Generality in ecosystem responses to global change: The power of intercontinental comparisons and network approaches

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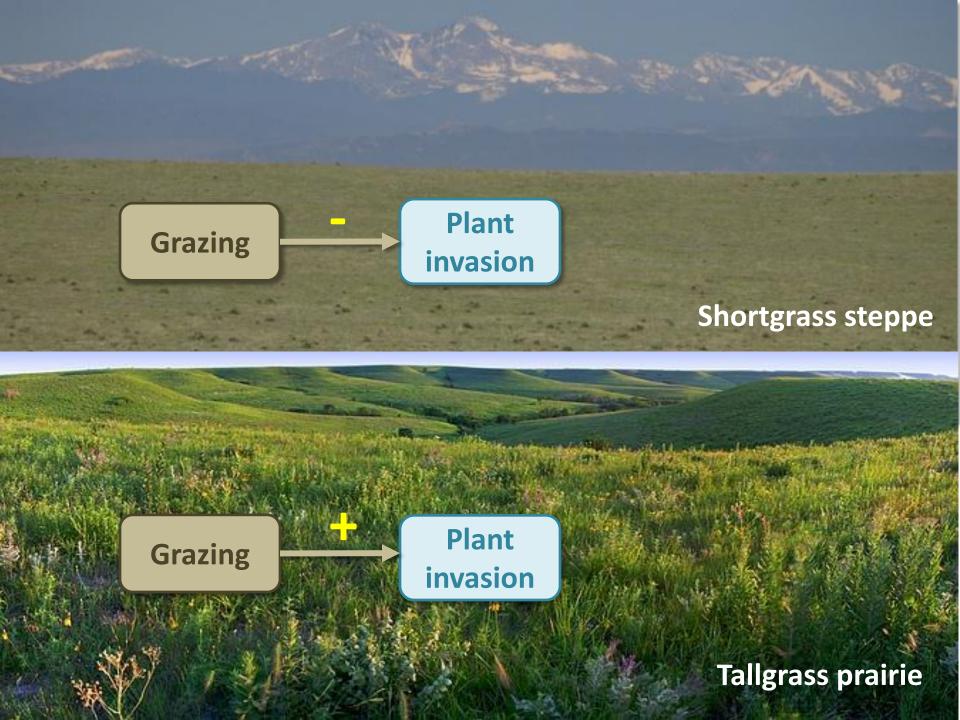
LTER Science Council Meeting, Las Cruces, NM 16 May 2013

