BENEFITS OF MANAGED SHEEP GRAZING ON SOLAR PHOTOVOLTAIC SITES

Elizabeth Towner

December 13, 2021

AGU FALL MEETING

SCIENCE is SOCIETY

AGU FALL MEETING

BENEFITS OF MANAGED SHEEP GRAZING ON SOLAR PHOTOVOLTAIC SITES

Elizabeth Towner

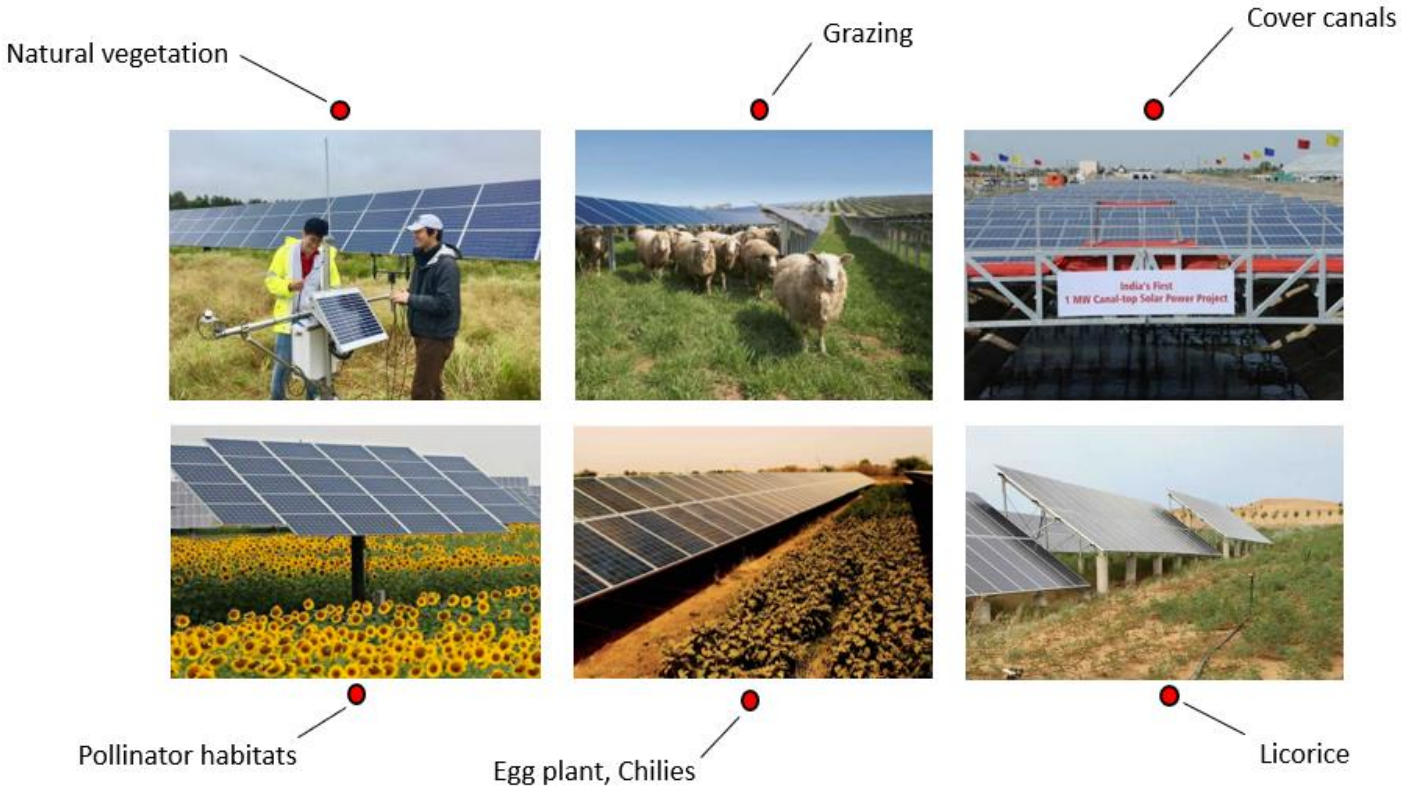
TEMPLE UNIVERSITY®

SCIENCE is SOCIETY

SOLAR ENERGY

- Solar energy is the fastest growing renewable.
- Predicted to fulfill 20-29% of global power by 2100.
- Solar energy requires a larger land footprint and long-term commitments for land use.
- Removal of vegetation leads to degradation of soil.

