Plant Populations and Grassland Dynamics

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Understanding grassland plant demography is important to:

- Provide a mechanistic understanding of patterns and dynamics at the community and ecosystem levels
- Link population and ecosystem level processes
- Predict responses to environmental change – many global change phenomena are demographic processes (e.g. species invasions, cover change)

In perennial grasslands, vegetative reproduction and and belowground bud banks are important regulators of vegetation dynamics and productivity

Plant recruitment in undisturbed sites

Recruitment from Seed = 0.6 %

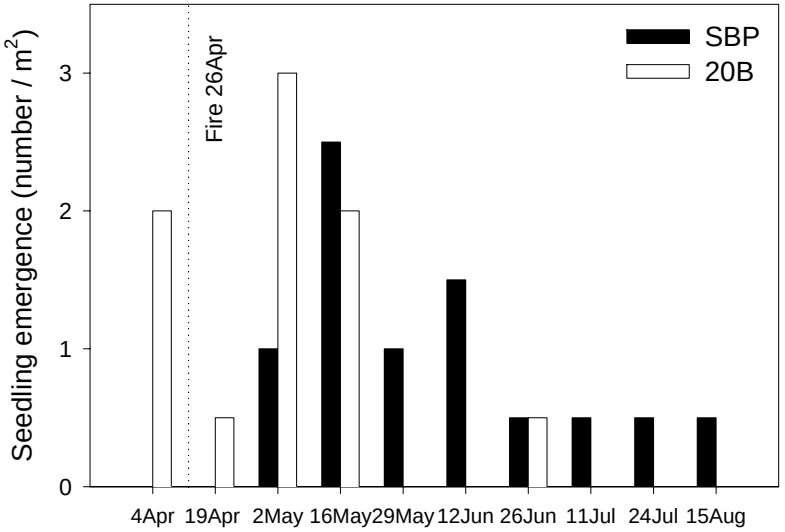
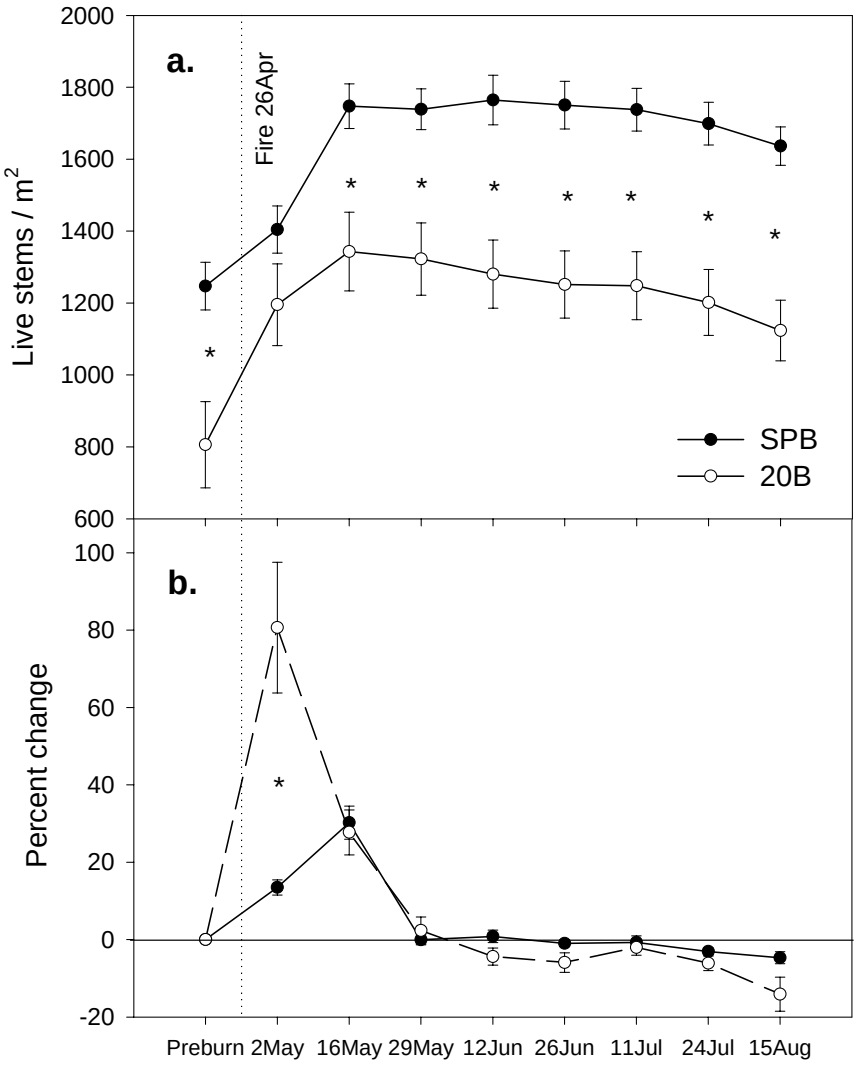


