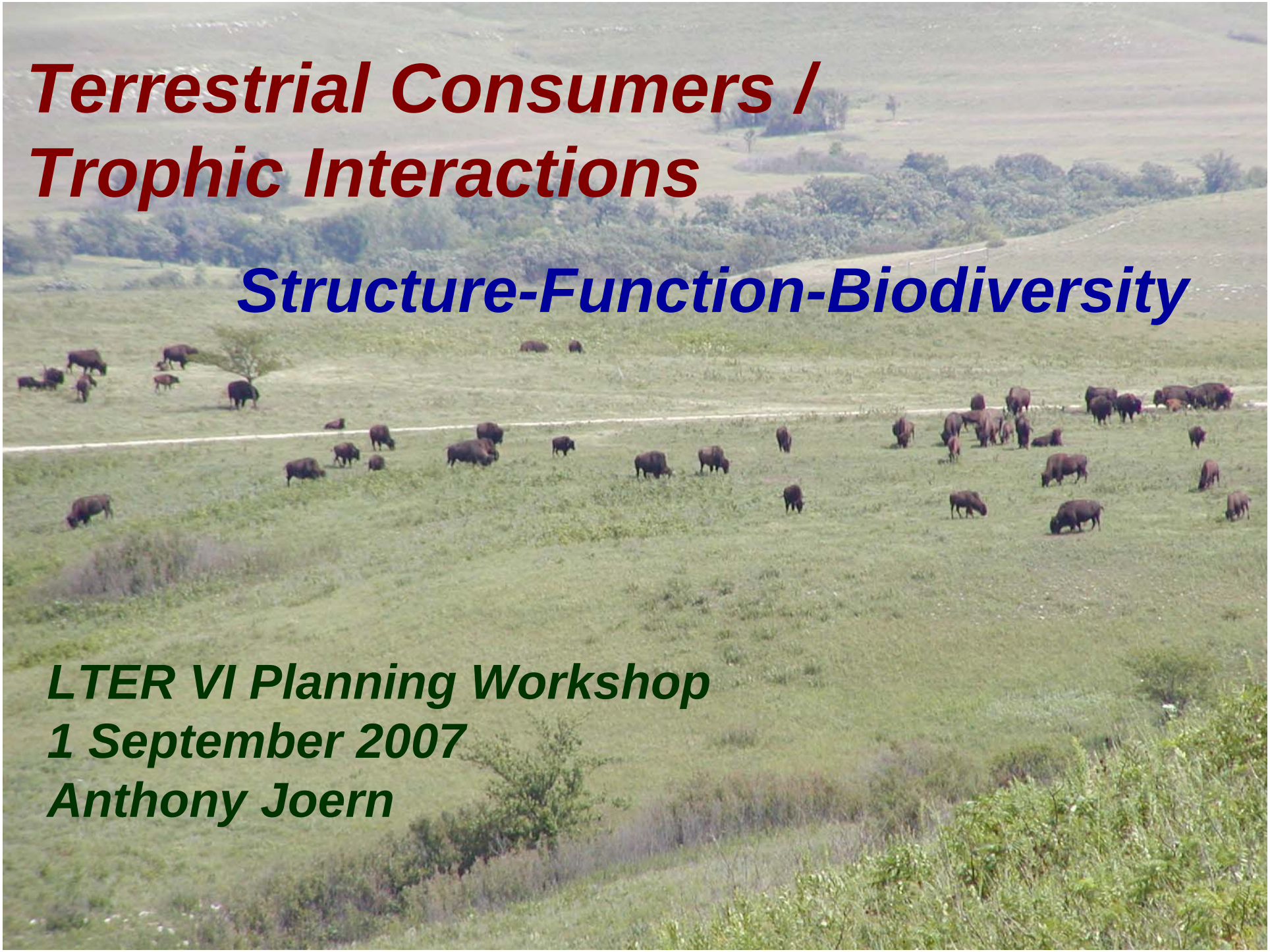
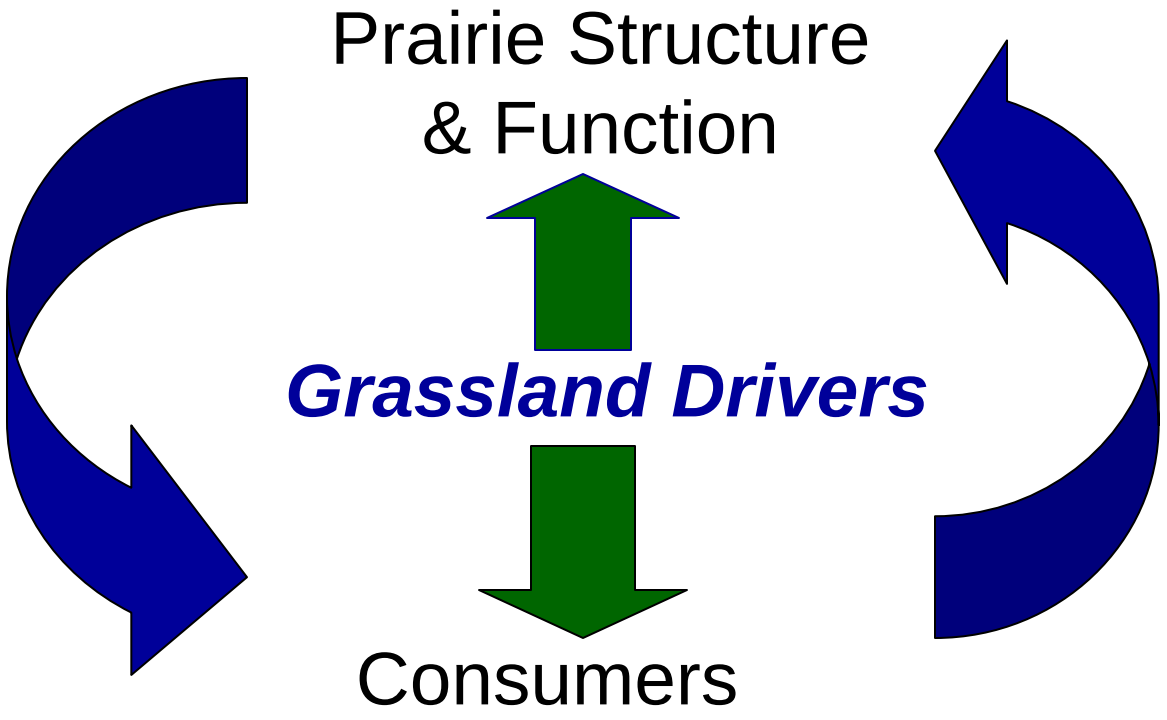