POSSIBLE SOLUTIONS



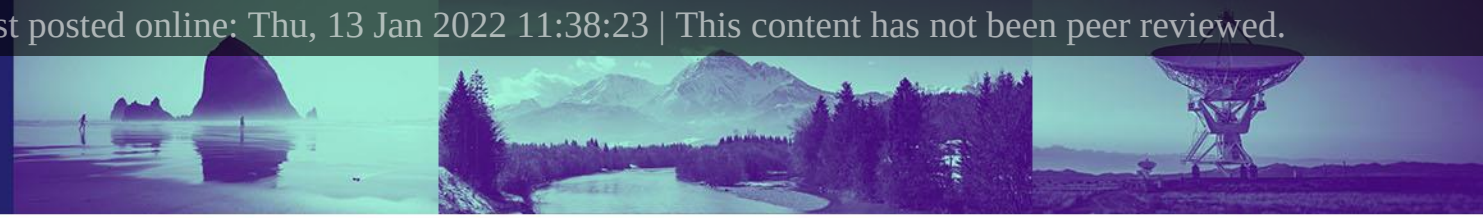
Source: ***Dupraz et al., 2011; Ravi et al; 2014; 2015, 2016***

SCIENCE is SOCIETY

SOLAR GRAZING

- Potential Benefits:
  - Dual income for farmers
  - Vegetation management

- Questions:
  - Impact of solar grazing on carbon sequestration?
  - Impact nutrient status and soil properties?



STUDY SITE

Site	2017	2018	2019	2020
Albany	x	x	x	x
Lawrence Creek	x		x	x
Lake Pulaski	x		x	
Chisago			x	x
Montrose			x	x
Annandale				x

- 6 commercial solar PV sites in Minnesota (ENEL Green Power)
- Native pollinator friendly vegetation under panels
- 500-700 sheep grazing treatment for 2-3 weeks per year.

SOIL SAMPLING

- Soil sampling once a year (15 soil cores each from top 5 cm from grazed and ungrazed sites)
- 0-30 cm deep samples
- Bulk density
- Soil compaction using soil penetrometer

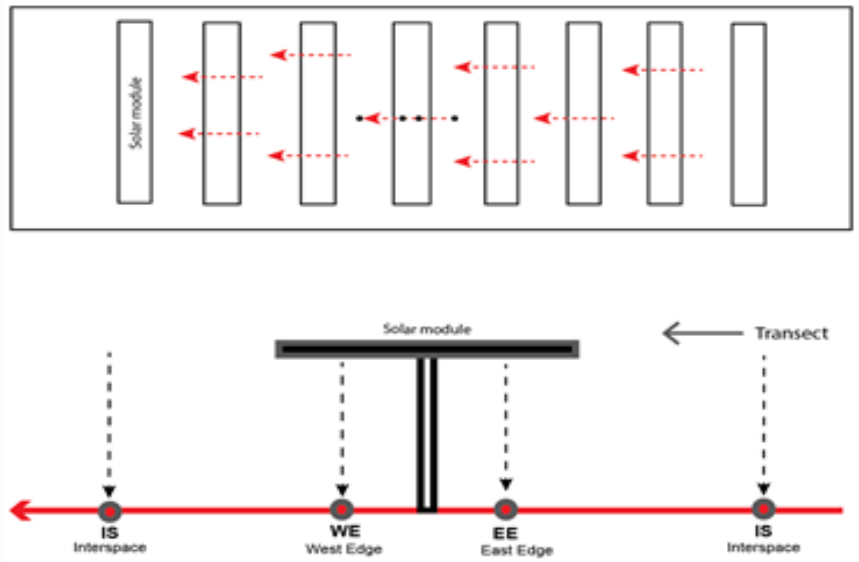


Figure 1. Soil sampling locations.