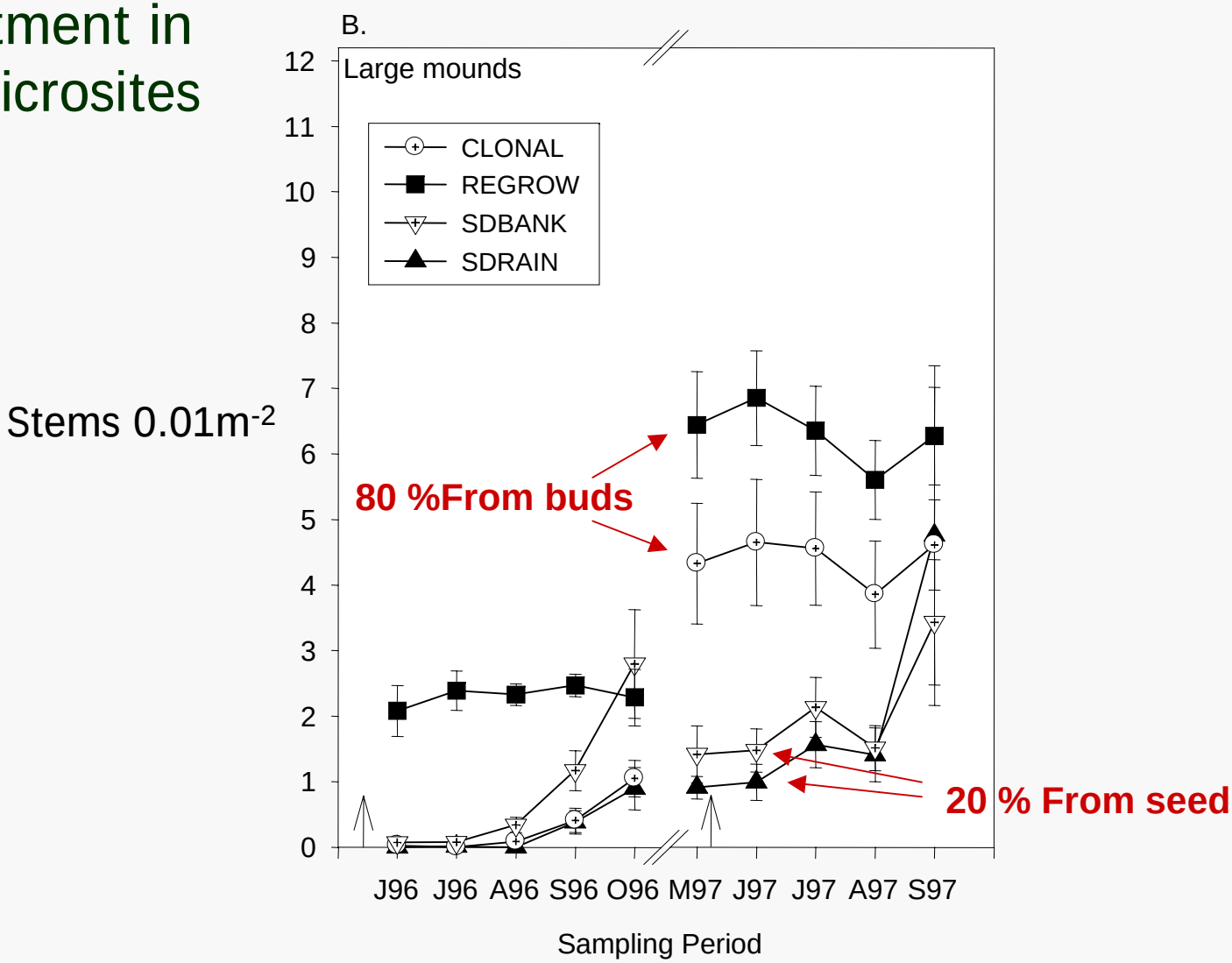
Fig. 2. The sample date on which each seedling was first detected, of the seedlings present at the last sampling date. Black bars represent seedlings emerging in the annually (spring) burned prairie. White bars represent seedlings emerging in the planned 20 year burn watershed.