Terrestrial Consumers / Trophic Interactions

Structure-Function-Biodiversity

LTER VI Planning Workshop
1 September 2007
Anthony Joern

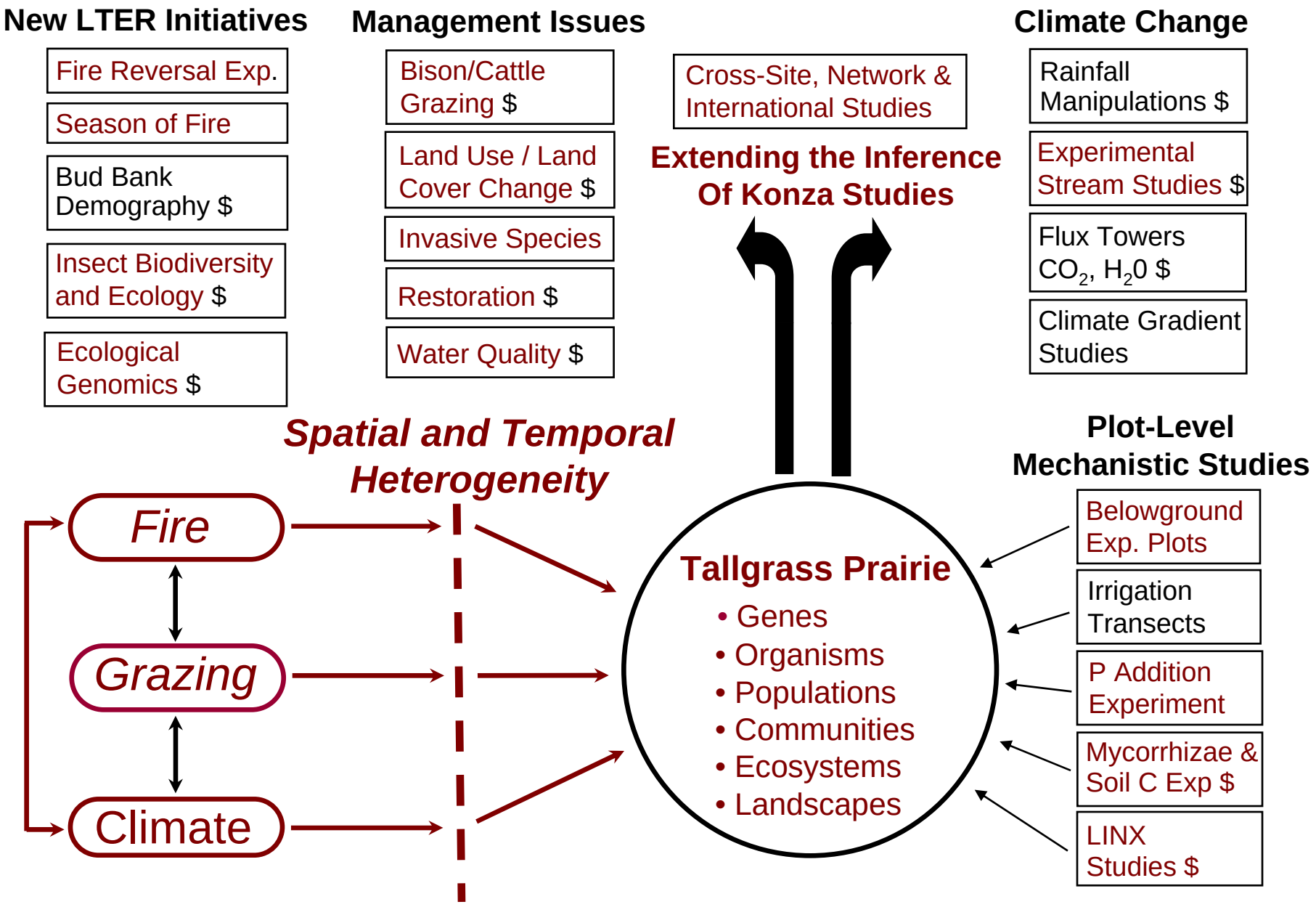
Primary system drivers and grassland consumers?



Konza Prairie Consumers …

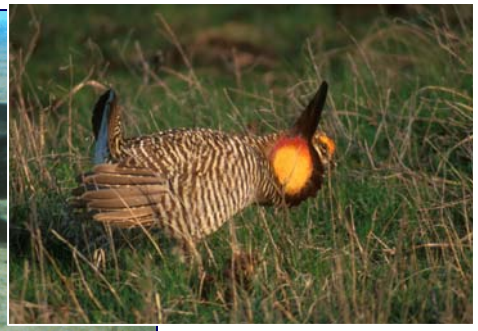
- Focus of many long-term core data sets
- Major contributors to site biodiversity
- Highly variable dynamics, especially densities
- Major participants in food webs, contributing to community & ecosystem dynamics
- Serve as key indicator species for understanding global environmental change
- Major foci of conservation biology

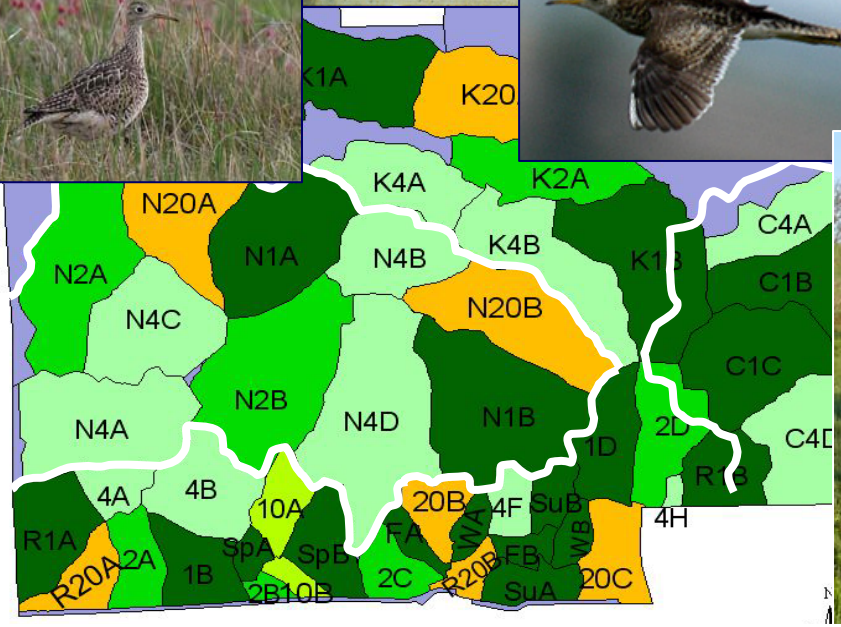
Integration of LTER Research at Konza Prairie

