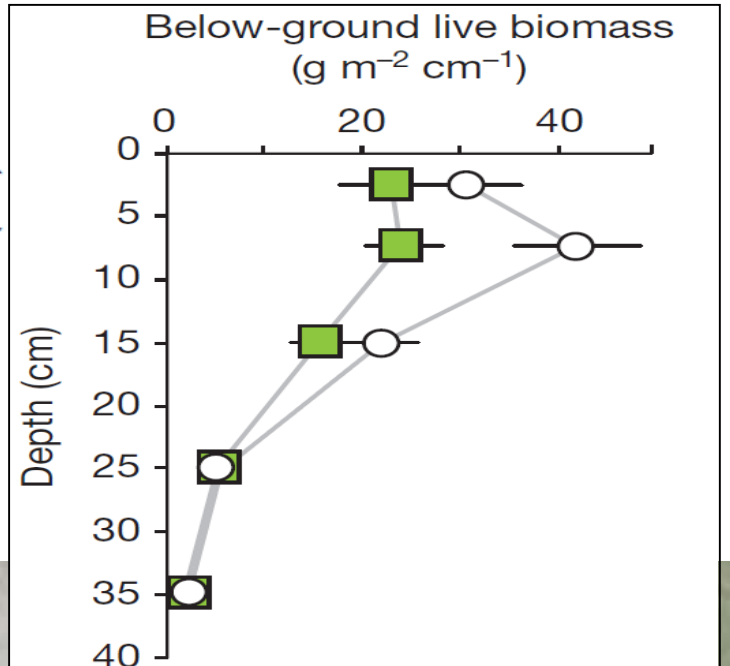


Mozdzer et al *in revision*

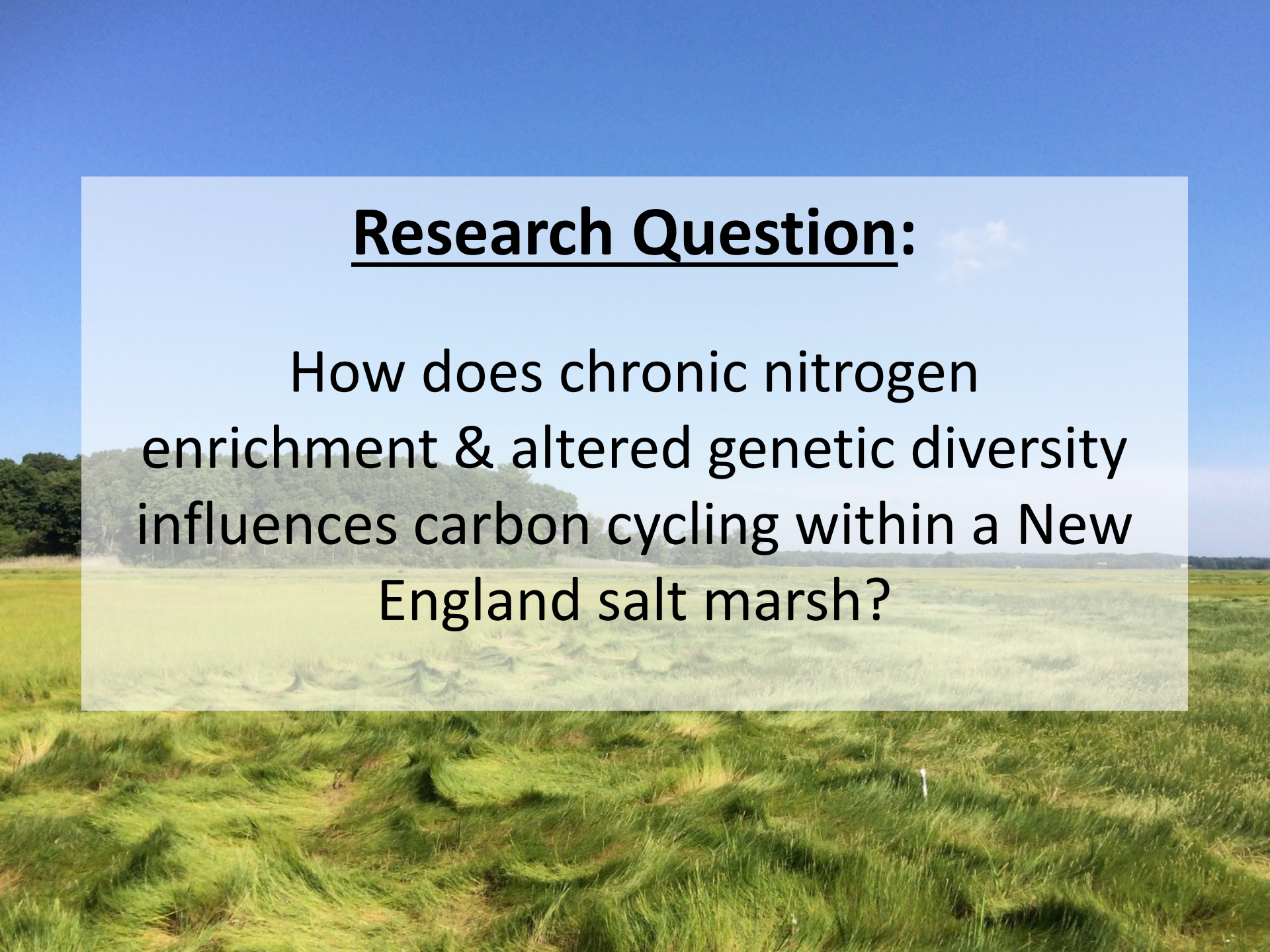
Changes in flowering phenology (& BNPP) are genetically inherited







