Plant Responses to Environmental Change

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Konza LTER Meeting: 09/01/07

Photo: Judd Patterson

Outline

H_a: Variable climate is a key determinant of the tallgrass ecosystem

H_a: Dominant grass species drive plant ecological responses

H_a: Local patterns and processes in this ecosystem reflect three drivers: micro-environment, disturbance, and dominant species

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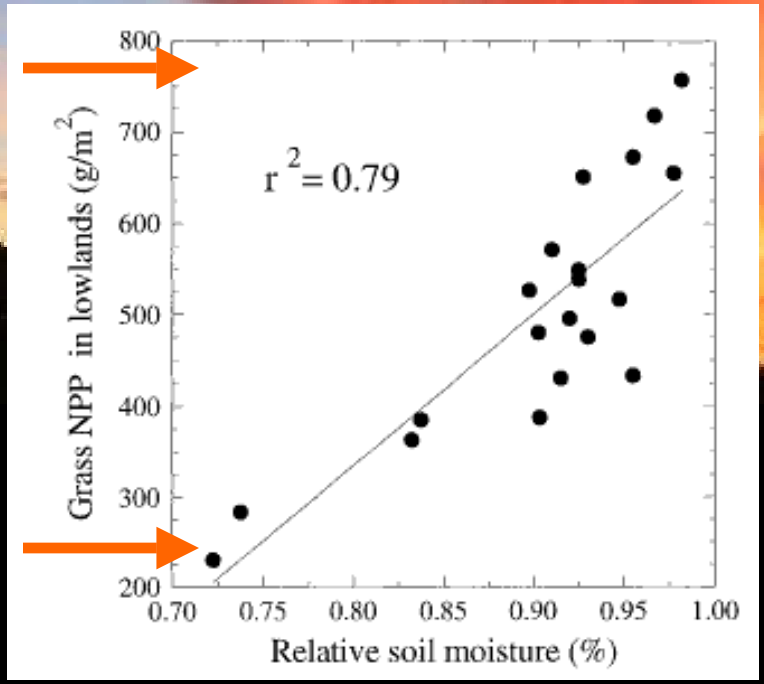
- Wireless sensor networks
- Multi-dimensional hypotheses
  - Resource-response relationships
  - Multi-investigator interactions

Photo: Judd Patterson

Climate variability:

- key driver of the prairie biome
- variable climate results in yearly differences in the pattern and amount of water availability and air temperature
  - intra-season changes
- variability in climate leads to variability in structure & function



Briggs & Knapp 1995

Climate variability in the prairie

- Microclimate varies in time and space
  - Each species' life history is influenced by variability

  - Disturbance reduces abundance of dominants
  - Environmental change increases resource availability for sub-dominants
- Variable species responses to rainfall, PET, solar radiation, and temperature
  - Site-specific gradients in productivity