Recruitment from the bud bank (belowground meristems) = 99.4%

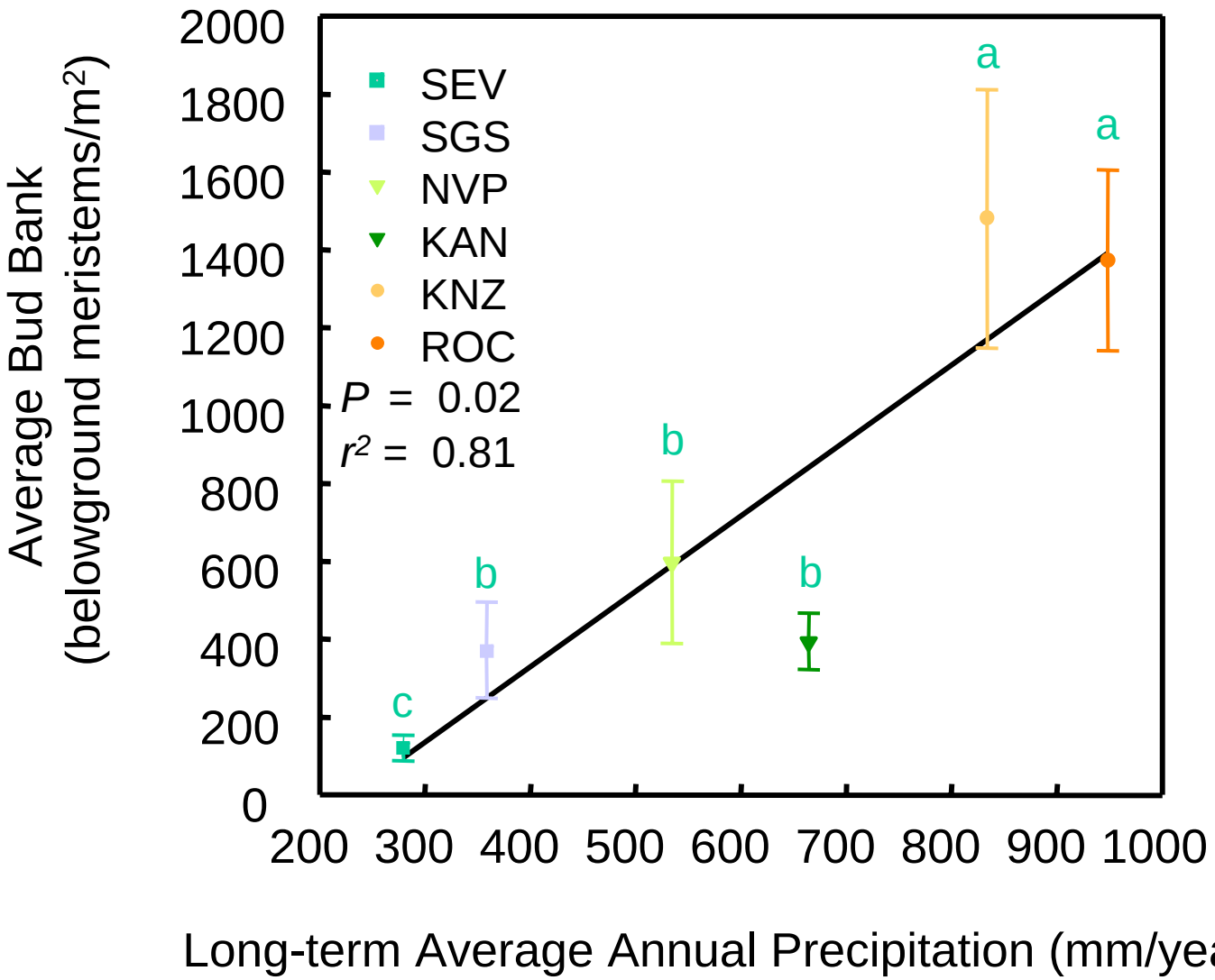


Benson & Hartnett. 2004.
***Plant Ecology* 6:1-15**

Plant recruitment in disturbed microsites



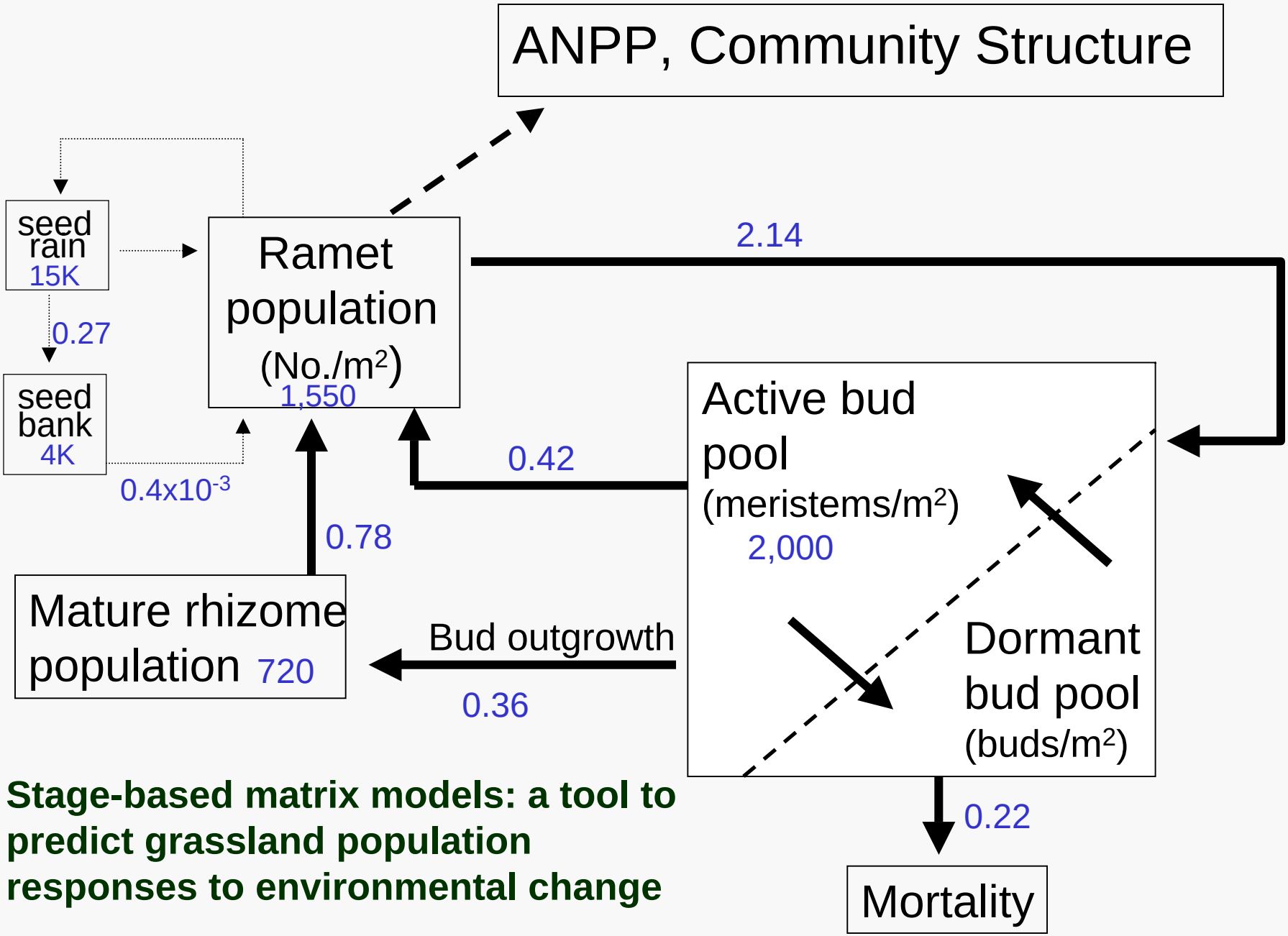
Rogers & Hartnett. 2001. *Amer. J. Botany* 88: 1634-1642



Dalgleish & Hartnett 2006

Site	Meristem Limitation Index (total buds/total stems)
Rockefeller Prairie	3.72
Konza Prairie	1.35
Niobrara Valley Preserve	0.45
Kanopolis State Park	0.50
Short Grass Steppe	0.33
Sevilleta	0.09