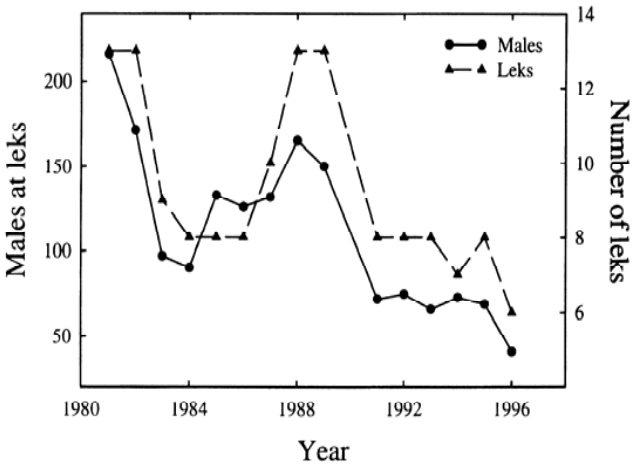


Avian Dynamics

Brett Sandercock, Kim With





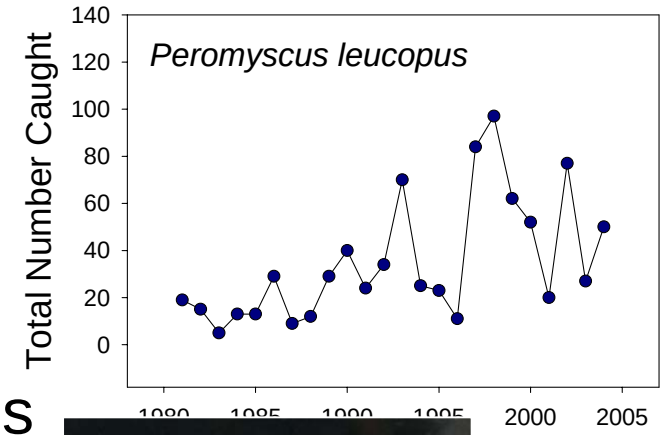


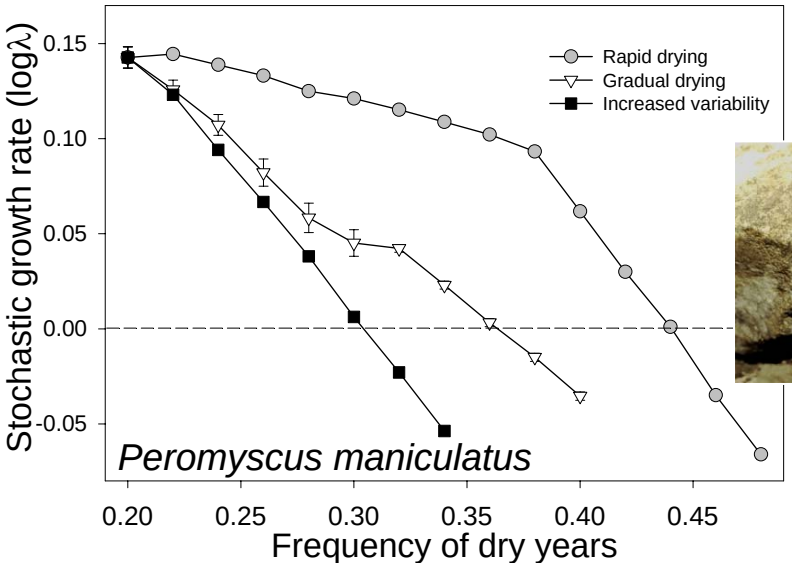
- Long-term LTER core data
- Landscape scale habitat use
- Long-term lekking activity
- Landscape-scale experiments

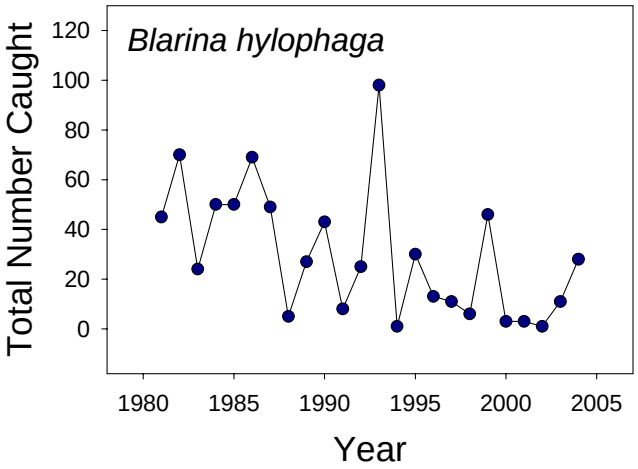
Small Mammal Dynamics

D. Kaufman, G. Kaufman

- Long-term core data on small mammals
- Temporal dynamics of core species
- Responses to key ecosystem drivers & land cover change
- Dynamic responses to climate change







Small Mammal Responses to Climate and Habitat Drivers

Four Research Phases in Konza LTER (since 1981)

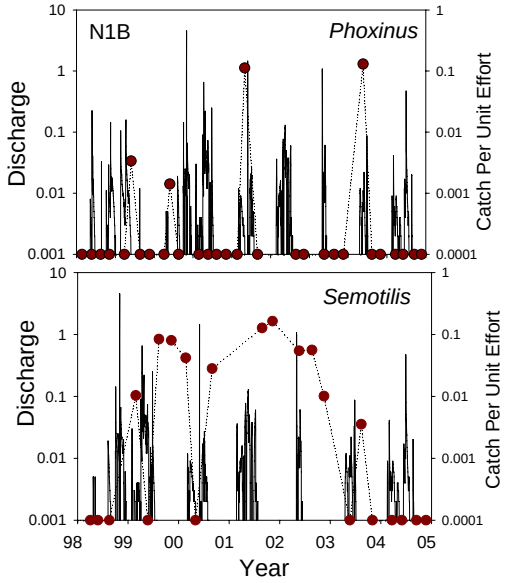
I Magnitude & causes in temporal/ spatial variation
II Season of annual fire effects on populations
III Impact of woody invasion (ongoing direction)
IV Deer mouse demography (new direction)