METHODS

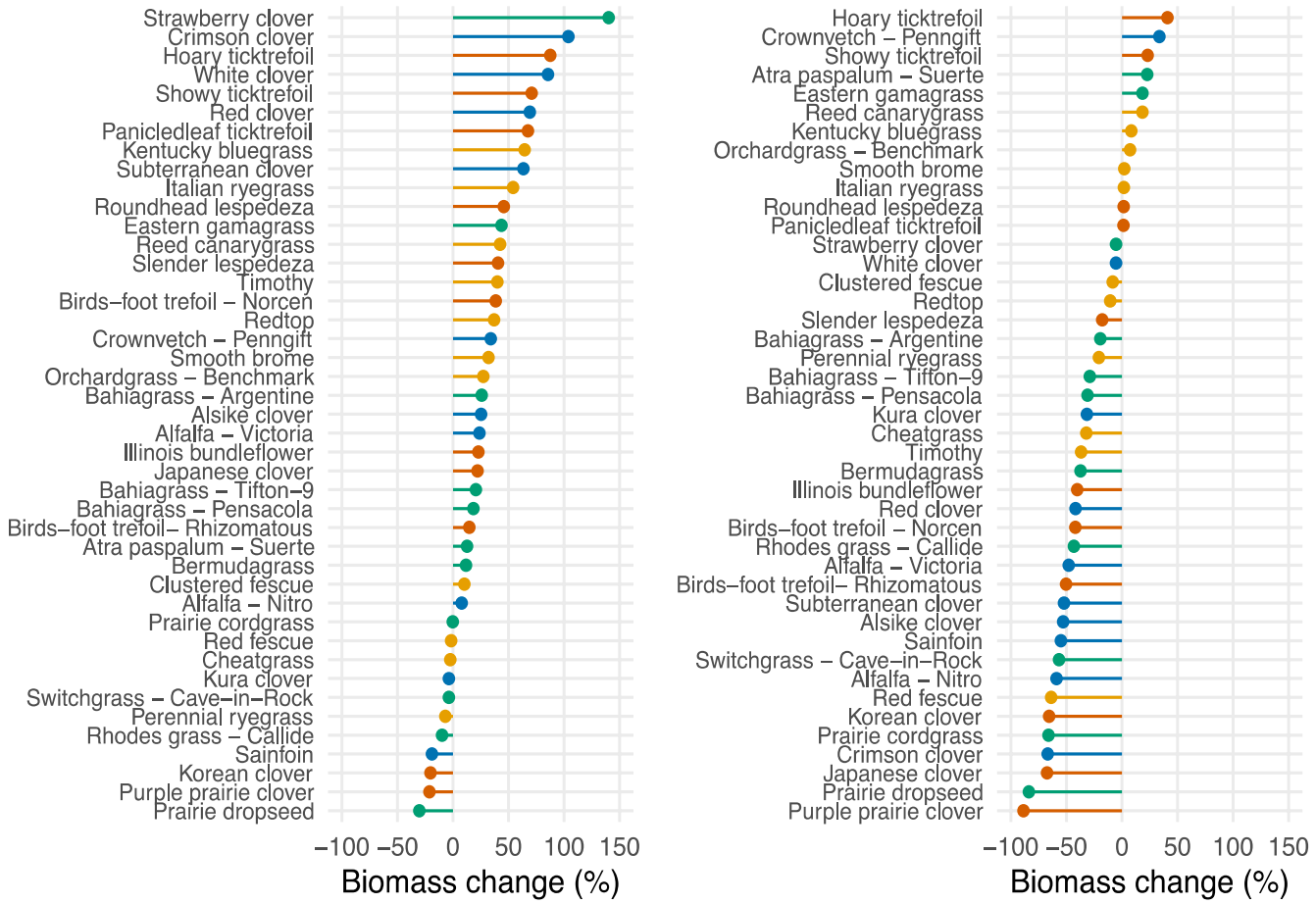
- Soil analysis:
  - Total Organic Carbon
  - Total Carbon, Total Nitrogen
  - pH, Organic Matter, Est. N. release, Bray I Phosphorus, Exchange Capacity, % base saturation of Cation, Available Nitrogen (NO_3-N + NH_4-N), and Mehlich III Extractable P, Mn, Zn, B, Cu, Fe, Al, S, Ca Mg, K, Na
- Particle size analysis