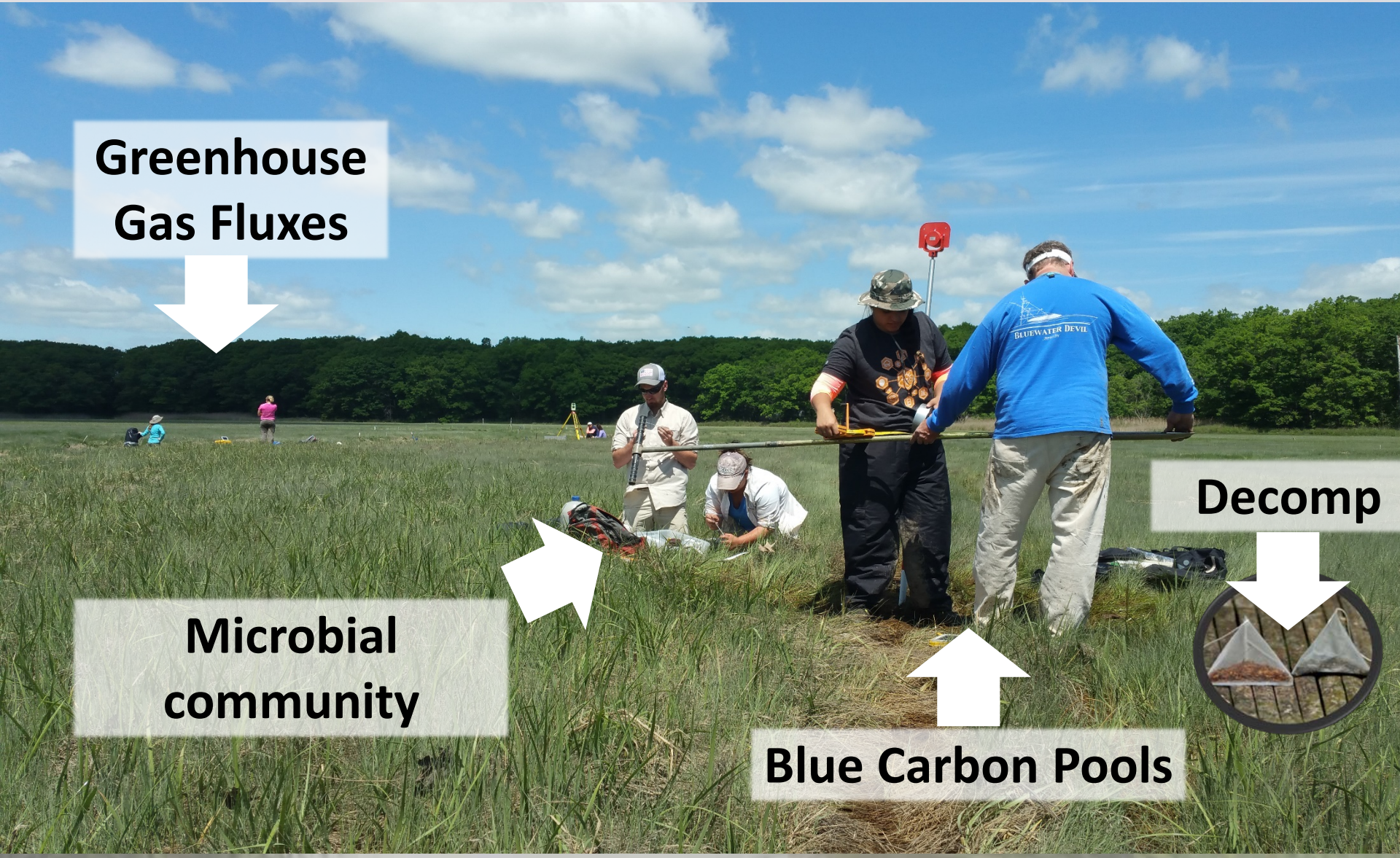
Mozdzer et al *in revision*



Research Question:

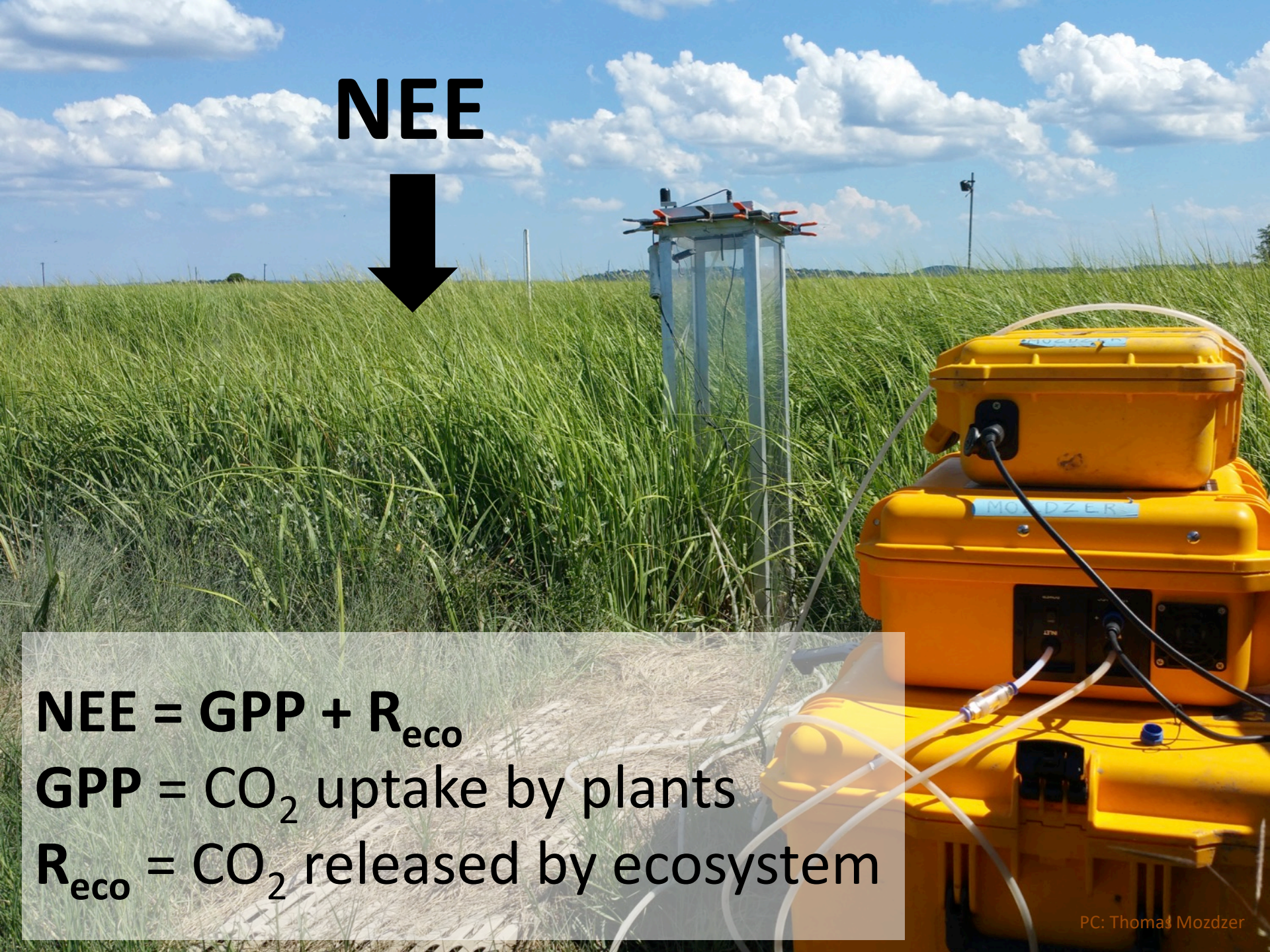
How does chronic nitrogen enrichment & altered genetic diversity influences carbon cycling within a New England salt marsh?