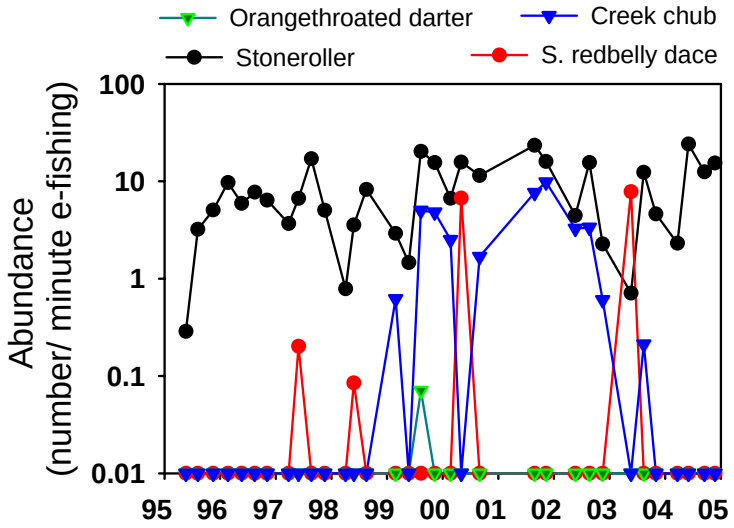
Key Points & Rationale

- Relevant to climate change themes
- Woody invasion/ habitat shifts changing communities
- Long term population trends provide baseline to link with additional
- Critical vertebrate component of trophic structure

Aquatic Consumers

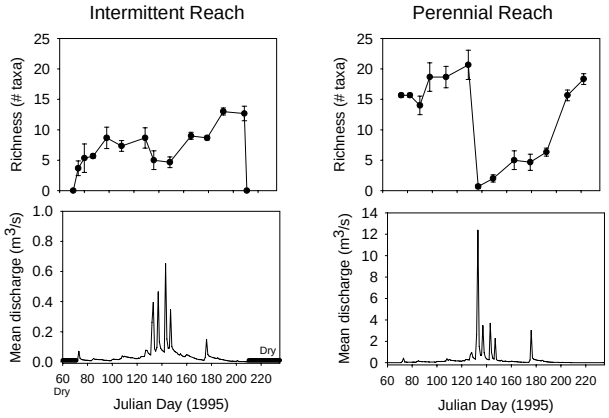
K. Gido, C. Paukert, & M. Whiles





- Long-term core data on fish
- Focus on stream permanence
- Impact of disturbance
- Stream macroinvertebrates & fish
- Links to ecosystem processes evident

Macroinvertebrates

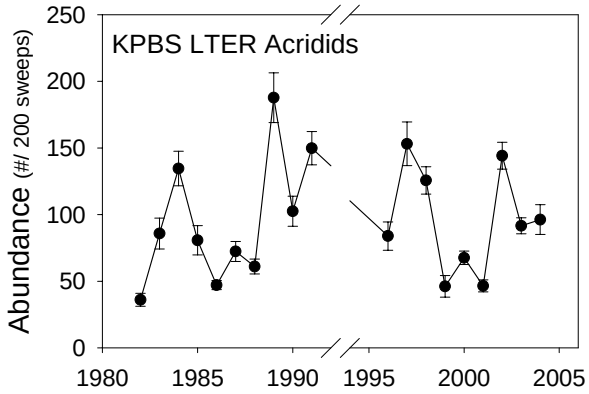


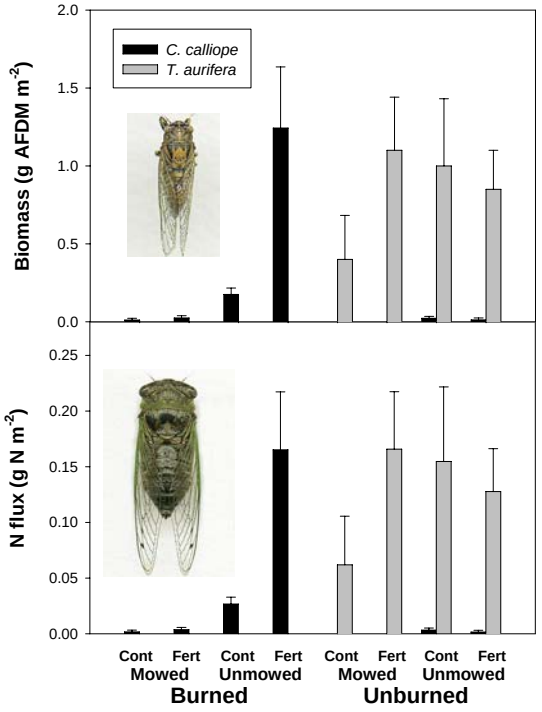
Experimental Steams

Terrestrial Arthropods & Nematodes

J. Blair, A. Joern, T. Todd,
M. Whiles, G. Zolnerowich

- Grasshoppers: Long-Term Core Data
- Responses to Prairie Drivers
- Food Webs & Trophic Cascades
- Parasitic hymenoptera biodiversity





Core Long-Term Records

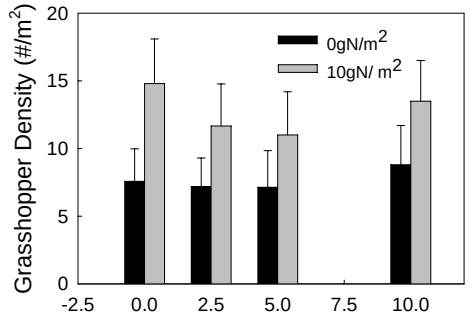
Analyses of long-term data are showing interesting insights with respect to role of key grassland drivers

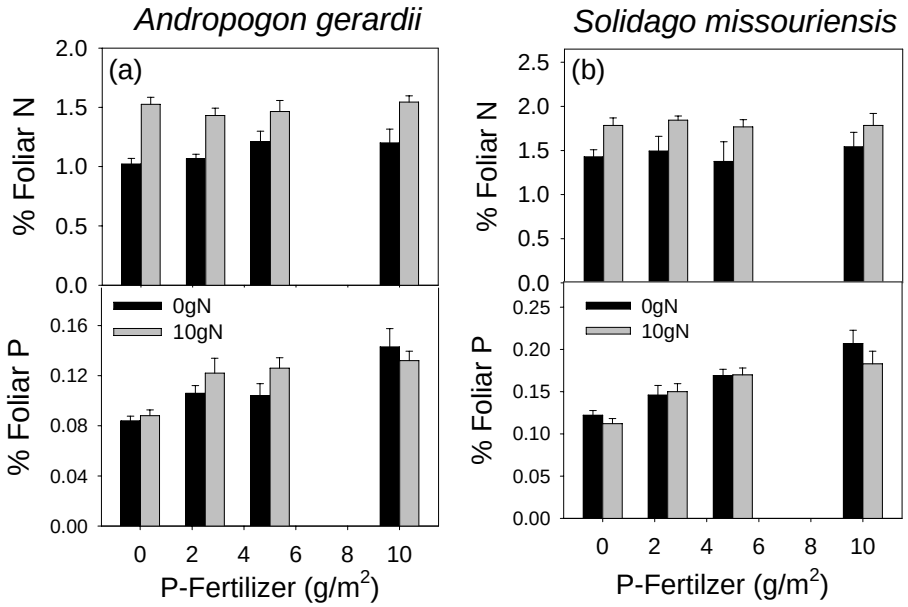
- ***Grasshoppers***: (Jonas & Joern. 2007. *Oecologia* 153: 699-711)
  - Dynamics affected by fire, bison and weather at local and regional scales (see Jonas & Joern poster; 25 years)
- ***Fish:*** (Franssen *et al*. 2006. *Freshwater Biology 51: 2072-2086)*
  - Seasonality rather than disturbance from floods is best predictor of stream fish assemblages
- ***Birds:*** (Powell. Auk 123: 183-197)
  - Variable species-specific responses to annual burning and bison grazing significant; heterogeneous landscape best approach.
- ***Small Mammals:*** Matlack *et al*. 2002. Journal of Mammalogy 83:280-289; Rehmeier *et al*. 2005. Journal of Mammalogy, 86:670-676.
  - Strong weather signal and woody vegetation determines temporal dynamics; variable species responses to fire and grazing for spatial variation.