SCIENCE is SOCIETY

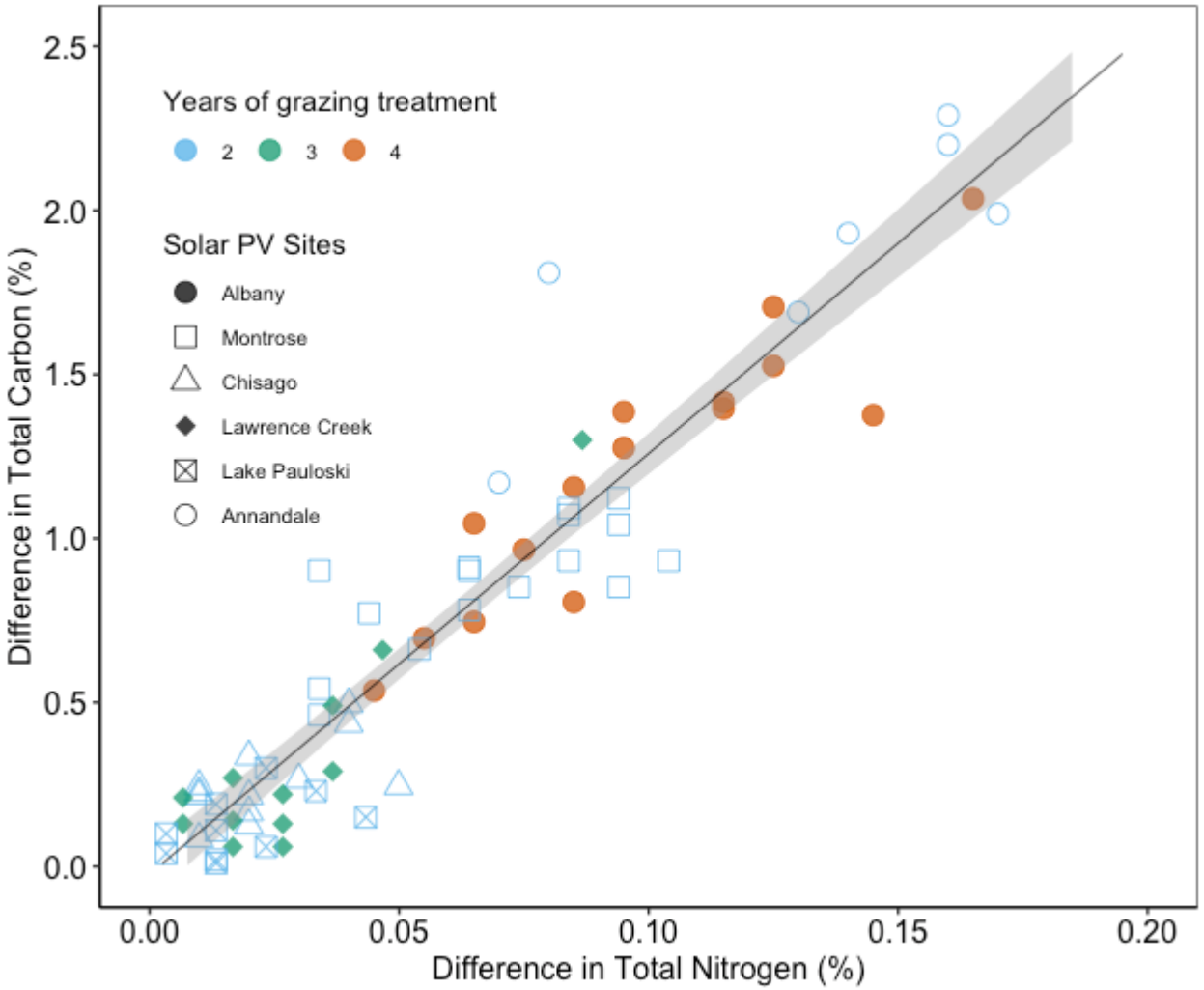
AGU FALL MEETING

RESULTS

MEANINGFUL FORAGE PRODUCTIVITY CAN BE ATTAINED UNDER SHADE (OR PANELS)