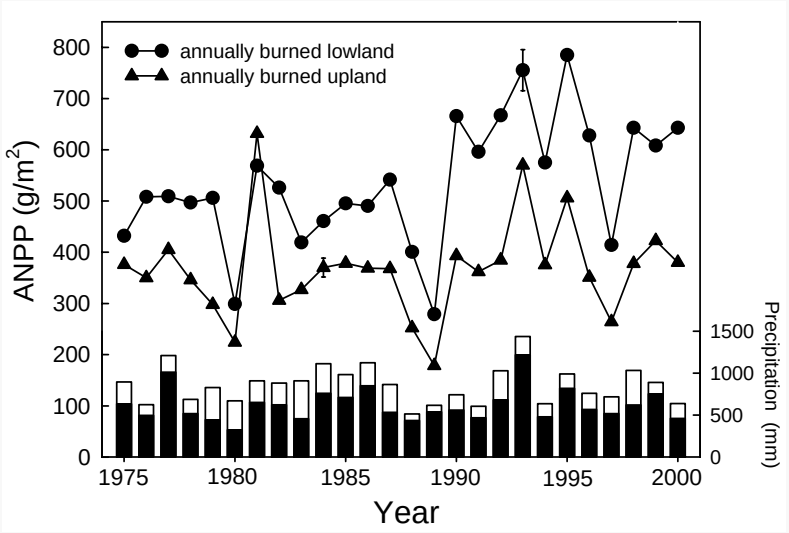
Dalgleish & Hartnett 2006



Stage-based matrix models: a tool to predict grassland population responses to environmental change

Consequences of bud bank populations and meristem limitation -

1. Grassland responses to environmental change
    - tracking changes in resource availability
    - resistance to invasibility
    - demographic buffering capacity in rare species
    - change in growth form dominance (grass-woody)
2. Genetic/evolutionary consequences



Future (LTER VI) Questions:

1. Partitioning variation in ANPP in response to environmental change

Variation in tiller size (physiology and RGR)

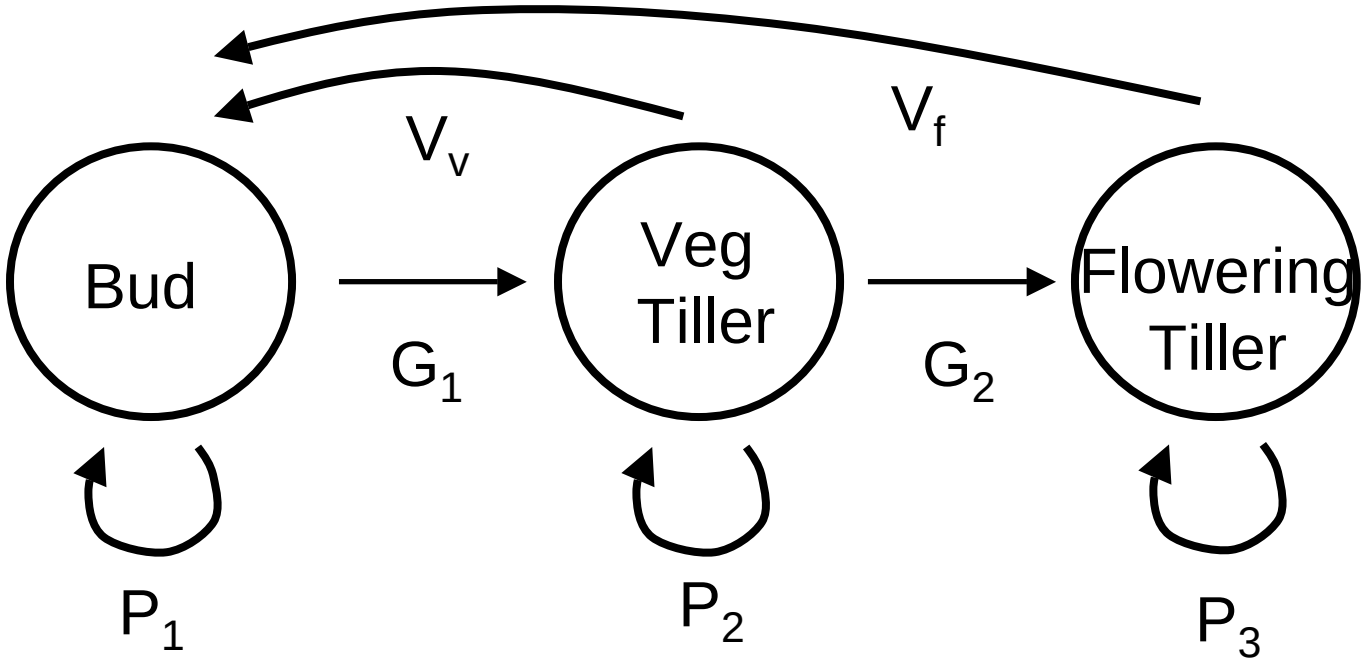
Variation in tiller number (bud bank dynamics)