Species abundance and distribution

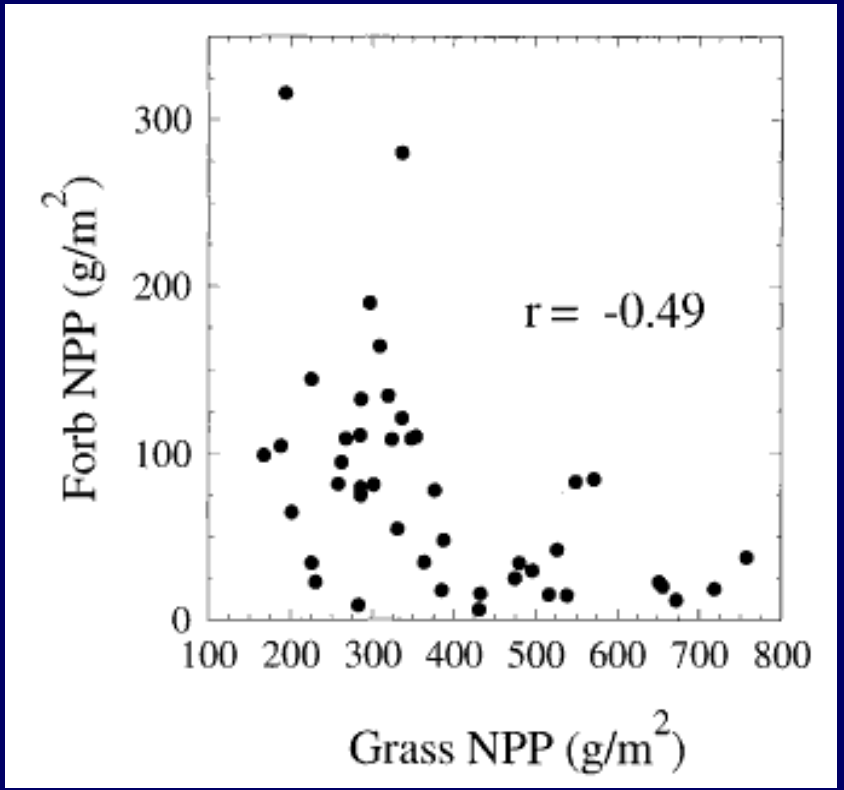
Grasses	Sub-dominants
abundant	species rich
widely distributed	localized
temporally stable	dynamic
predictable	temporally unpredictable

- Landscape position
- Disturbance drivers
- Micro-environment

Variability by scale: frequency and spatial

Dominant species drive ecological responses

- Inverse response by forbs to the dominant grasses
- Grasses play a key role in overall species diversity and community structure
- Species coexistence reflects patch dynamics, disturbance, and competition for resources



Briggs & Knapp 1995

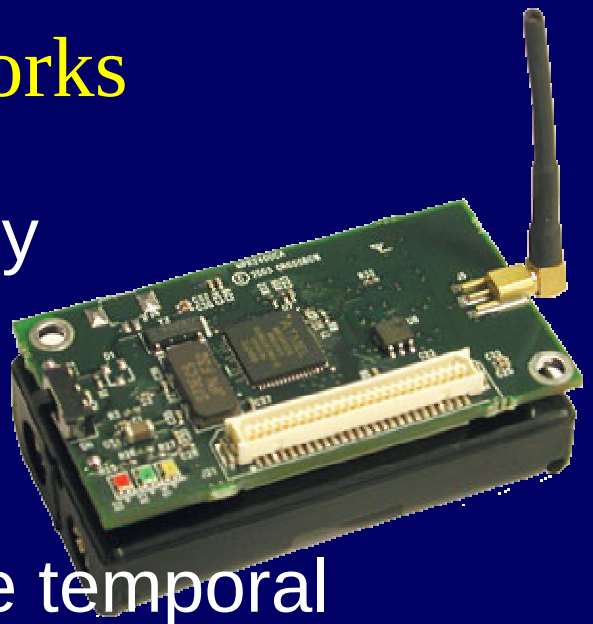
- To successfully predict the community response, the forb response to dominant grasses must be independent from the forb response to climate variability

Previously, work on site has focused on:

1) Plant species composition & abundance
2) Competition & community organization
3) Disturbance responses & development of the non-equilibrium paradigm
4) Life history & population demography