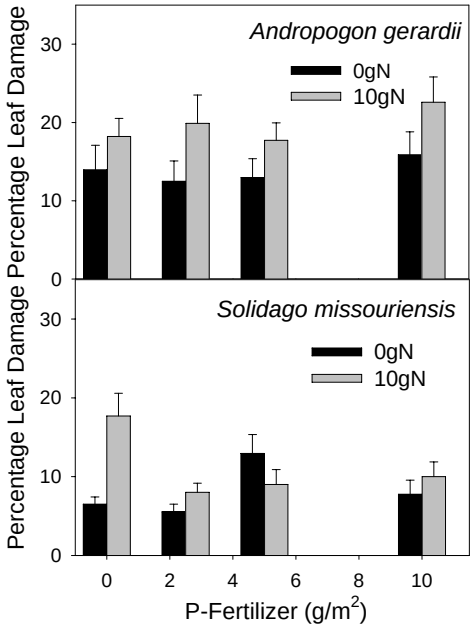
Stoichiometric responses

- N is key, little support for role of P in grasshoppers in P-plots
- Useful to extend stoichiometric approach to understand dynamics of trophic interactions

(Viviana Loaiza REU)







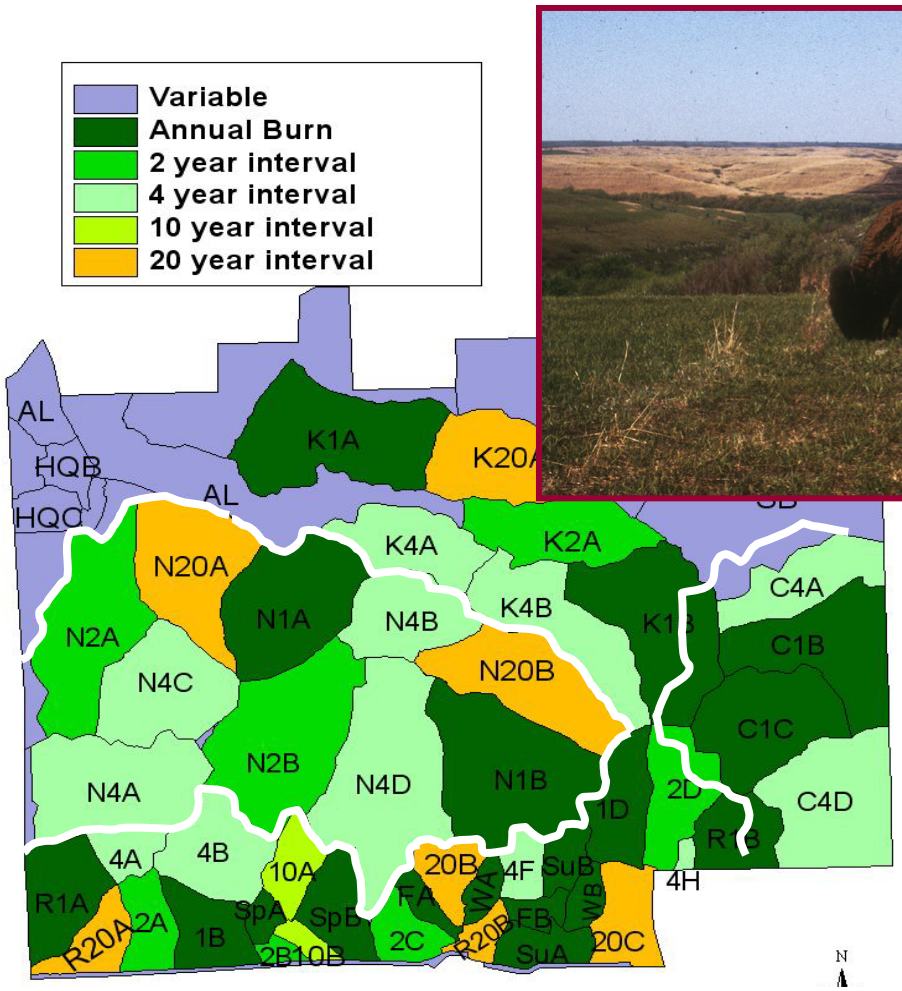
Some New Directions & Syntheses

- Synthesize scale-dependent processes affecting consumer responses to canonical prairie drivers
- Develop detailed scale-dependent understanding of effects of bison foraging on heterogeneity of vegetation structure, food quality, nutrient cycling, and plant species availability
- Determine the critical elements of habitat heterogeneity in response to grazing-fire-climate interactions that underlie different consumer dynamics
- Further define the functional contributions of consumers in tallgrass prairie, and their trophic interactions
- Develop detailed demographic studies of targeted taxa to track consequences of climate and habitat change

Bison Create Habitats & Heterogeneity

- Plant species richness
- Vegetation height
- Foliar nutritional quality
- Variable microclimates & structural microhabitats for smaller consumers

Consumer responses to heterogeneity induced by fire & grazing?