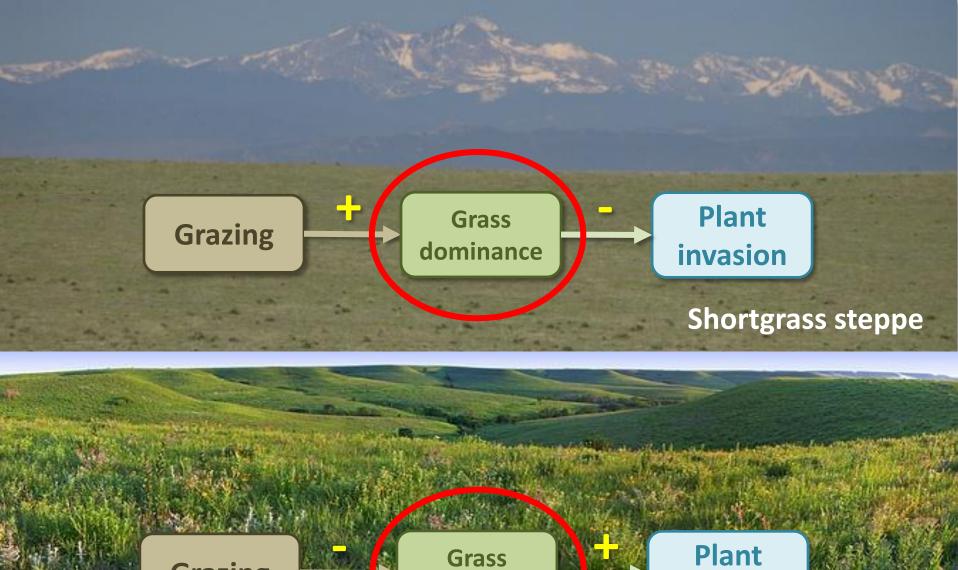
Ecosystem impacts of global change

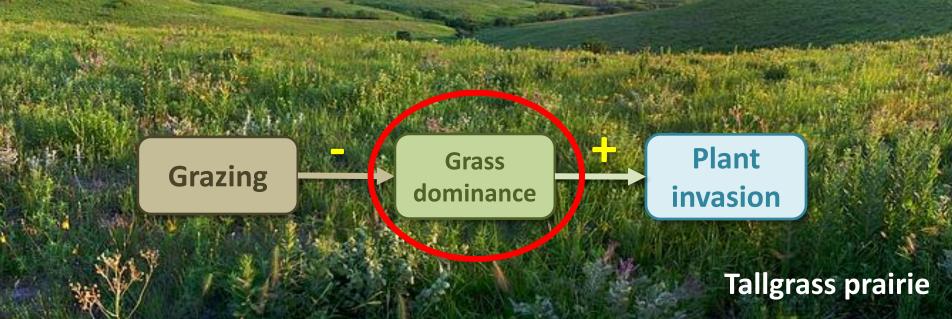


- How do ecosystems/ biomes differ in their responses to global change?
- Do the mechanisms governing responses differ between ecosystem/ biome types?

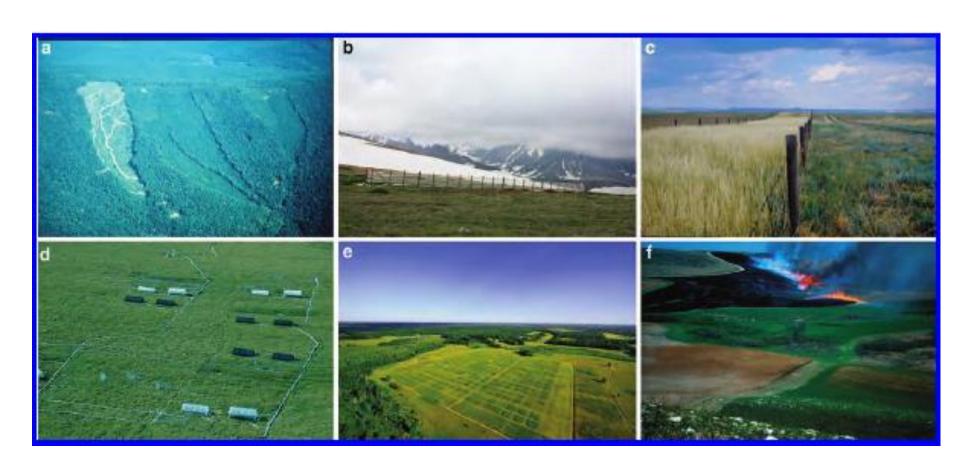
Answering both of these questions is critical for predicting future responses.







Addressing the how and the why of global change



How do we gain generality in mechanistic understanding?

- Meta-analysis of experiments
 - Can identify similarities or differences in responses, but...
 - Mechanisms often difficult to elucidate

- Comparative experimental approaches
 - 1. Within ecosystem/biome type
 - 2. Among ecosystem/biome types