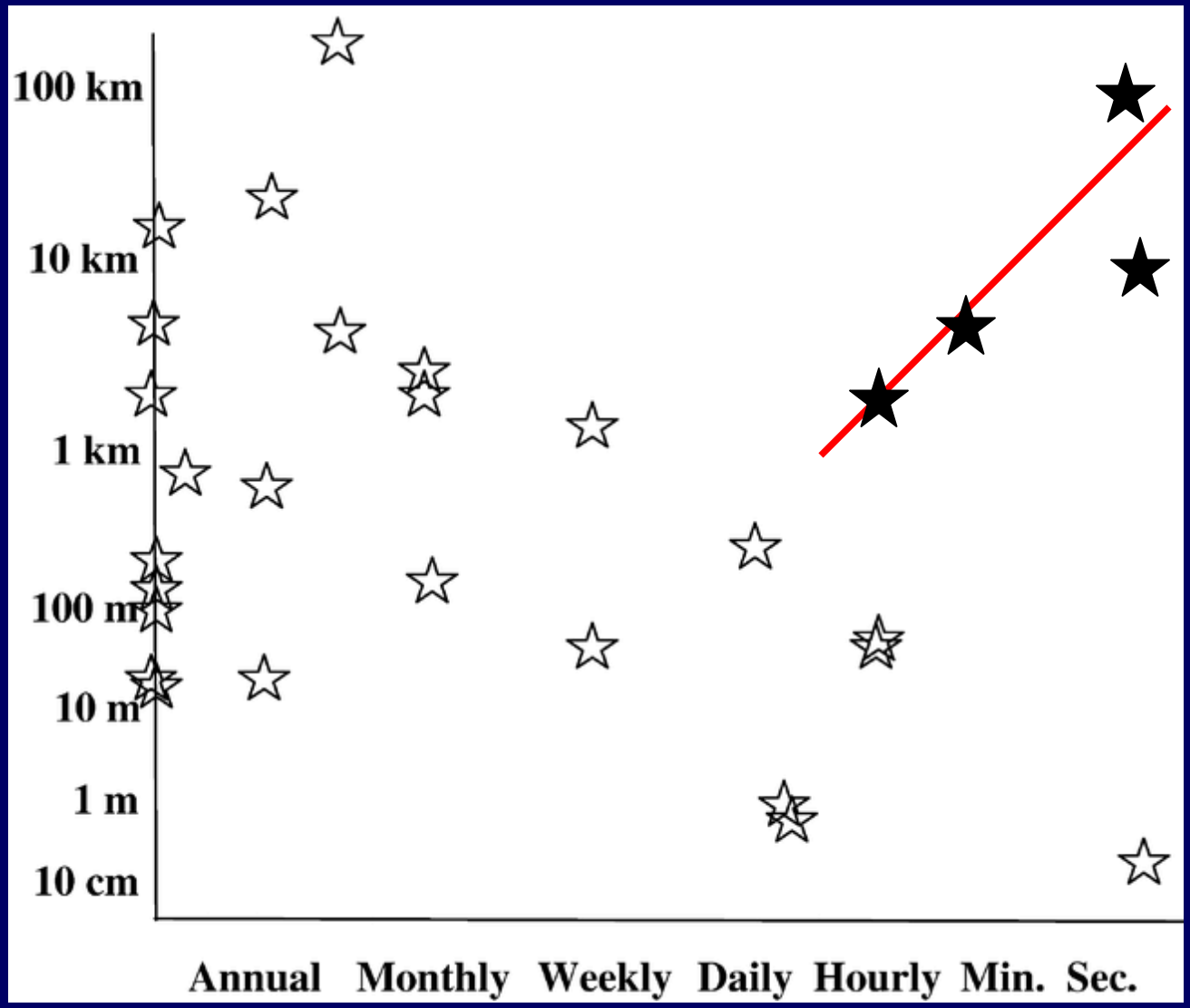
Detailed measurements of local microclimate variability will increase our understanding of the patterns and processes in 1 - 4

Wireless Sensor Networks



- Limitations of traditional technology
  - Cost
  - Wired sensors to dataloggers
  - Ecological applicability
- WSN's capture data at appropriate temporal and spatial scales
- New methods to analyze and interpret large datasets
  - Real-time data screening
  - Sensor web at the Sevilleta LTER
    - Synchronized spatially distributed pods
      - Collins et al. *Frontiers* 2006