SCIENCE is SOCIETY

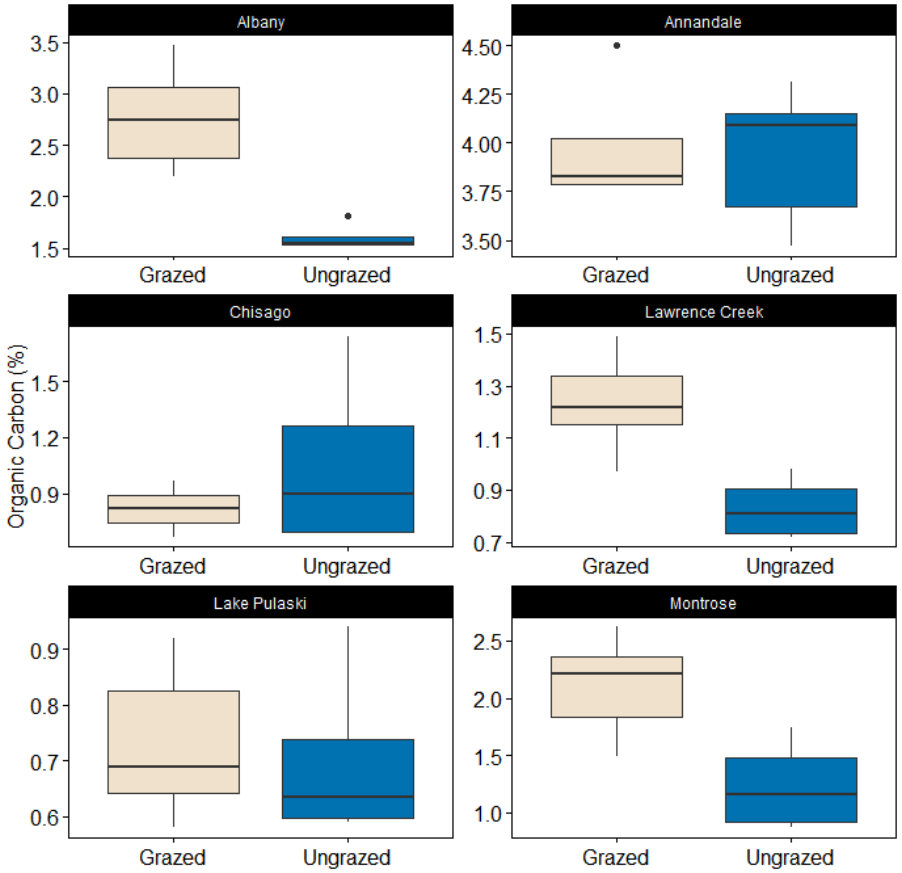


RESULTS

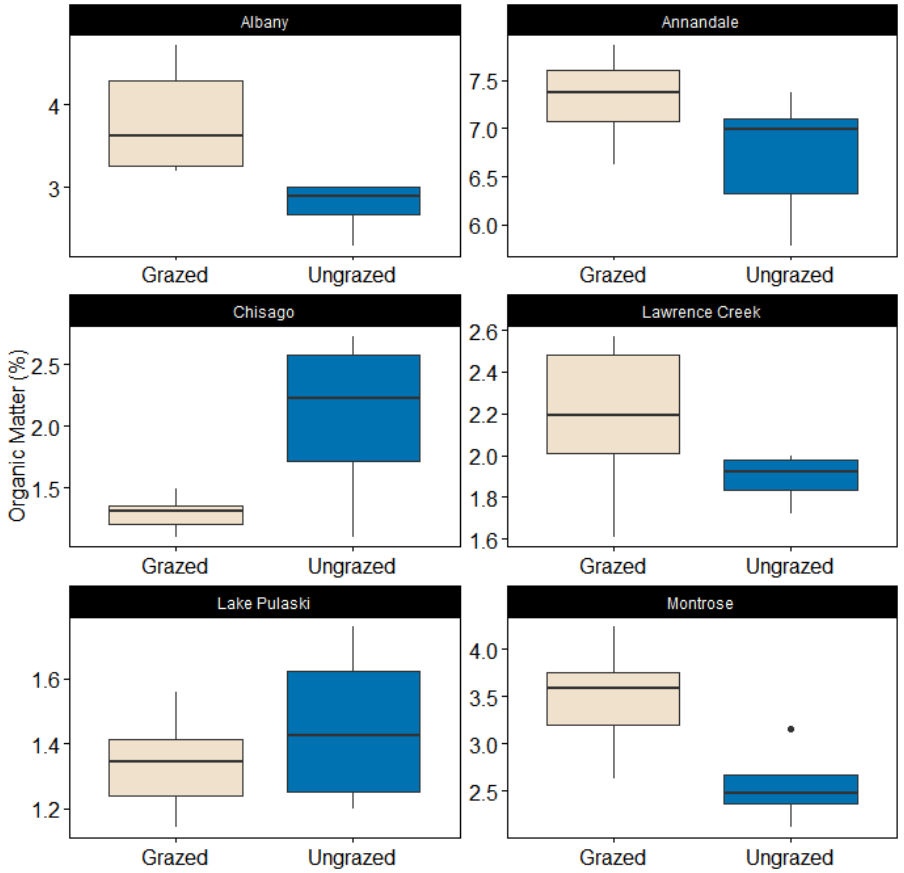
- Higher content of both carbon and nitrogen in grazed sites compared to control sites
- No correlation with grazing frequency

SCIENCE is SOCIETY

Organic Carbon (%)