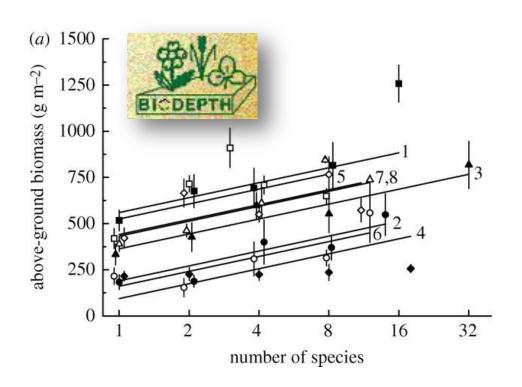
Comparative experimental approaches

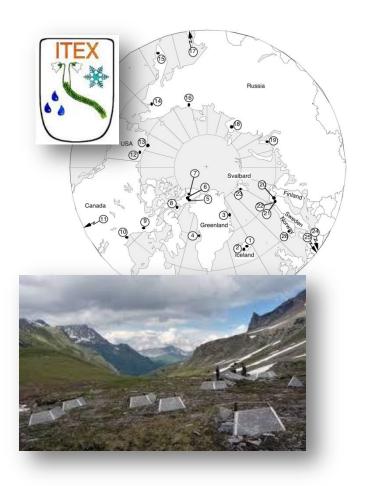
- Within ecosystem/biome comparisons
 - Different responses may be observed, but likely similar mechanisms underlying response

- Between ecosystem/biome comparisons
 - Different or similar responses may be observed, but...
 - Mechanisms governing responses may differ or they may vary in their relative importance over time

Comparative experimental approaches

Not new...

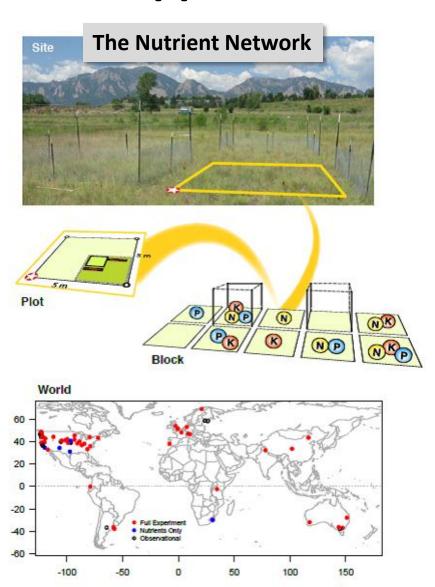




Comparative experimental approaches

Not new...

But most ecological experiments are site-based.



Borer et al. in review

Outline

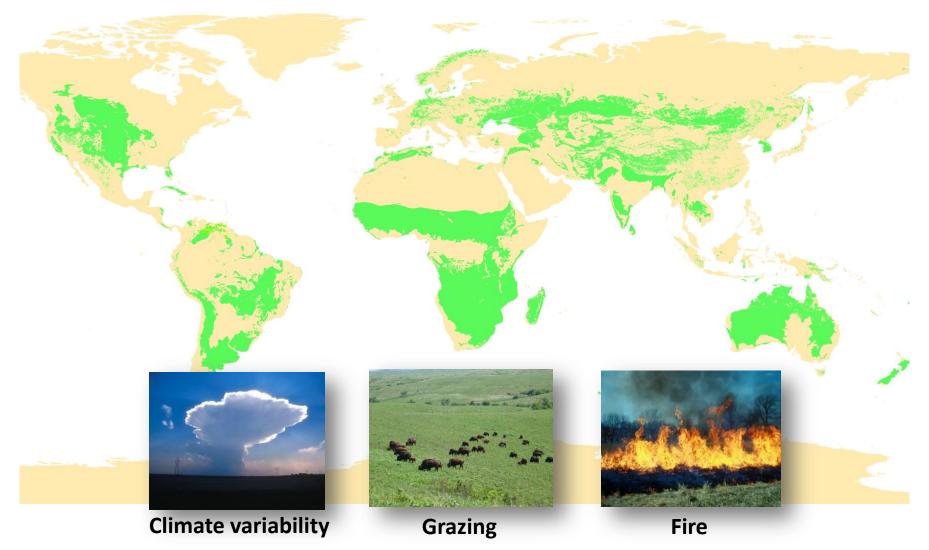
Examples of the power of comparative experiments:

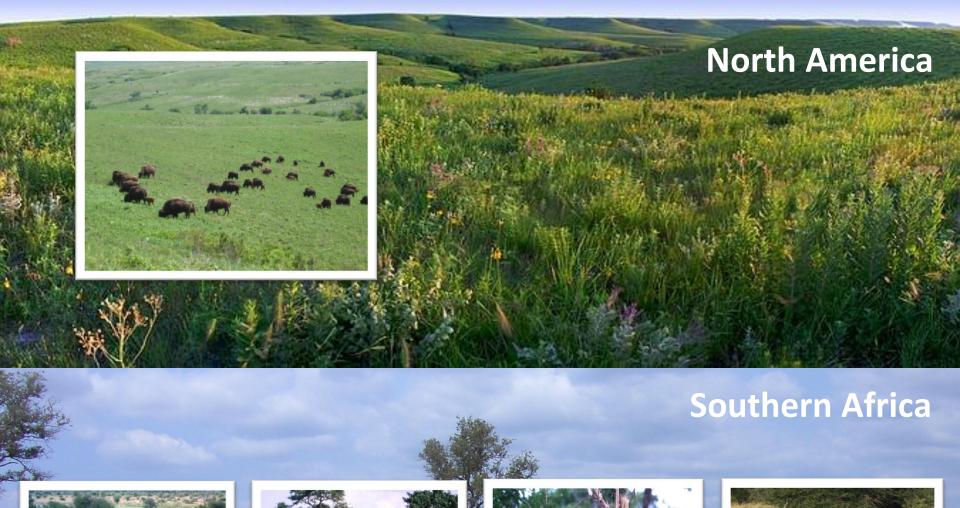
- 1. Within-biome comparison
 - Inter-continental comparative experiment

- 2. Among ecosystem/biome comparison
 - International, highly coordinated experimental network



Determinants of grassland distribution, structure and function





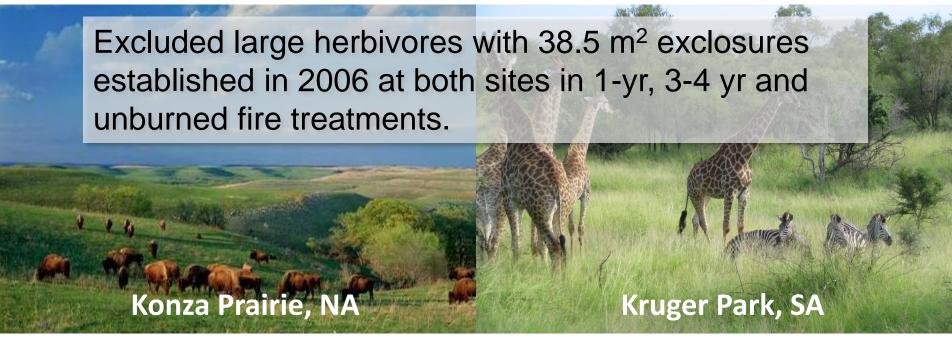




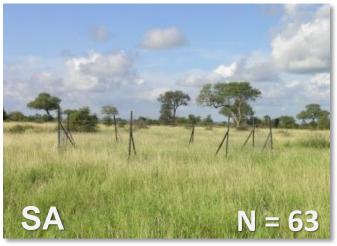




Will loss of large herbivores affect plant communities in NA and SA similarly?