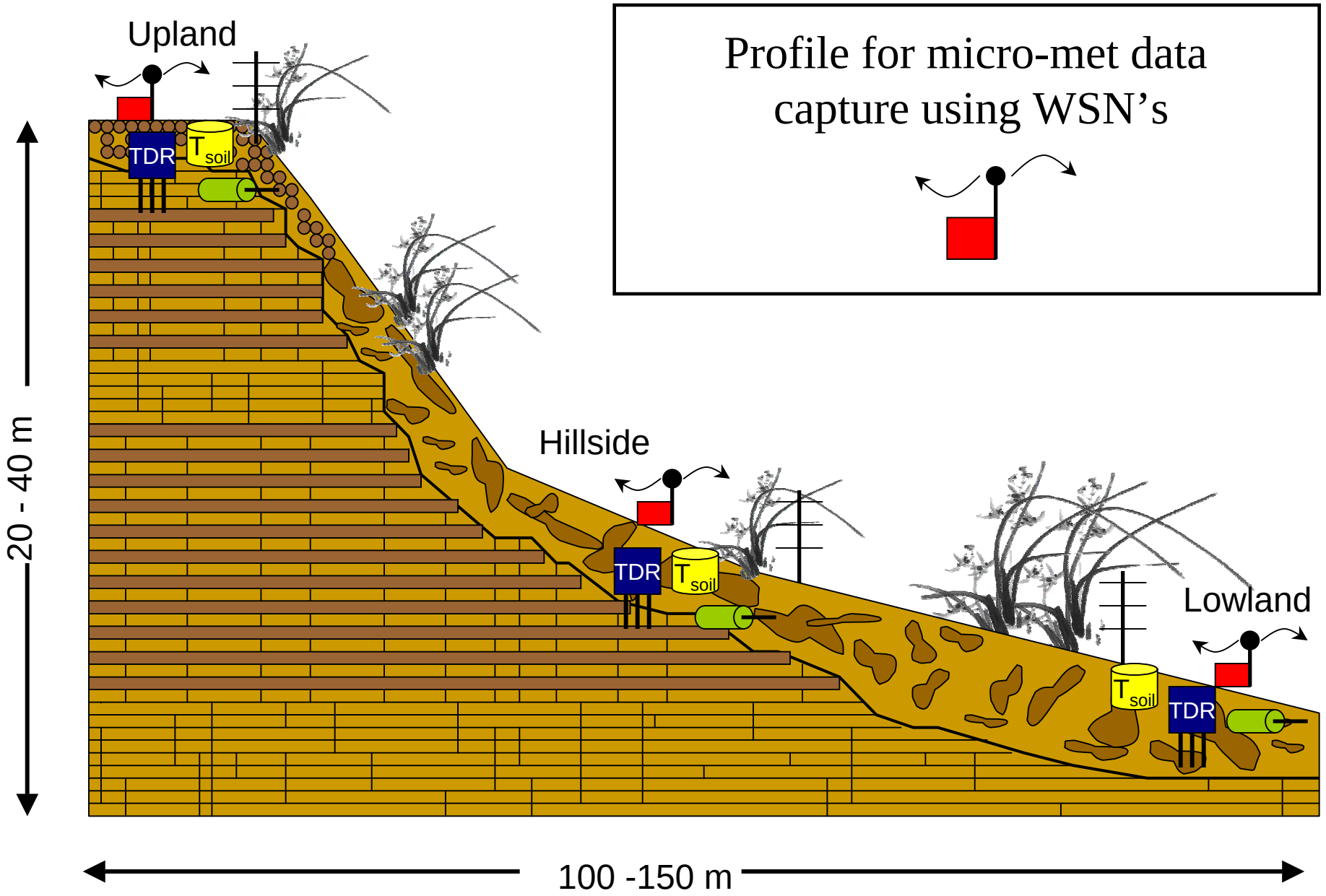
Wireless Sensor Networks in Ecology



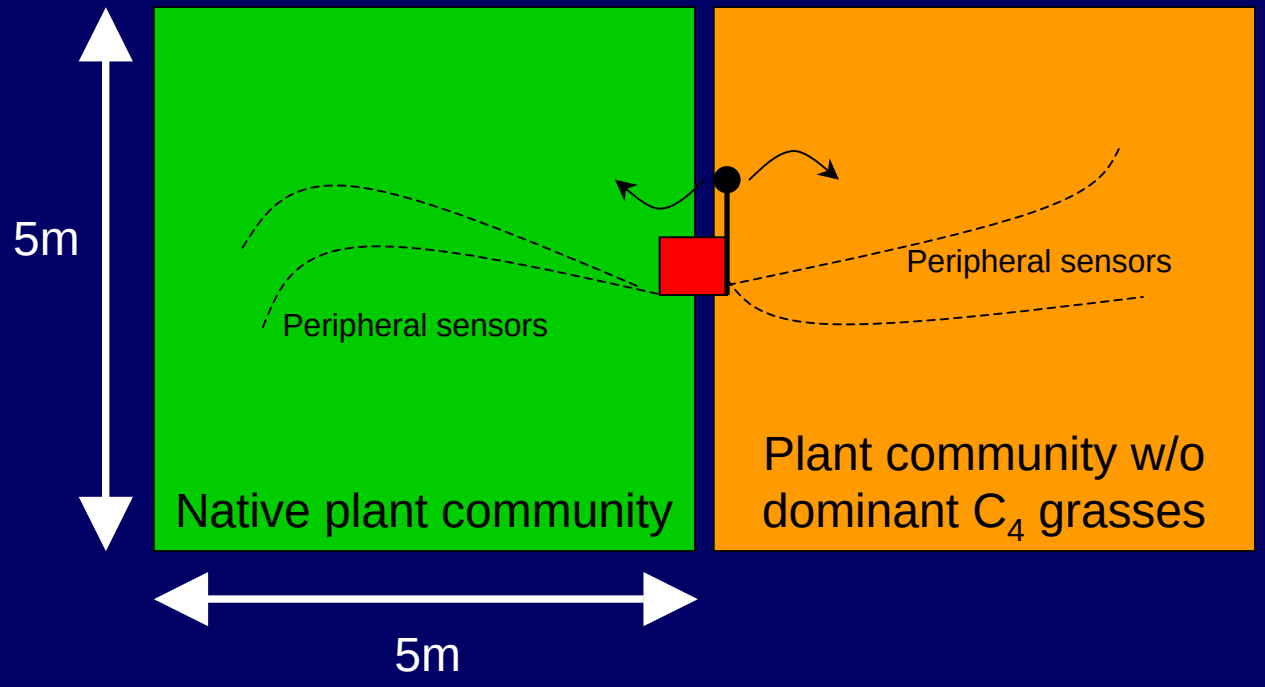
Porter et al. *BioScience* 2005

WSN placement to capture inherent KPBS variability

Burn Freq.	1yr		4yr		20yr	
Grazing	UG	G	UG	G	UG	G
Topography						
upland	1	4	7	10	13	16
hillside	2	5	8	11	14	17
lowland	3	6	9	12	15	18


Profile for micro-met data capture using WSN's
Upland
Hillside
Lowland
TDR
T soil
TDR
T soil
T soil
TDR
20 - 40 m
100 -150 m