↓

Variation in species composition

→ Variation in Net Primary Productivity

Response to increased resources (Nitrogen) in *Sporobolus heterolepis*



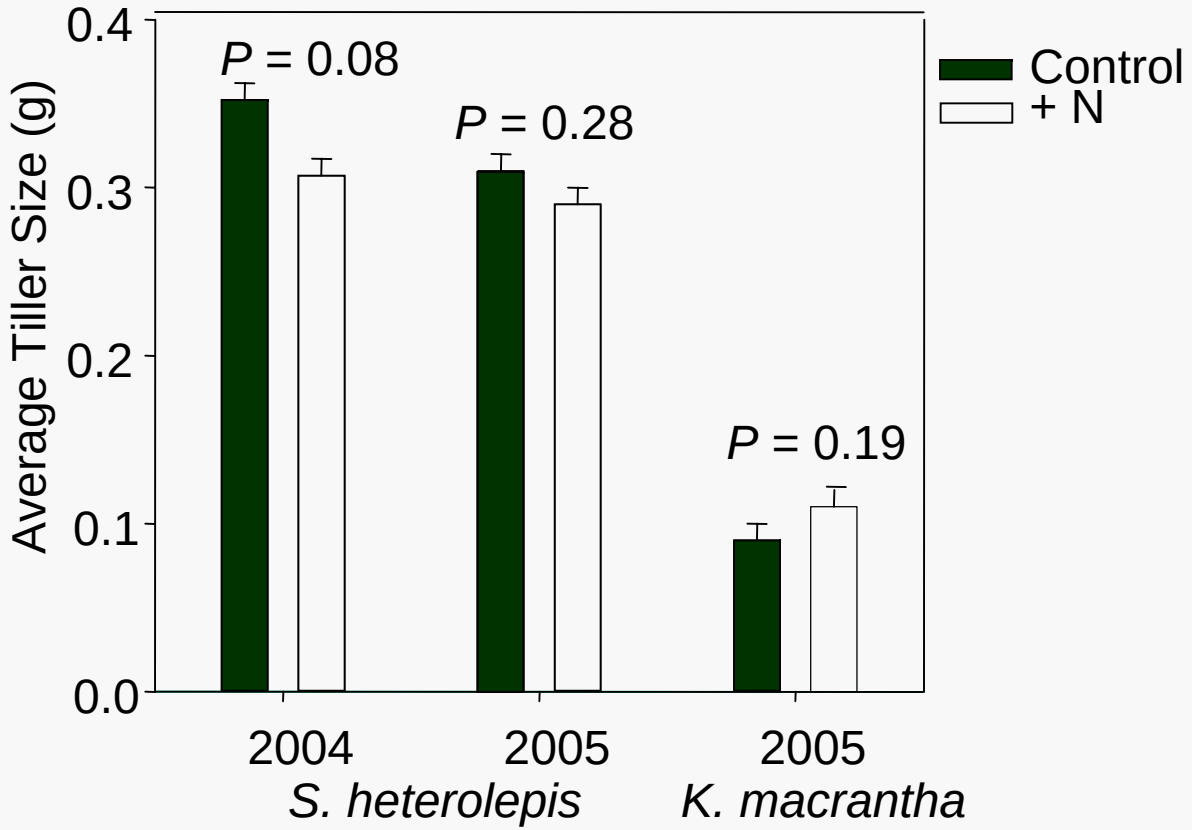
$$A = \begin{bmatrix} P_1 & V_v & V_f \\ G_1 & P_2 & 0 \\ 0 & G_2 & P_3 \end{bmatrix}$$