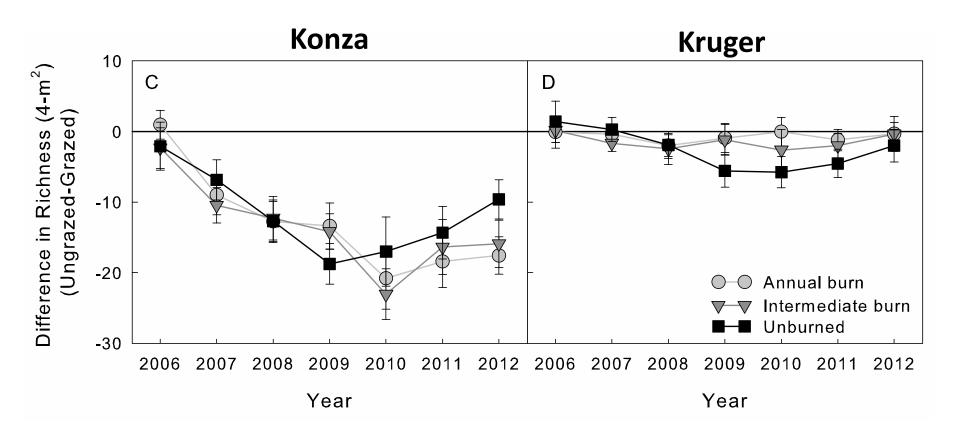


Predictions

- Loss of large herbivores in SA would have greater and more rapid effects on herbaceous plant community composition than in NA.
- 2. Herbaceous plant species diversity and richness would increase with removal of large herbivores in SA but not in NA.
- Differences in diversity in large herbivore assemblages were expected to govern responses to large herbivore loss.

We were wrong...

1) loss of large herbivores had a greater and more rapid effect on plant community composition in NA <u>not</u> SA.

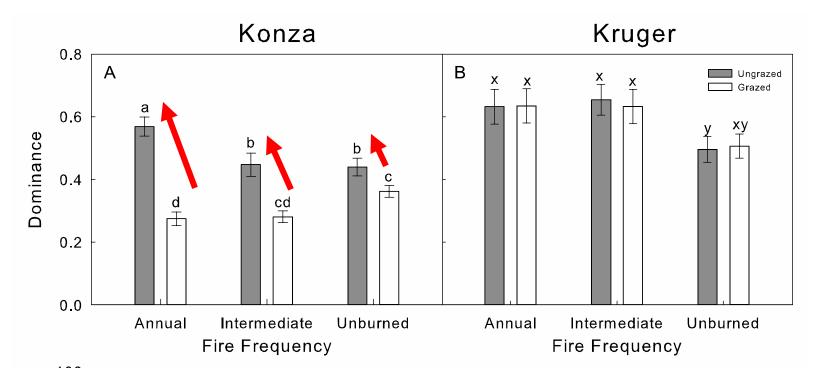


2) plant richness declined with loss of large herbivores in both NA <u>and</u> SA.

Koerner *et al*. in review

Why the greater and more rapid response in NA vs. SA?

 At both sites, richness is negatively correlated with dominance (Konza: r = -0.75, Kruger: r = -0.64, p < 0.001).



Why did dominance change in NA but not SA?

- Differences in traits of dominant grasses is key for understanding differences in responses:
 - NA palatable, rhizomatous grass
 - SA unpalatable, caespitose grass





Is there generality in mechanism governing response to loss of large herbivores?

- Dominance drives patterns of plant diversity.
 - Increased abundance of C₄ grasses leads to lower richness.

 The divergent responses observed were not due to difference in herbivore diversity, but rather the traits of the dominant grasses.

The power of comparative experimental approaches

- 1. Within-biome comparison
 - Inter-continental comparative experiment

- 2. Among ecosystem/biome comparison
 - International, highly coordinated network

Ecosystem Sensitivity to Rainfall Experiment (EcoSeRE)

 What are the mechanisms of differential sensitivity of terrestrial ecosystems to severe drought?



Key attributes of EcoSeRE

- Distributed, highly coordinated network capturing a broad range of ecosystem types (desert, grassland, shrubland, forest)
- Core treatment: 67% reduction in annual rainfall using passive shelters
- Minimum of three years duration for the drought, with year of pre-treatment data collection
- Target start date: late 2013 (Southern Hemisphere),
 2014 (Northern Hemisphere)

Please contact me if you are interested in getting involved!

Harnessing the power of intercontinental comparisons and network approaches

- Need to be highly coordinated to be effective
- Opportunities for grassroots initiatives
 - The Nutrient Network
 - EcoSeRE
 - [Your favor experiment here]

Leveraging existing networks



The role of the LTER/ILTER

- Platform for coordinated experiments
- Long-term datasets provide context