Multi-disciplinary approach



Monthly measurement of GHG fluxes using static chambers in 2015 & 2016

PC: Thomas Mozdzer

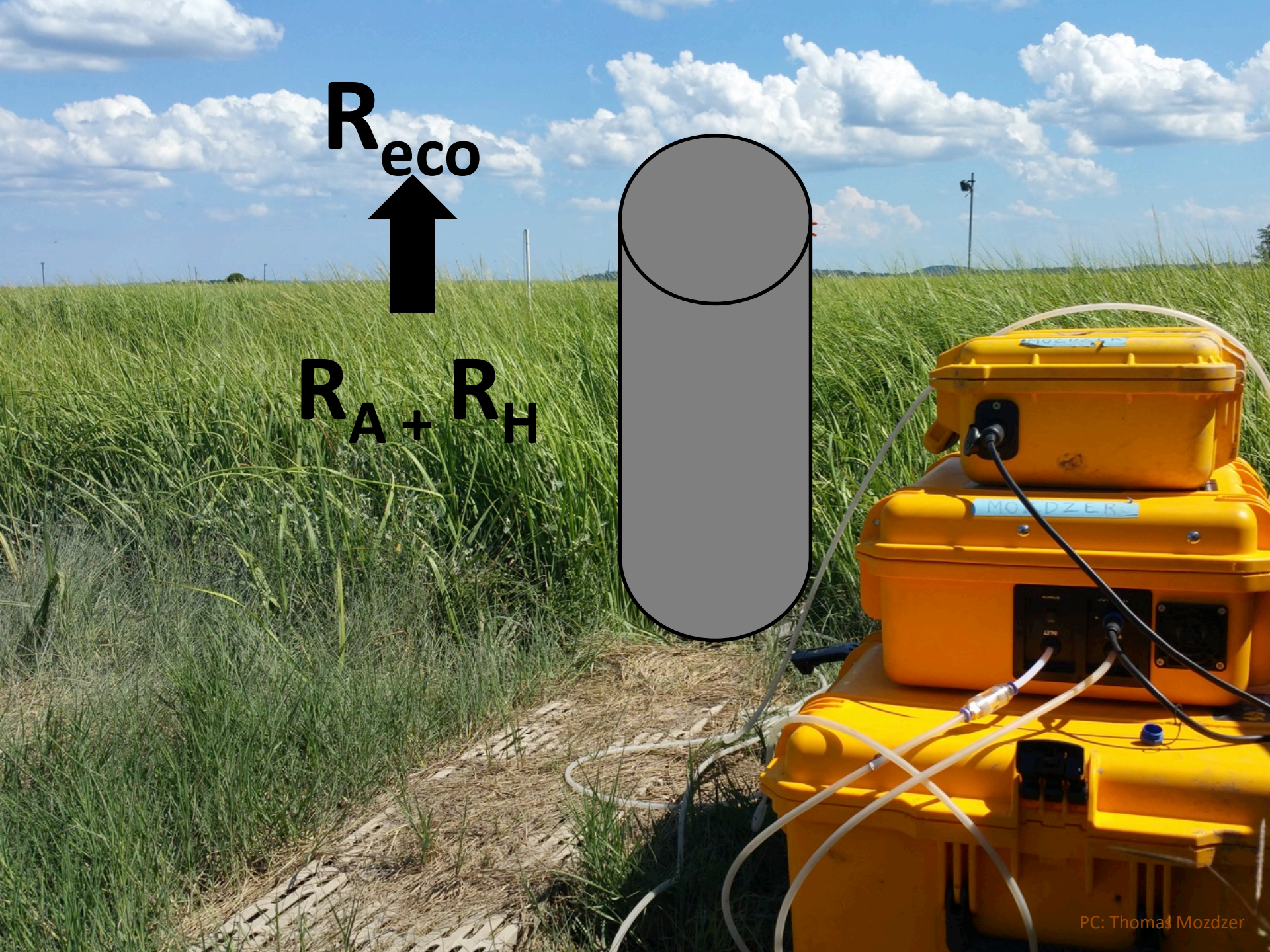


NEE = GPP + R_{eco}

GPP = CO_2 uptake by plants

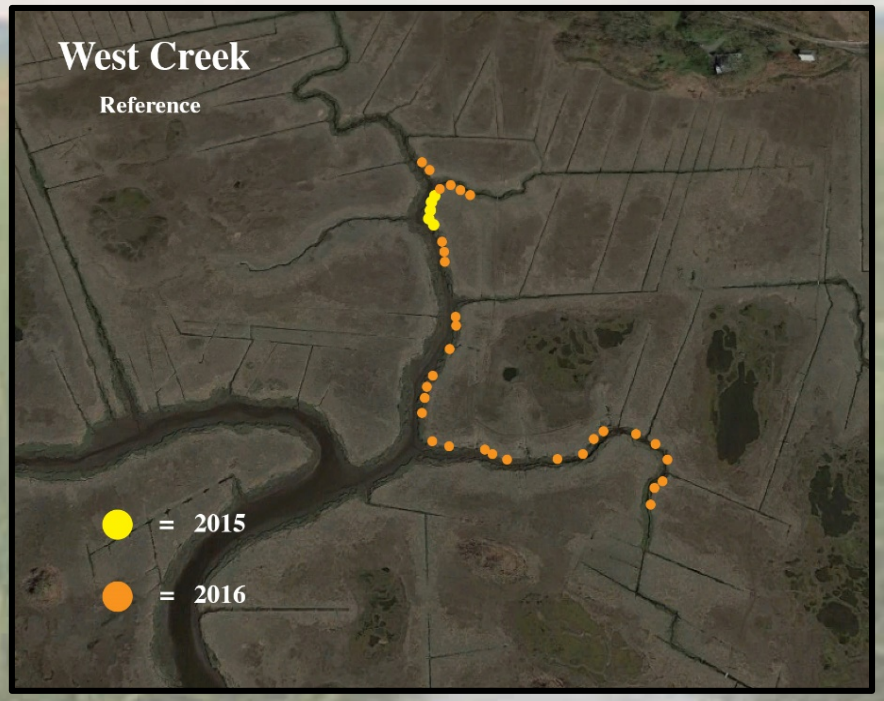
R_{eco} = CO_2 released by ecosystem

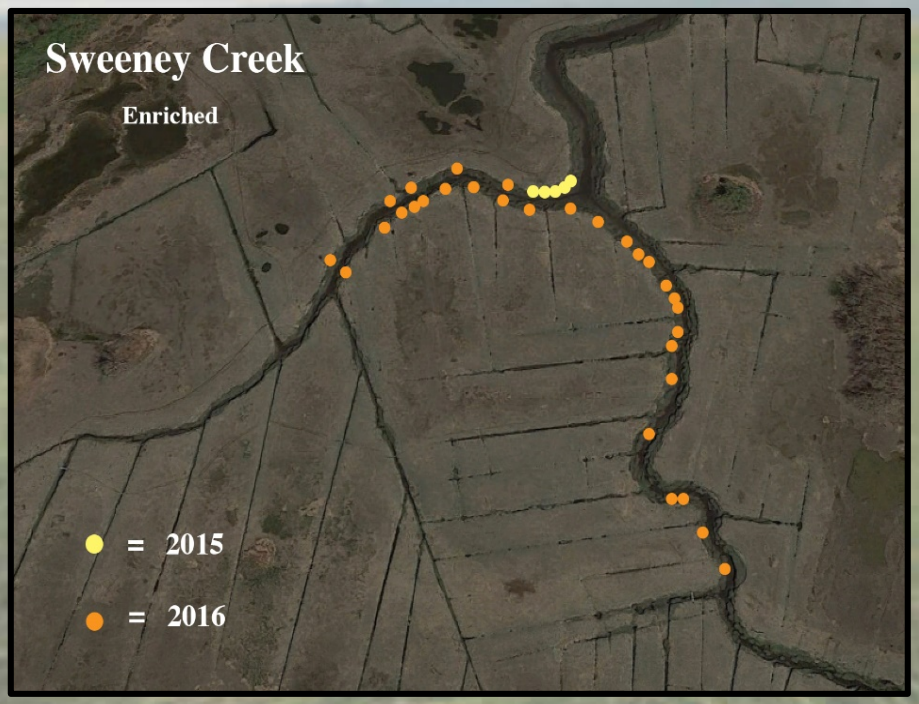