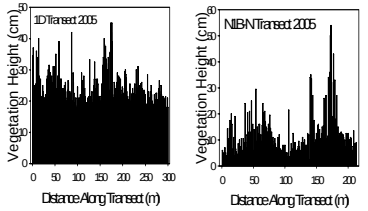
Remote sensing & forage quality

Vegetation Height

Ungrazed *Grazed*

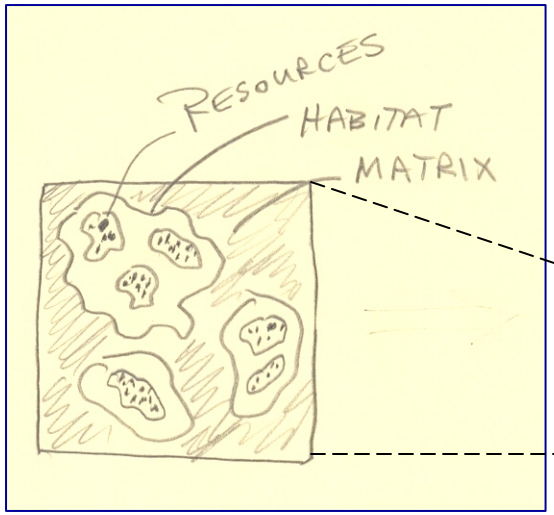
1-year burn

4-year burn

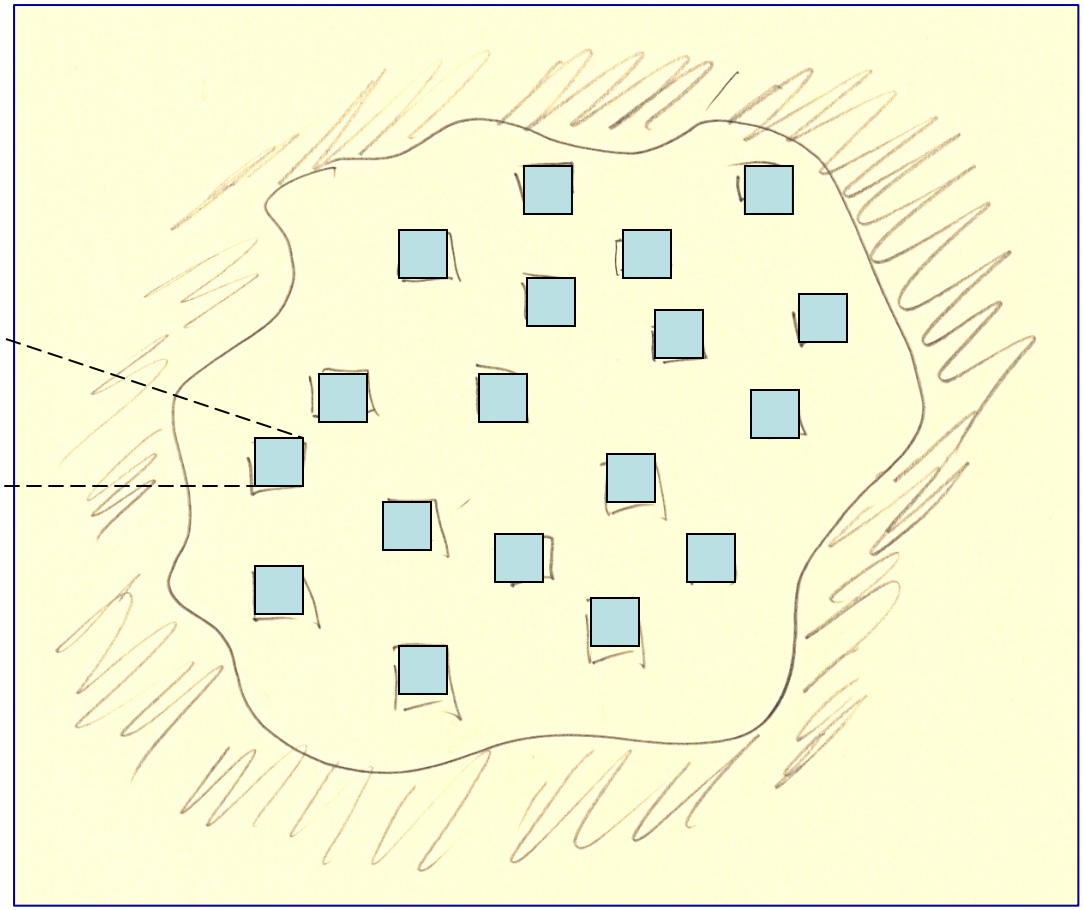


Characterizing & Scaling Effects of Habitat Heterogeneity

Grasshopper



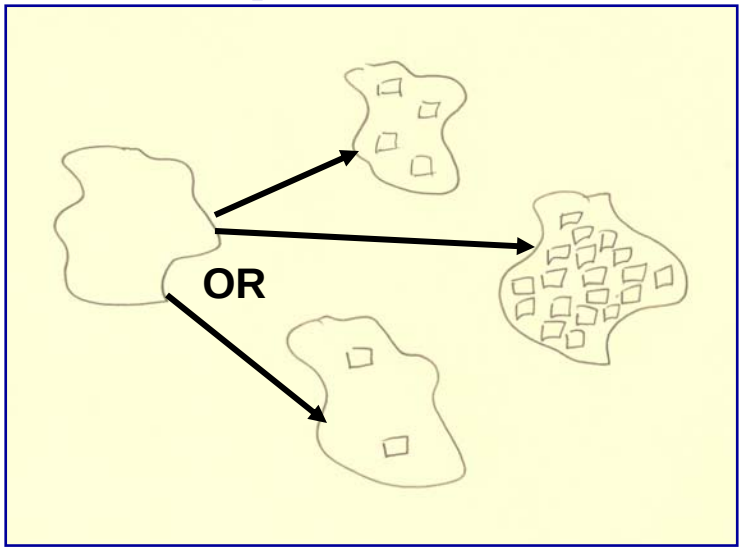
Rabbits?
Voles?
Birds?



Bison

Distribution of
depends on bison, fire, soil nutrients

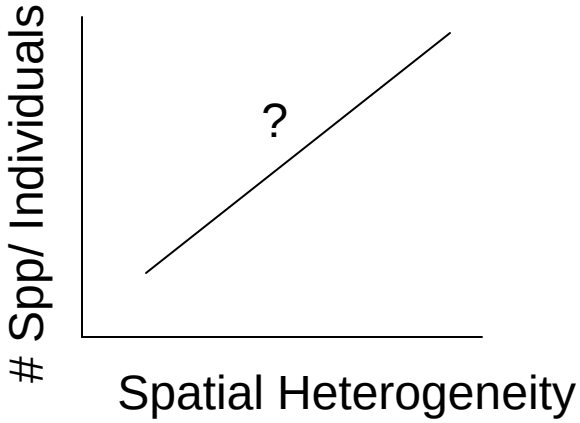
Hierarchical, scale- and size-dependent responses to habitat quality & structure?