Multi-dimensional hypotheses

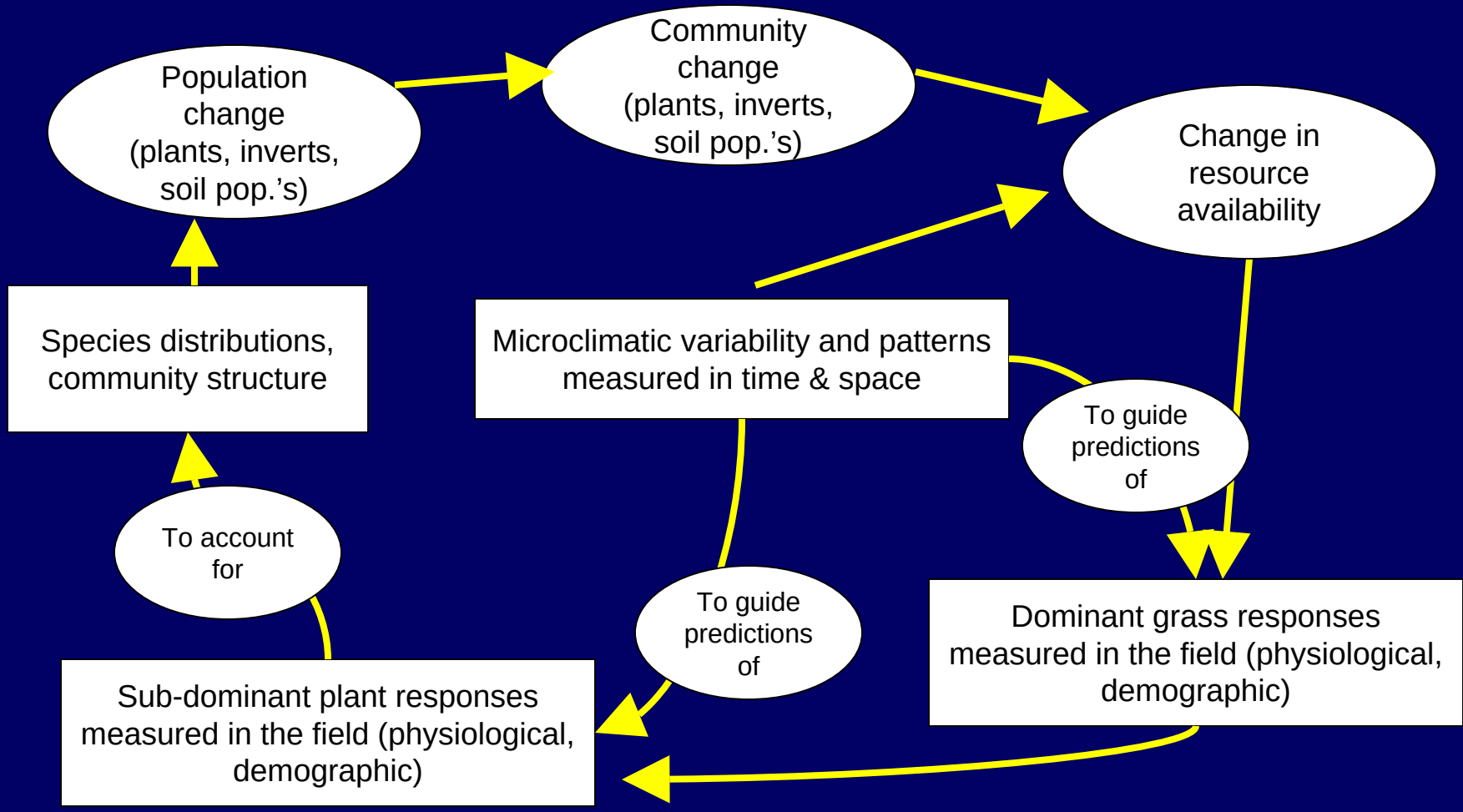


Greater characterization of interacting processes:

Dominant * sub-dominant species *

environment * disturbance frequency

Plants in Changing Environments: Resource – response relationships



Modified from: Bazzaz 1998

"Within the prairie the conditions of life are severe… after thousands of years, the species have adjusted to the environment. The plants, with few exceptions, are remarkably free from disease, regardless of weather, and are little injured by high winds or extreme heat. They may be harmed by late freezing or – infrequently – be stripped of their leaves and battered to the ground by hail, but they rarely or never are killed. Those that were unfit have disappeared."

--- John E. Weaver