PC: Thomas Mozdzer


R_{eco}
$R_A + R_H$
PC: Thomas Mozdzer

2015 – GHG in one permanent location

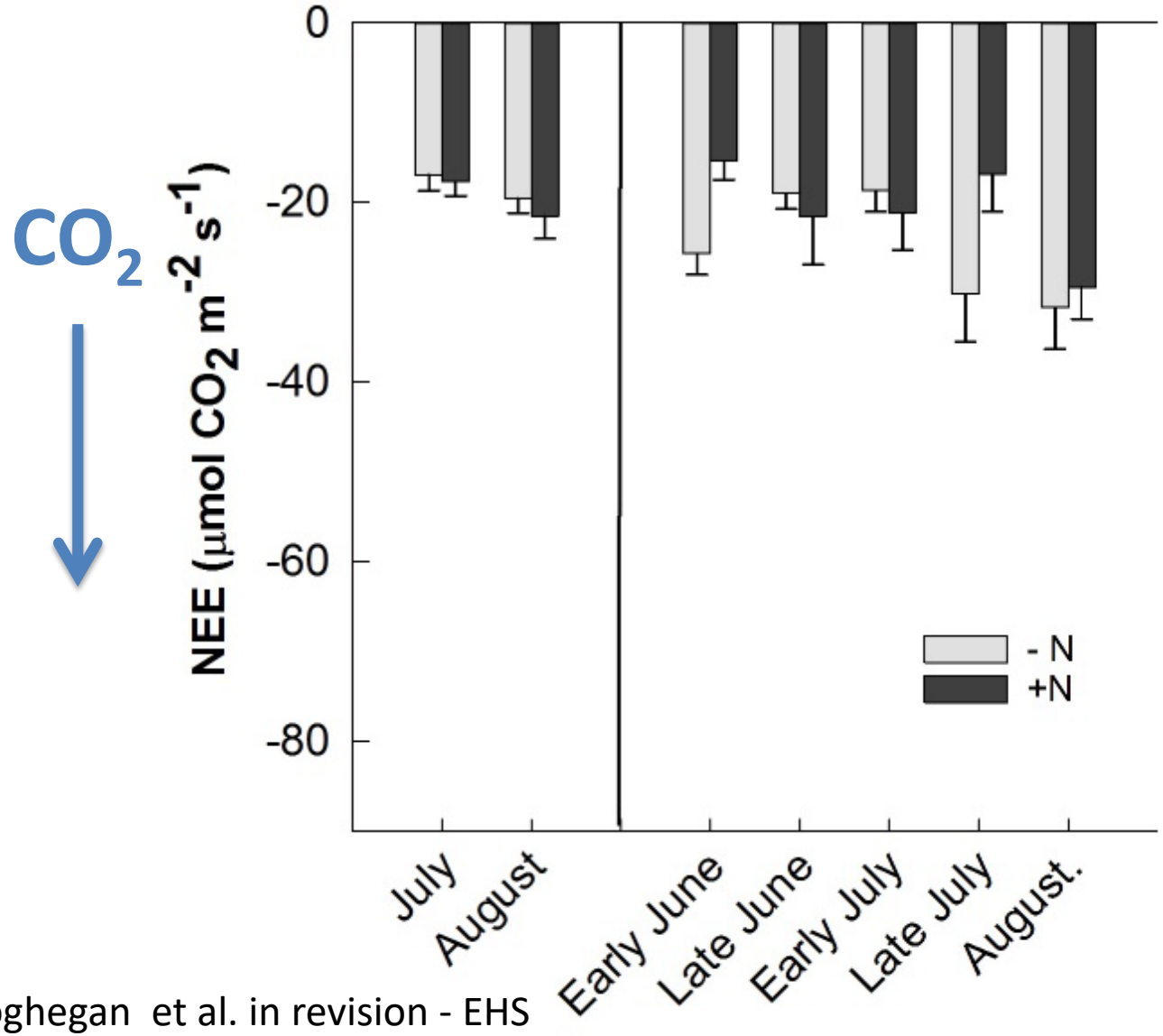
2016 – GHG fluxes in new location each time





Data analyzed by mixed effects linear models and multi-model inference that produces β, that are proportional to the effect size