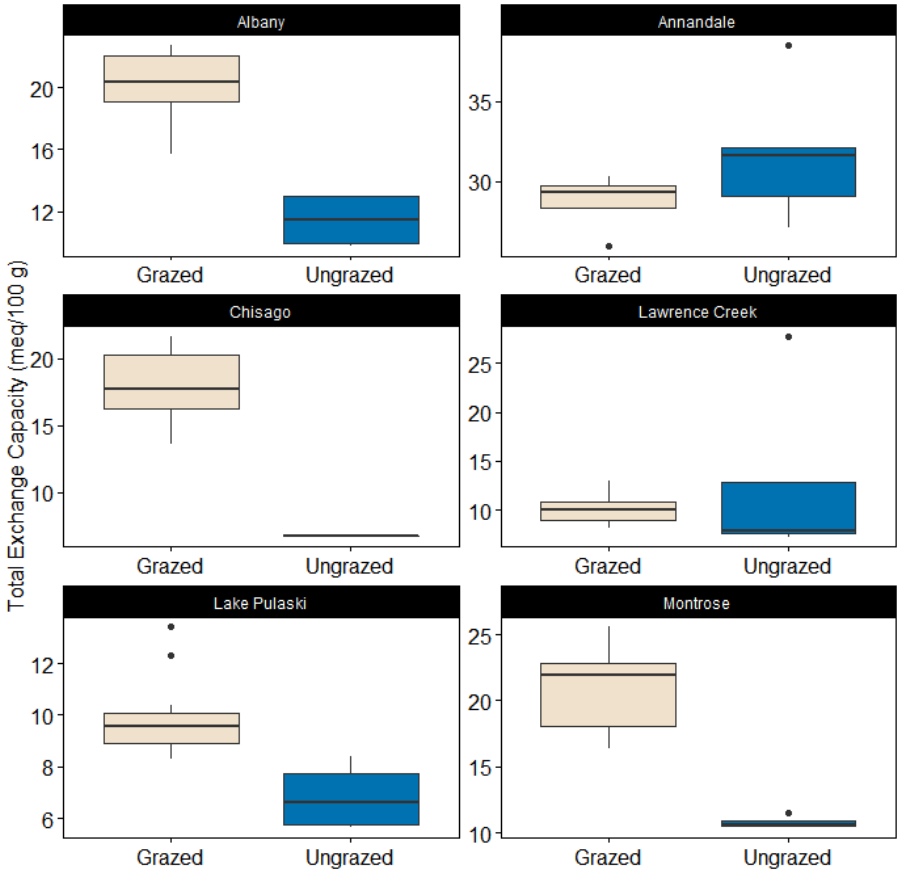


Organic Matter (%)

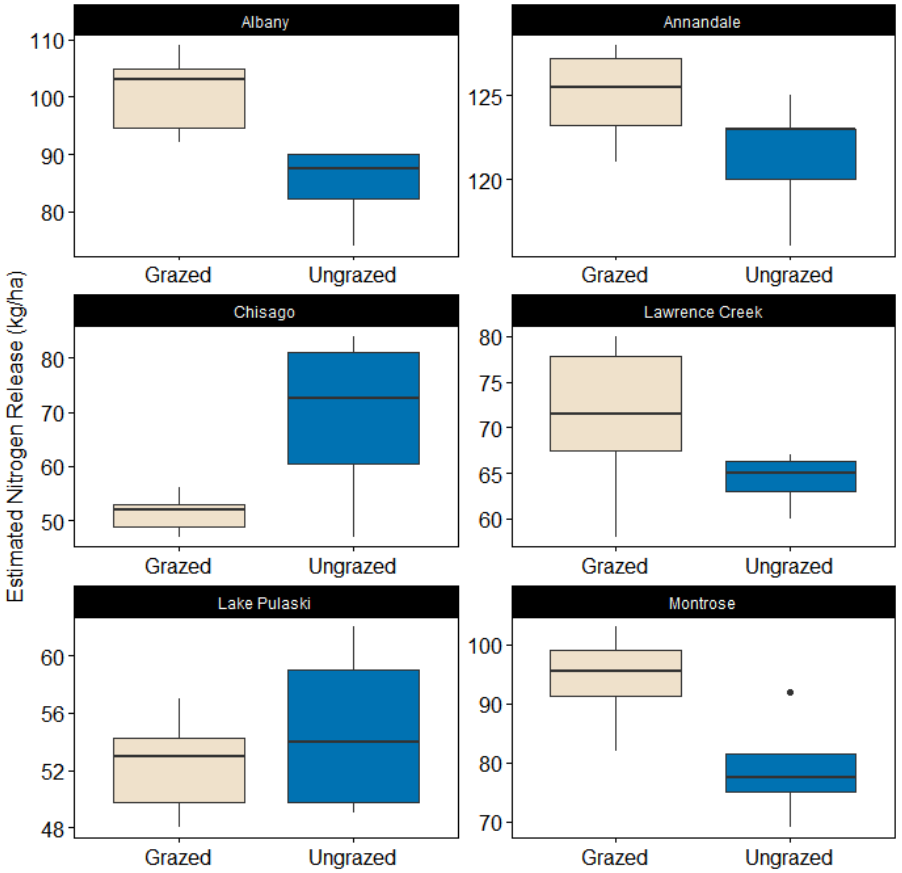


SCIENCE is SOCIETY

Total Exchange Capacity (meq/100g)