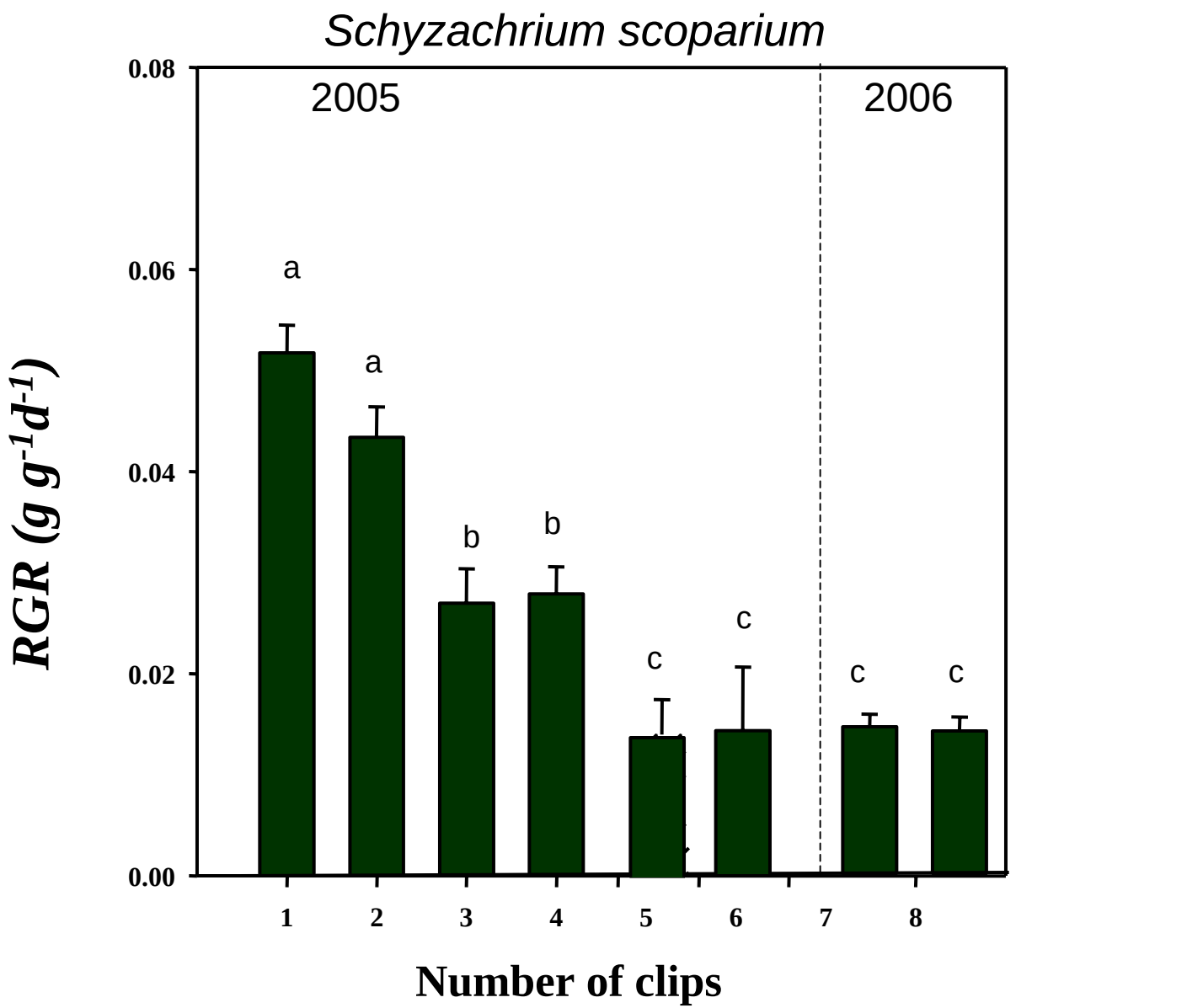
Elasticities

S. heterolepis - 2004

	Control	**+ N**
P_1	0.10 ± 0.003	0.09 ± 0.003
P_2	0.19 ± 0.005	0.19 ± 0.007
P_3	0.01 ± 0.001	0.02 ± 0.003
G_1	0.35 ± 0.003	0.33 ± 0.004
G_2	0.01 ± 0.002	0.02 ± 0.003
V_v	0.33 ± 0.005	0.31 ± 0.007
V_f	0.01 ± 0.002	0.02 ± 0.003