Nitrogen has no effect on NEE

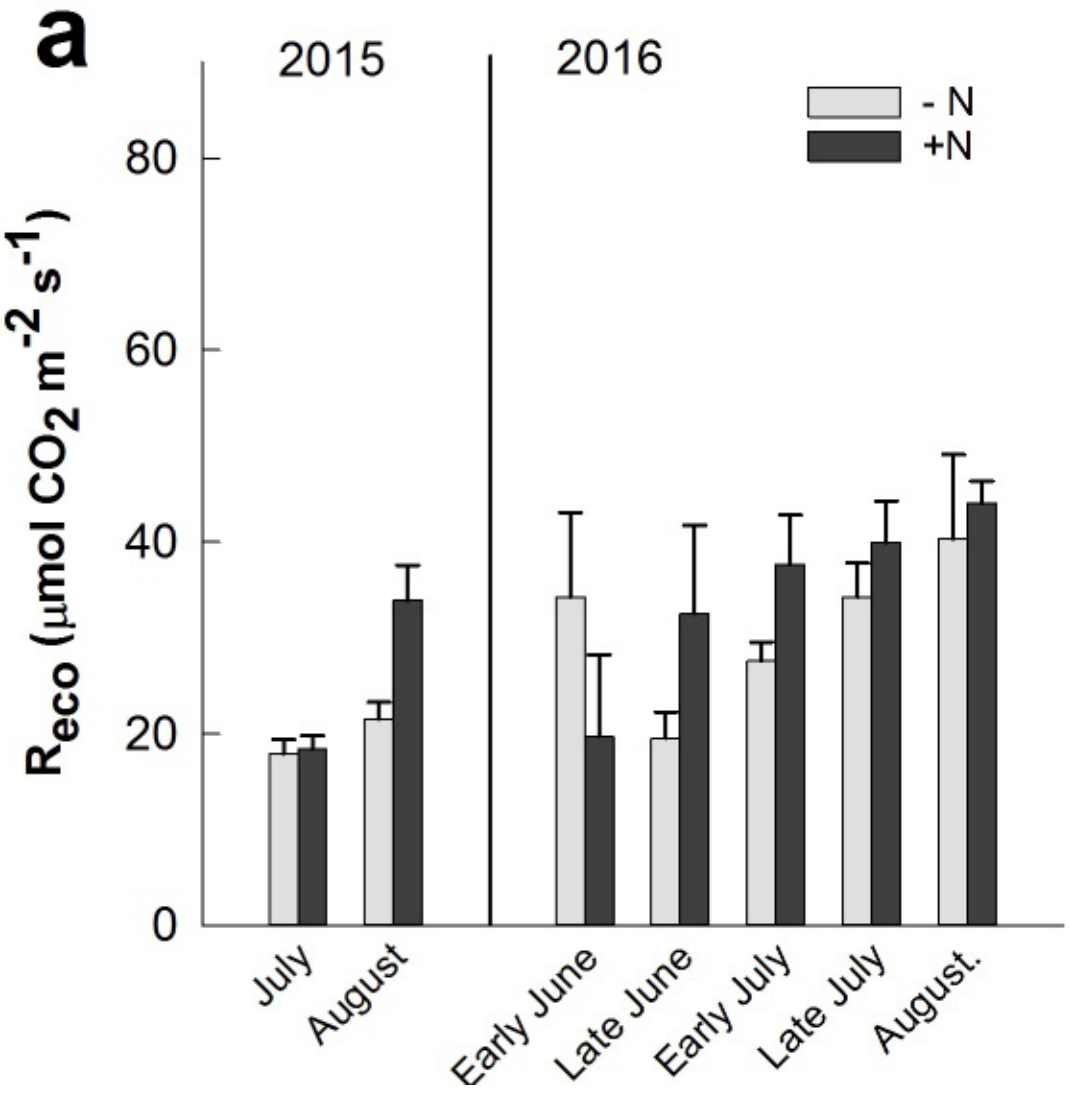


Geoghegan et al. in revision - EHS

β = 0.05

Nitrogen <u>increases</u> R_{eco}

CO_2

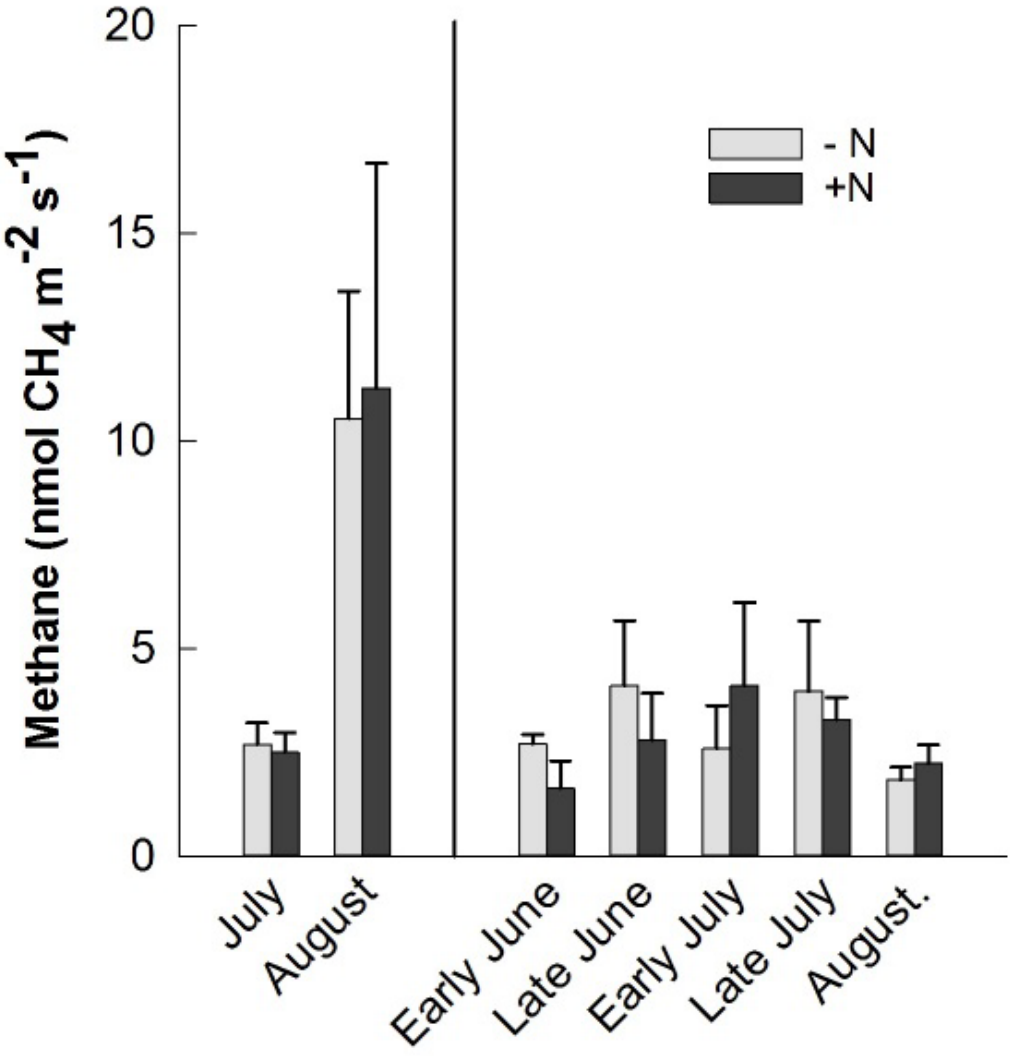


$\beta = -0.23$

Geoghegan et al. in revision - EHS

N has <u>no effect</u> on CH_4 emissions

CH_4