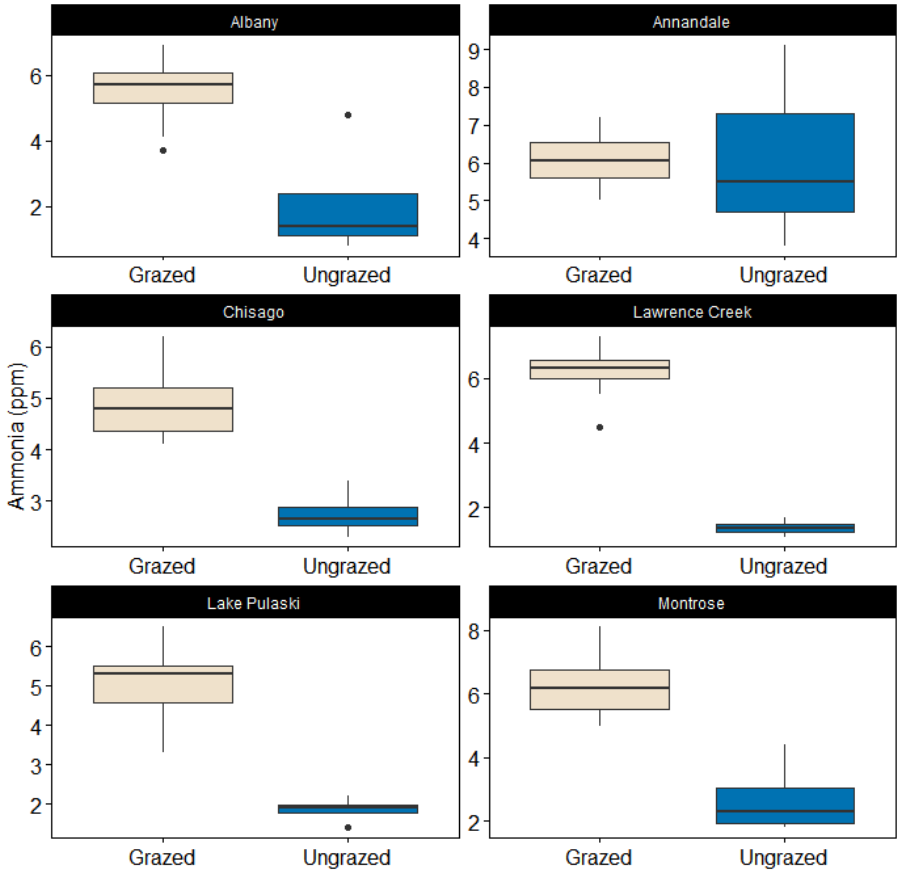


Estimated Nitrogen Release (kg/ha)