Ongoing: Konza-Kruger study of top-down effects of grazers/ browsers on vegetation dynamics and plant community
(Knapp, Smith, Collins, Blair)

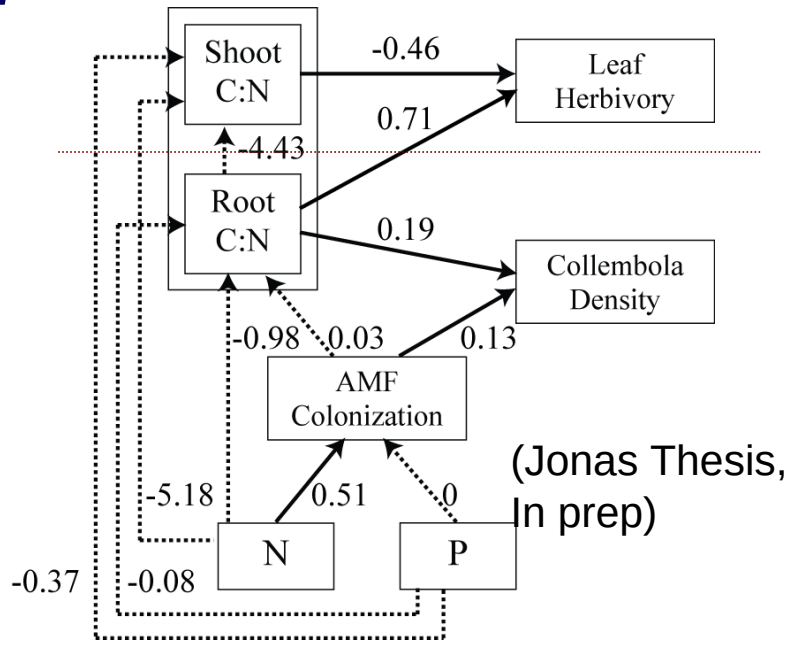
Variable heterogeneity determines diversity

Some Theory: size-dependent fractal relationships of habitat/ resource use by consumers
(Ritchie & OLff 1998)



Small herbivores more likely limited by food quality & habitat structure (ectotherms), large herbivores by quantity

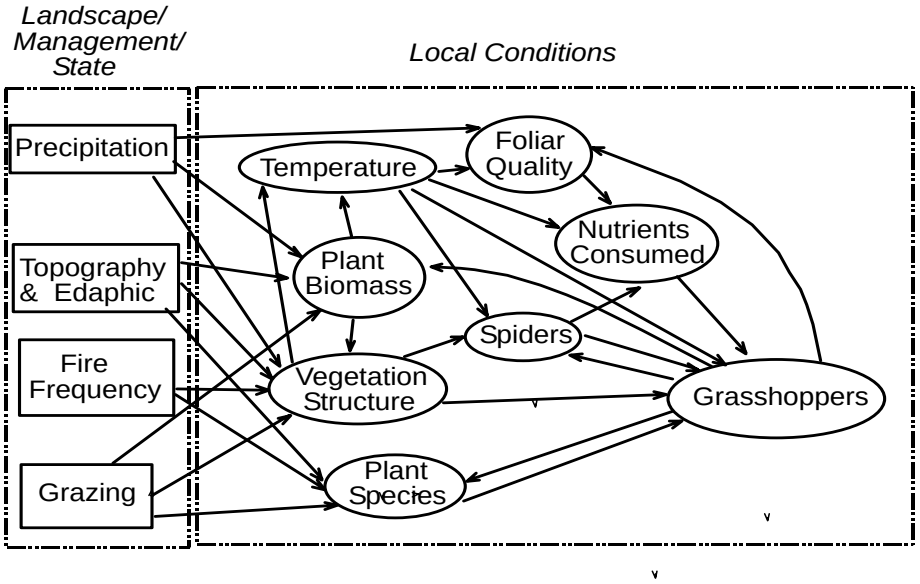
Link Dynamics of Aboveground and Belowground Trophic Structure

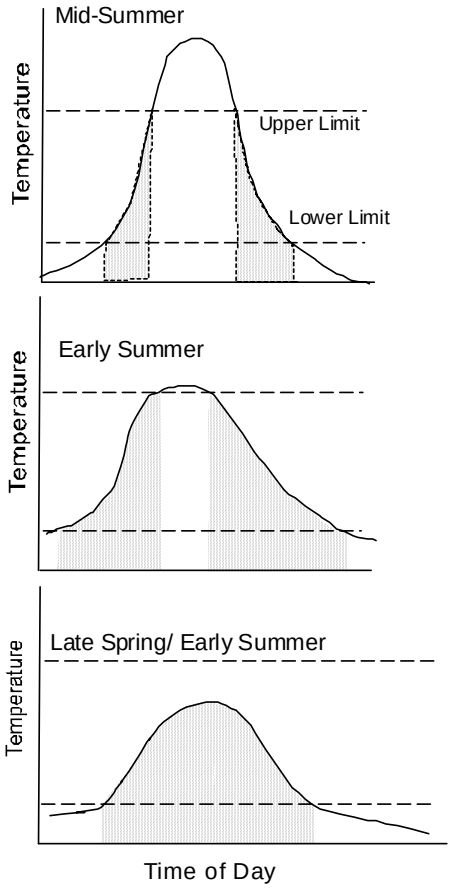


(Jonas Thesis, In prep)

- Use long-term belowground plot experiment to work out role of bottom-up processes determining trophic structure
- Link aboveground and belowground dynamics
- Have most resources needed to proceed – need conceptual framework and explicit hypotheses
- Stable isotope technology may be useful

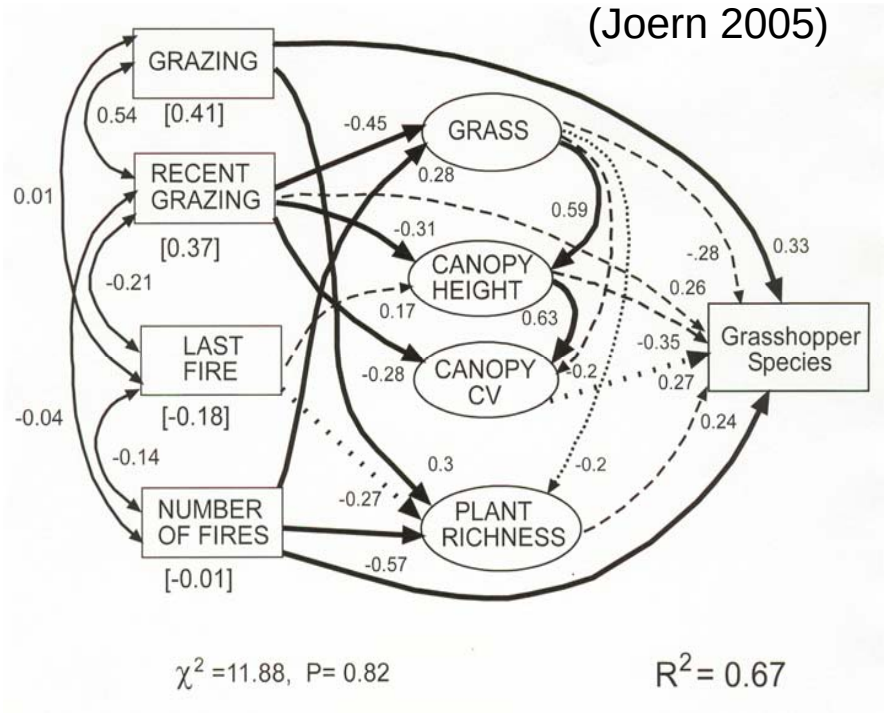
Climate change affects biotic interactions: consumer responses