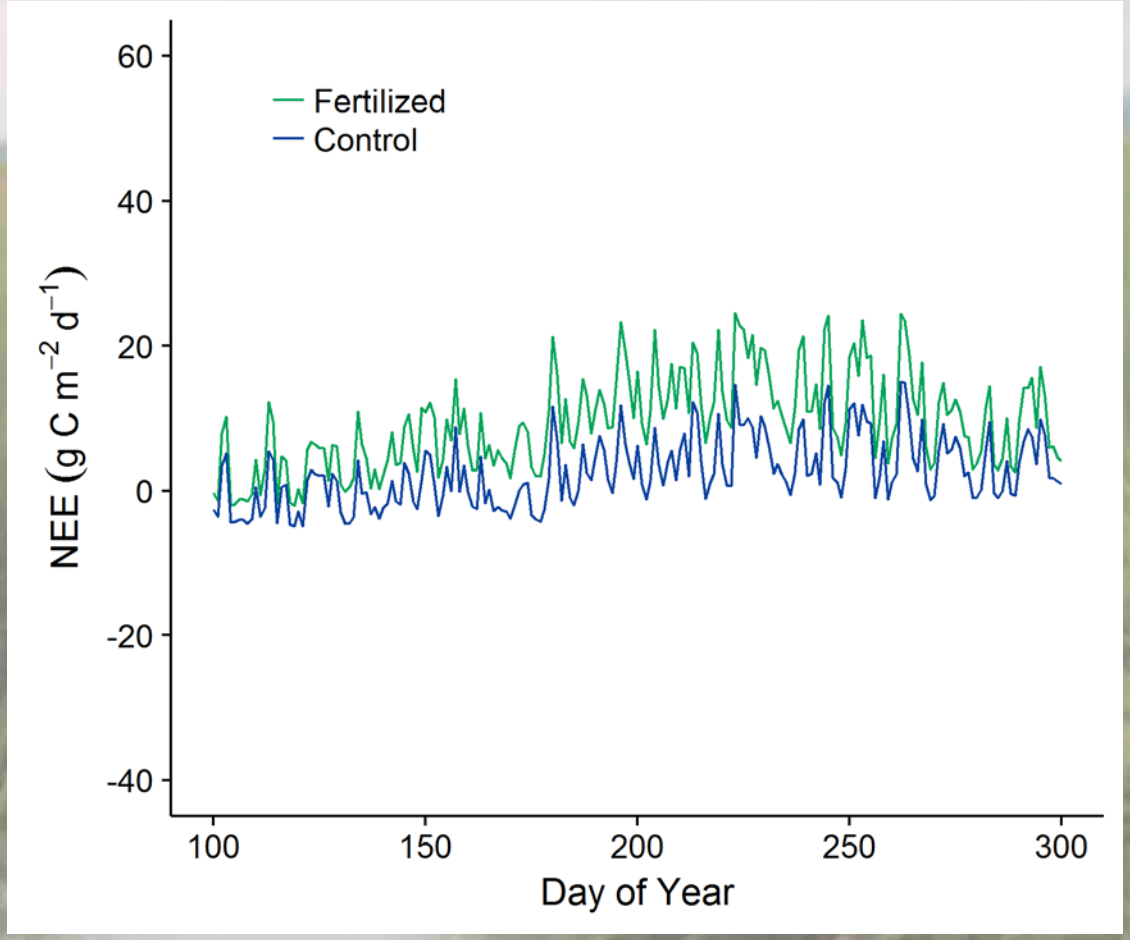


Geoghegan et al. in revision - EHS

$\beta = 0.05$

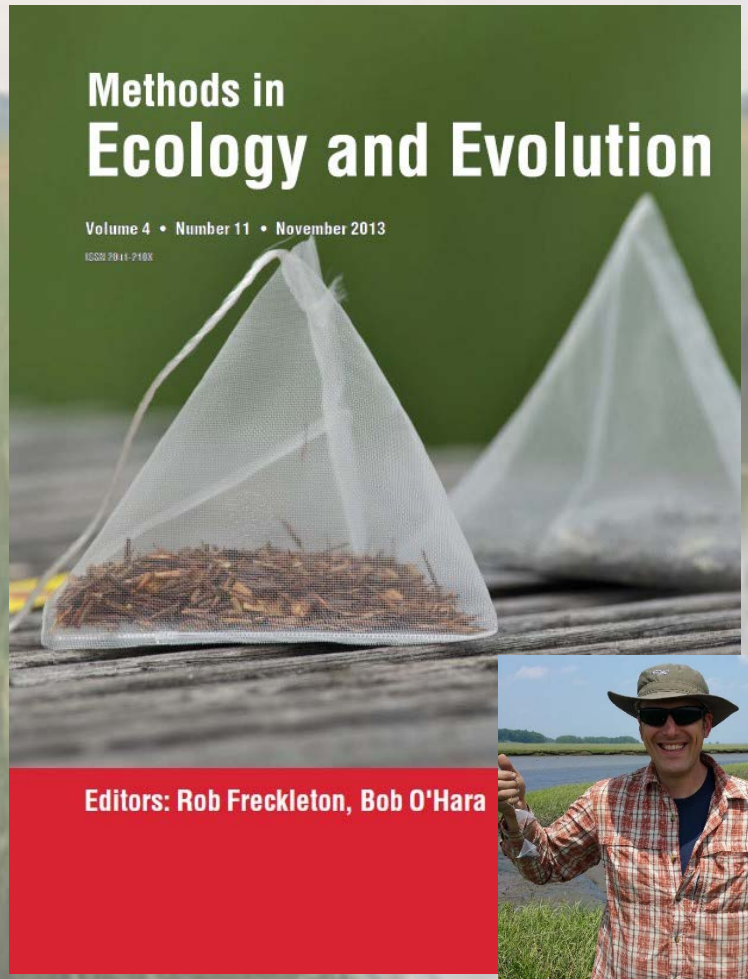
Estimated annual C storage in low marsh

VERY preliminary – N may lead to net heterotrophy



Refining annual model – need to integrate soil temp, seasonally adjust Q10s, & tides