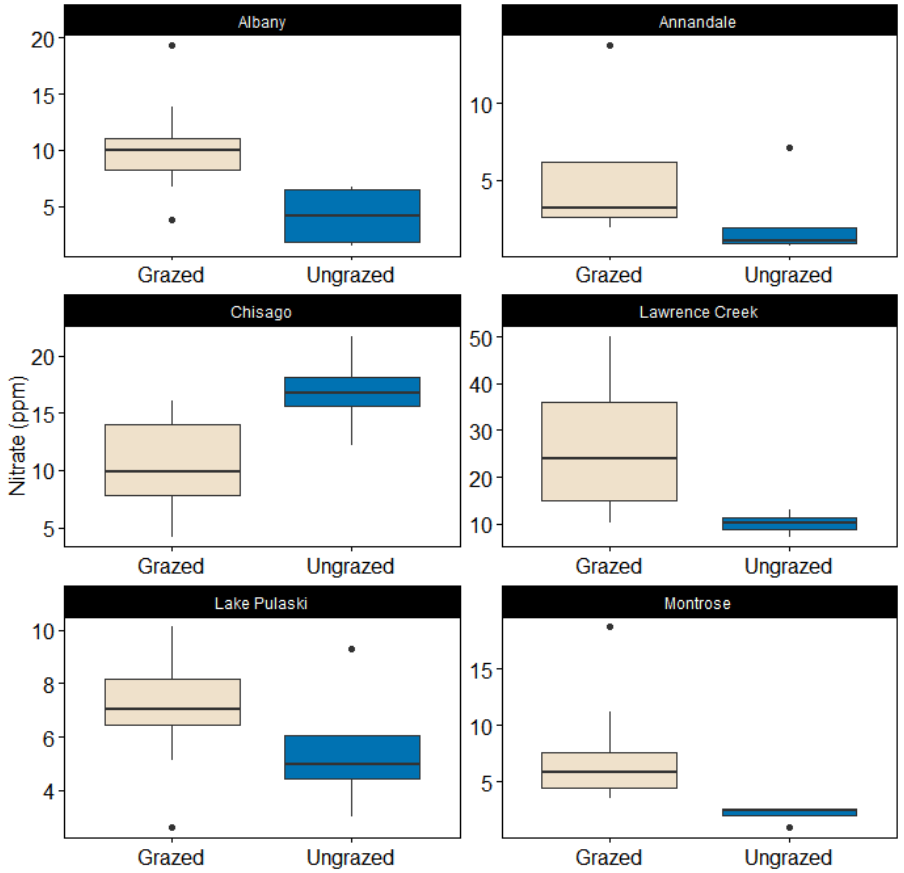


SCIENCE is SOCIETY

Ammonia (ppm)



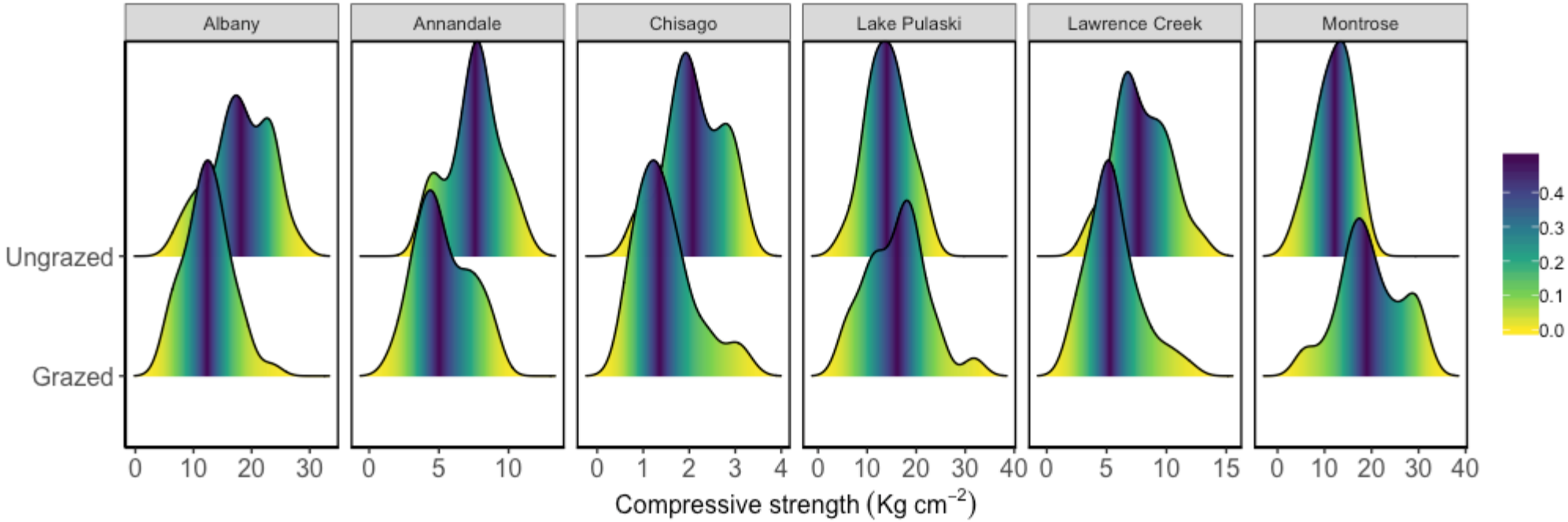
Nitrate (ppm)



Similar increase was seen in other nutrients at grazed sites, including Mg, Na, K, P, Ca, S

COMPRESSIVE STRENGTH

- Grazing has no significant impact on sandy or loamy soils based on our short time period
- Compaction in soil increases over time, especially in clay soils



SCIENCE is SOCIETY

CONCLUSION

- Managed episodic grazing can be used as a strategy for carbon sequestration and vegetation management
- Soil properties show an overall improvement and benefits depend on soil properties
- Future work: long term measurements on soil carbon and hydrological properties

SCIENCE is SOCIETY

THANK YOU

Thanks to Sujith Ravi, Paul Choi, the Francis A. Velay Fellowship program, Minnesota Native Landscapes, and ENEL Green Power