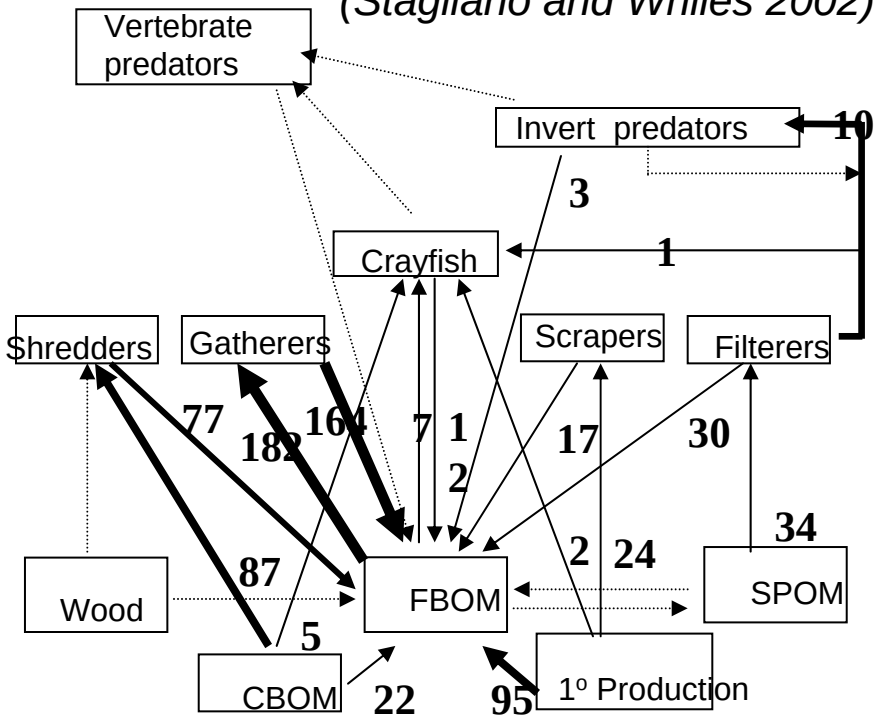


Integrate Understanding of Dynamics in Terrestrial & Aquatic Habitats

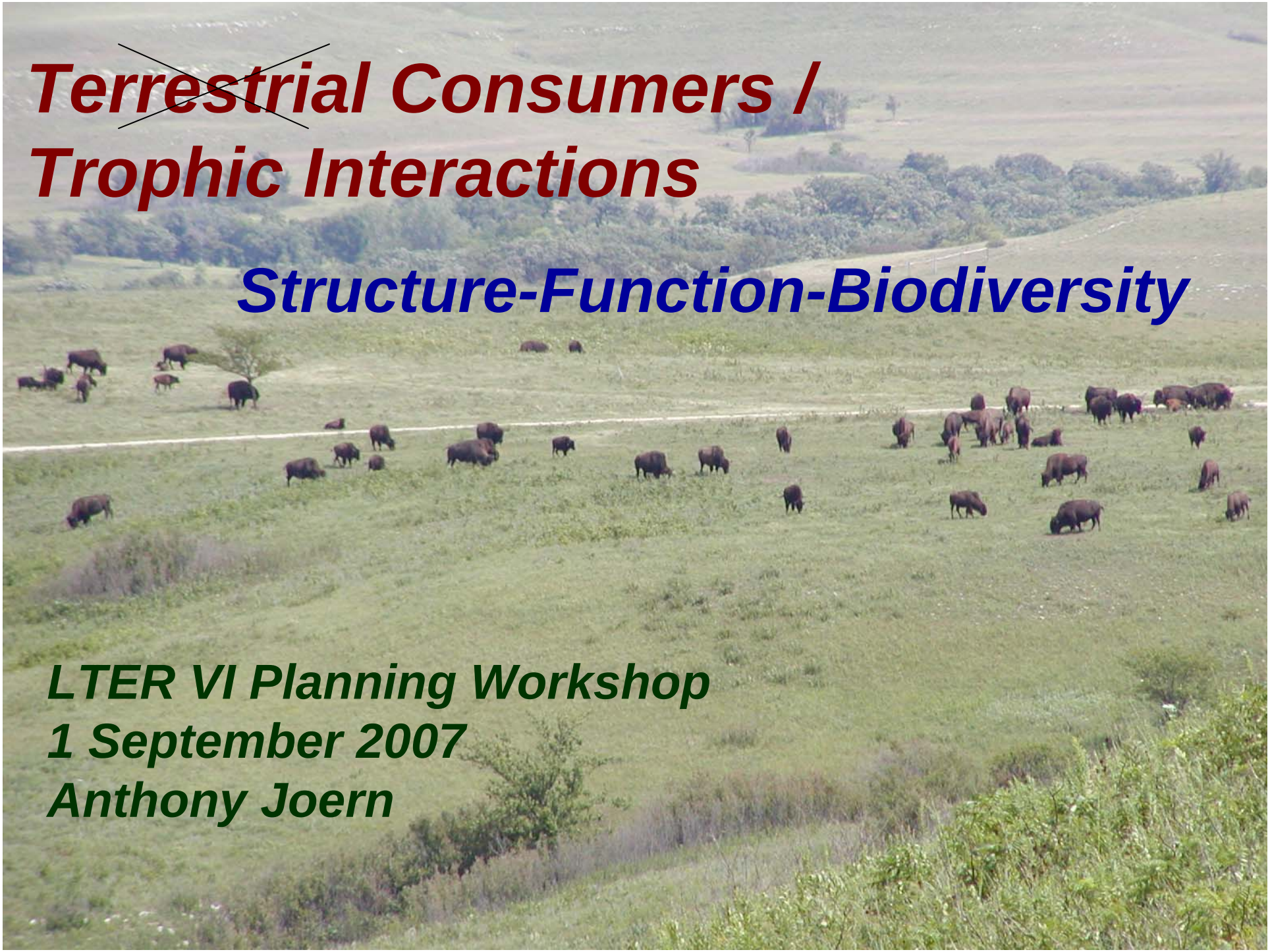
(Joern 2005)



(Stagliano and Whiles 2002)



- Multiple approaches
- Can these be profitably linked?



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