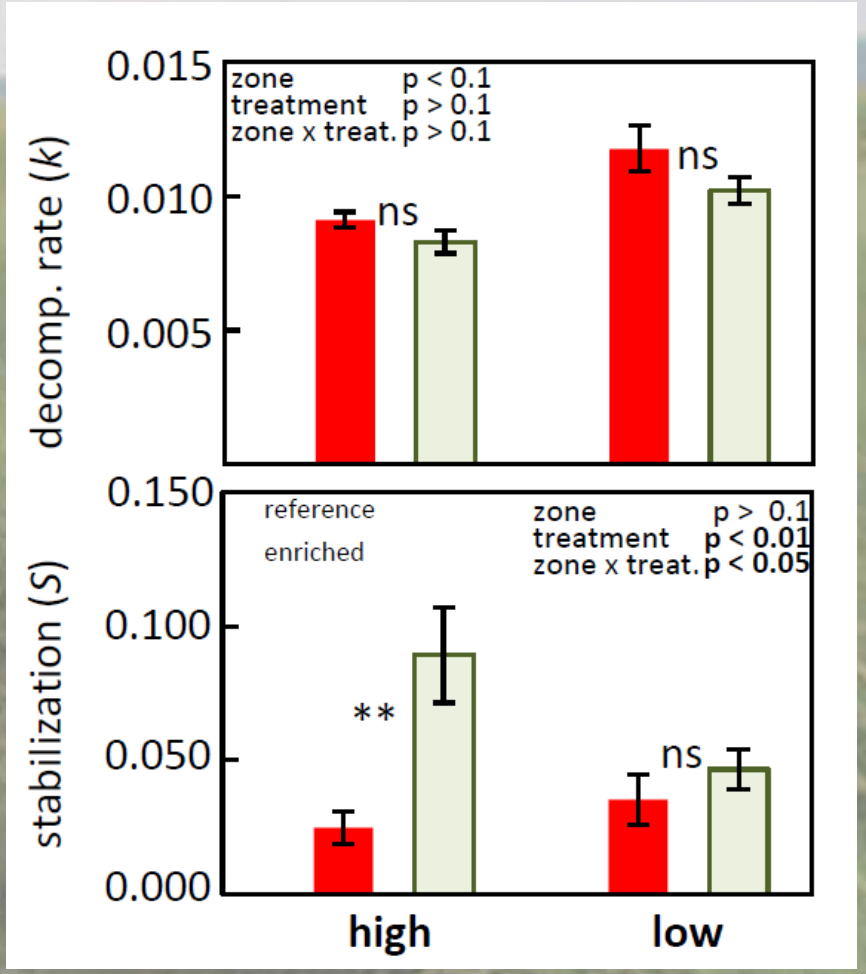
Tea Bag Index to estimate *k* and *S*



- **Gives estimates of OM decomposition rate (k) and OM stabilization rate (*S*)**
  - Deployed tea bags in High and Low marsh at both sites as part of global study (Mueller et al. 2017)
  - Deployed another array in 2016 – Part of ILTER Global **TeaComposition** (Djukic et al. 2018)
  - Deployed another array in 2017 as part of **TeaCompostionH_2O** in both the high and low marsh

N decreases SOM stabilization

- N non-significantly increased (P>0.1) decomposition rate (k)
- N significantly decreases (P<0.01) SOM stabilization



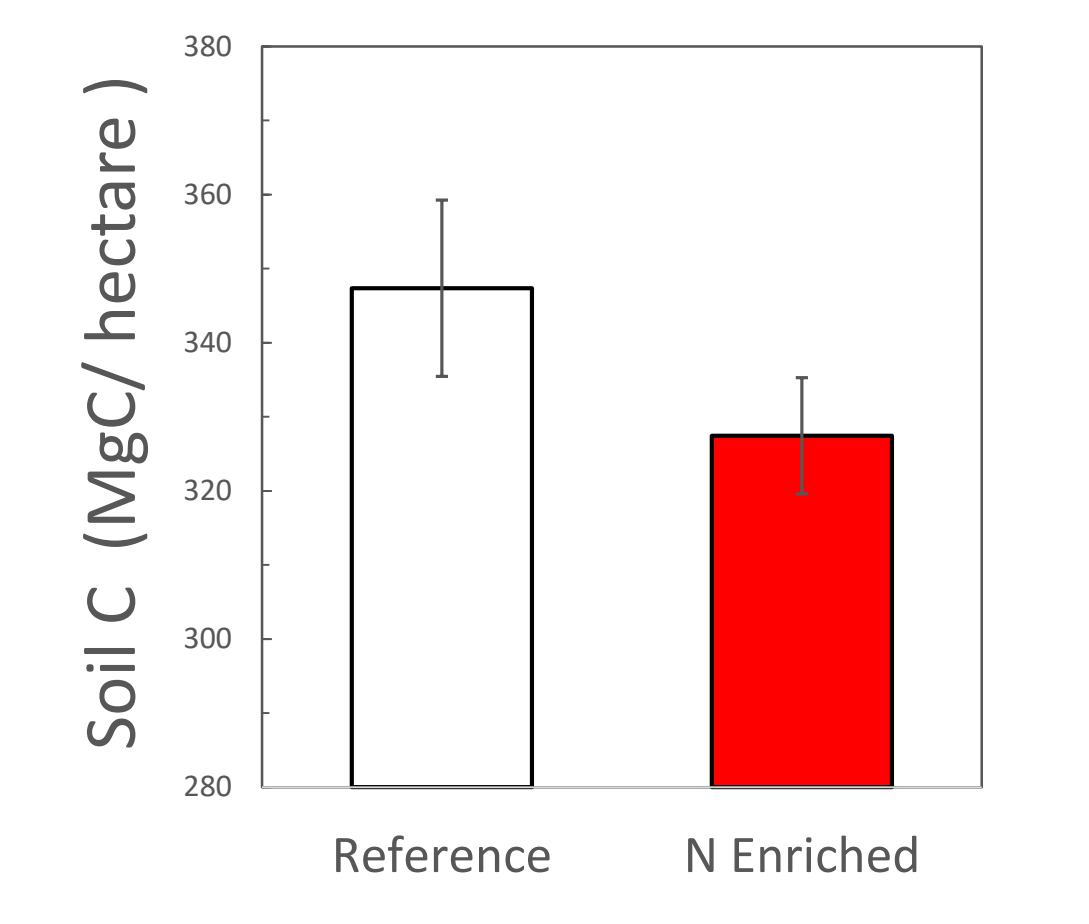
Mueller et al 2017- Biogeosciences

Blue Carbon Inventory

Sampling Approach

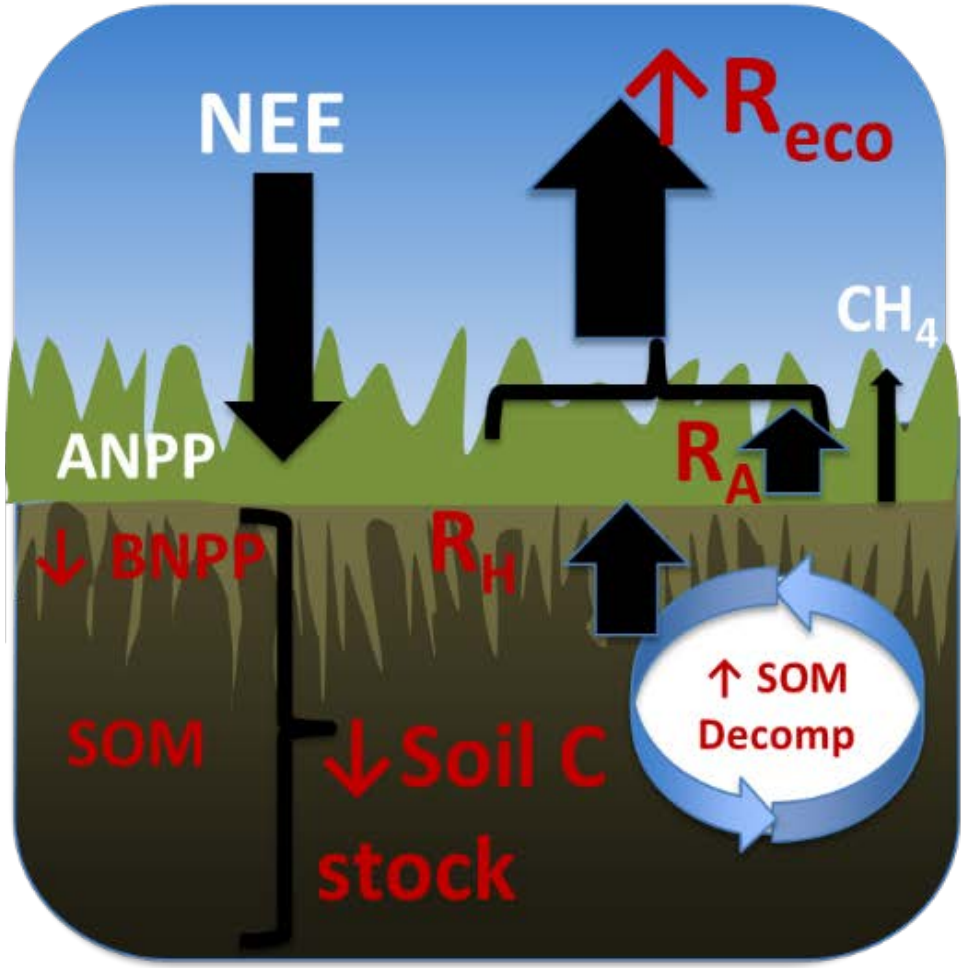
- 16 cores to 1 meter in the high marsh platform at both sites
- 2 cores to ~ 3 meter to point marine clay layer
- Measured bulk density, LOI, [C], and δC^{13}

N decreases soil C pools

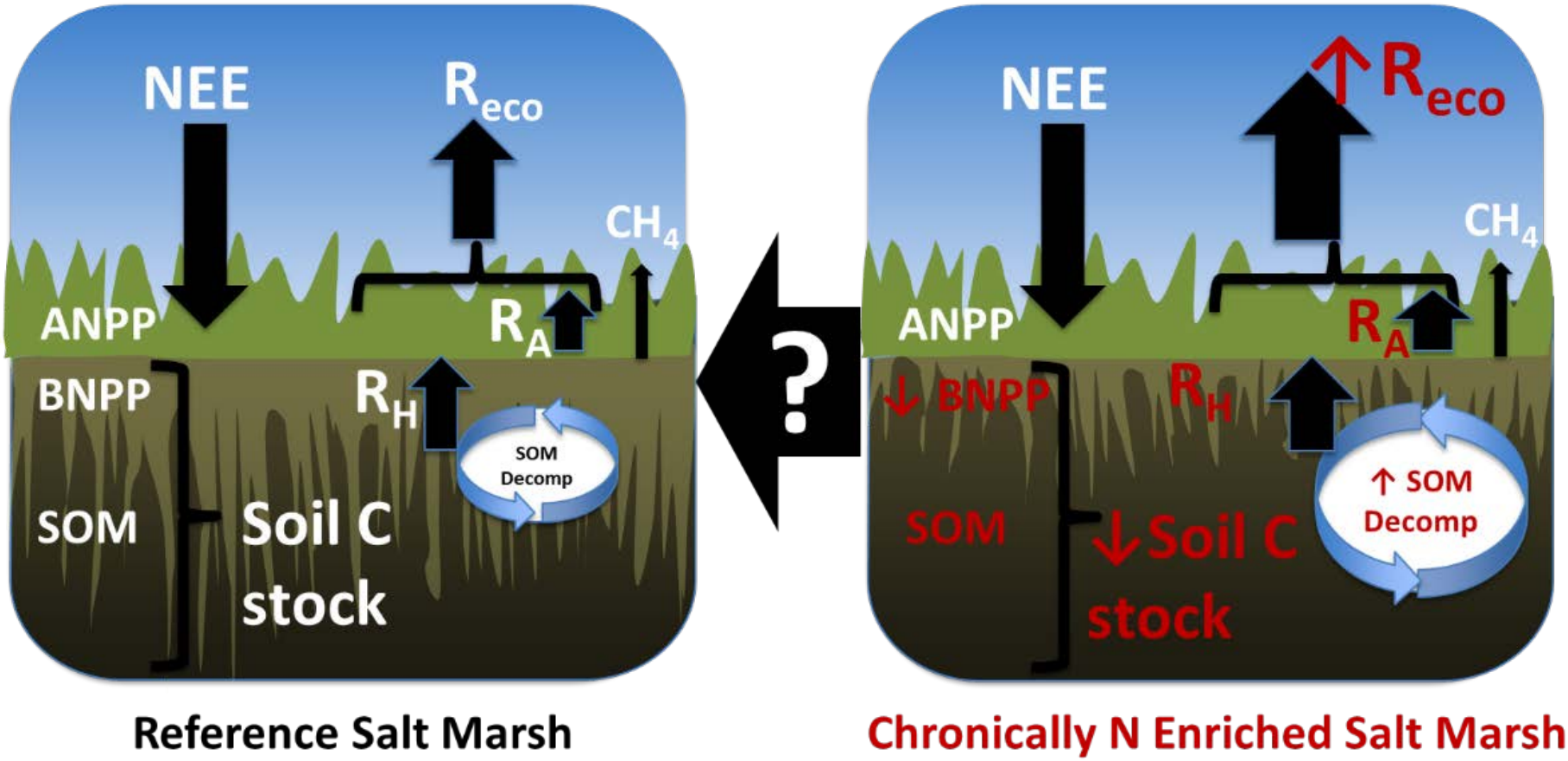


- 6% loss of soil C pools in high marsh platform in top meter
- Only 13 of 18 cores from each site processed

Conceptual model on the effects on N on blue carbon pools & processes



Chronically N Enriched Salt Marsh



Reference Salt Marsh

Chronically N Enriched Salt Marsh

- Can land management practices limiting N-enrichment restore genetic diversity and ecosystem C sequestration?
- What is the role of rapid evolutionary processes in ecosystem science?

Acknowledgements:

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Questions?

tmozdzer@brynmawr.edu

Twitter: @tjmozdzer
Facebook: @MozdzerEcologyLab