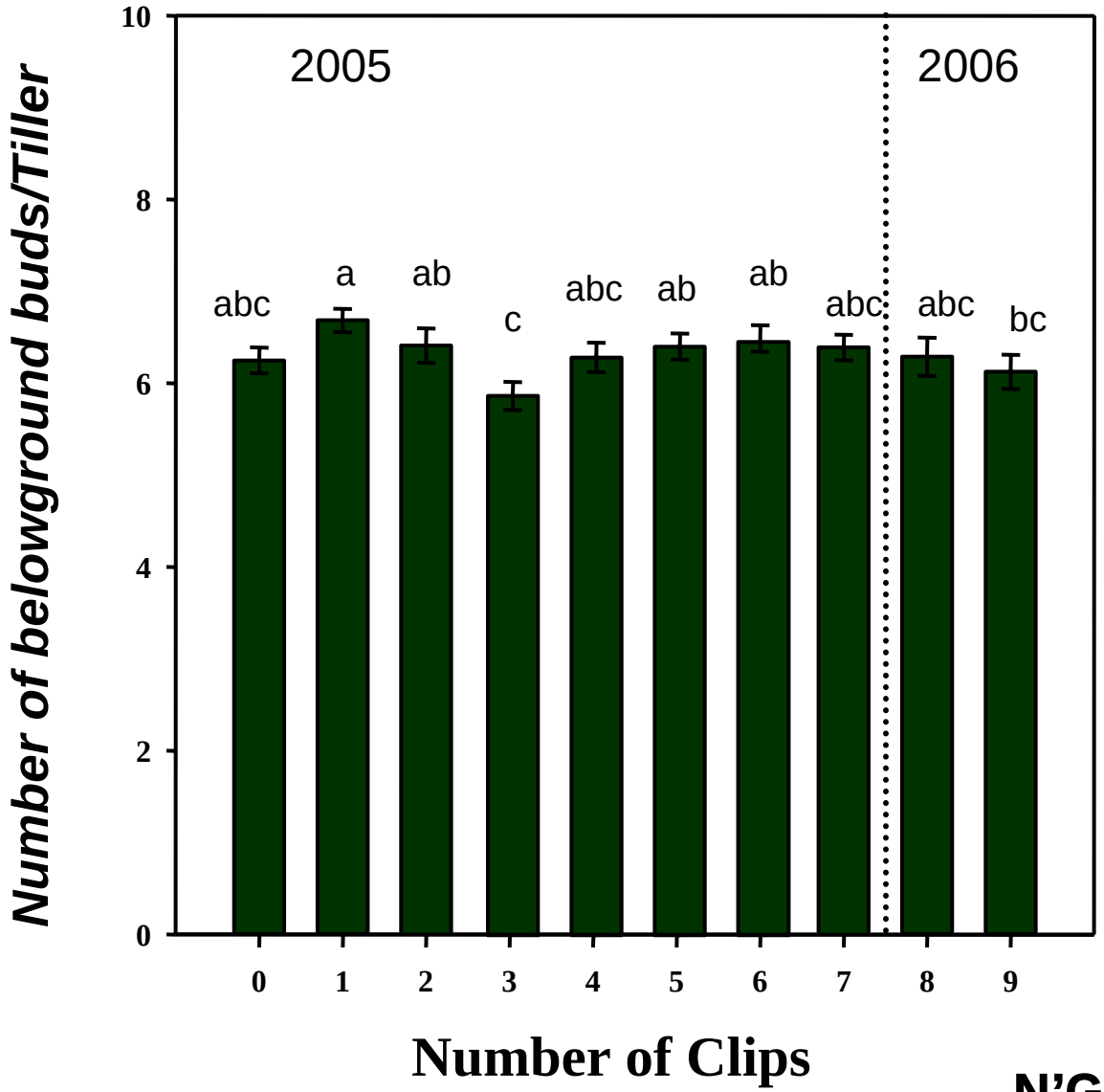
Tiller Size


0.4
0.3
0.2
0.1
0.0
Average Tiller Size (g)
P = 0.08
P = 0.28
P = 0.19
Control
+ N
2004
2005
2005
S. heterolepis
K. macrantha



N'Guessan (2007)

Reserve (dormant season) bud bank in *Schyzachrium scoparium*



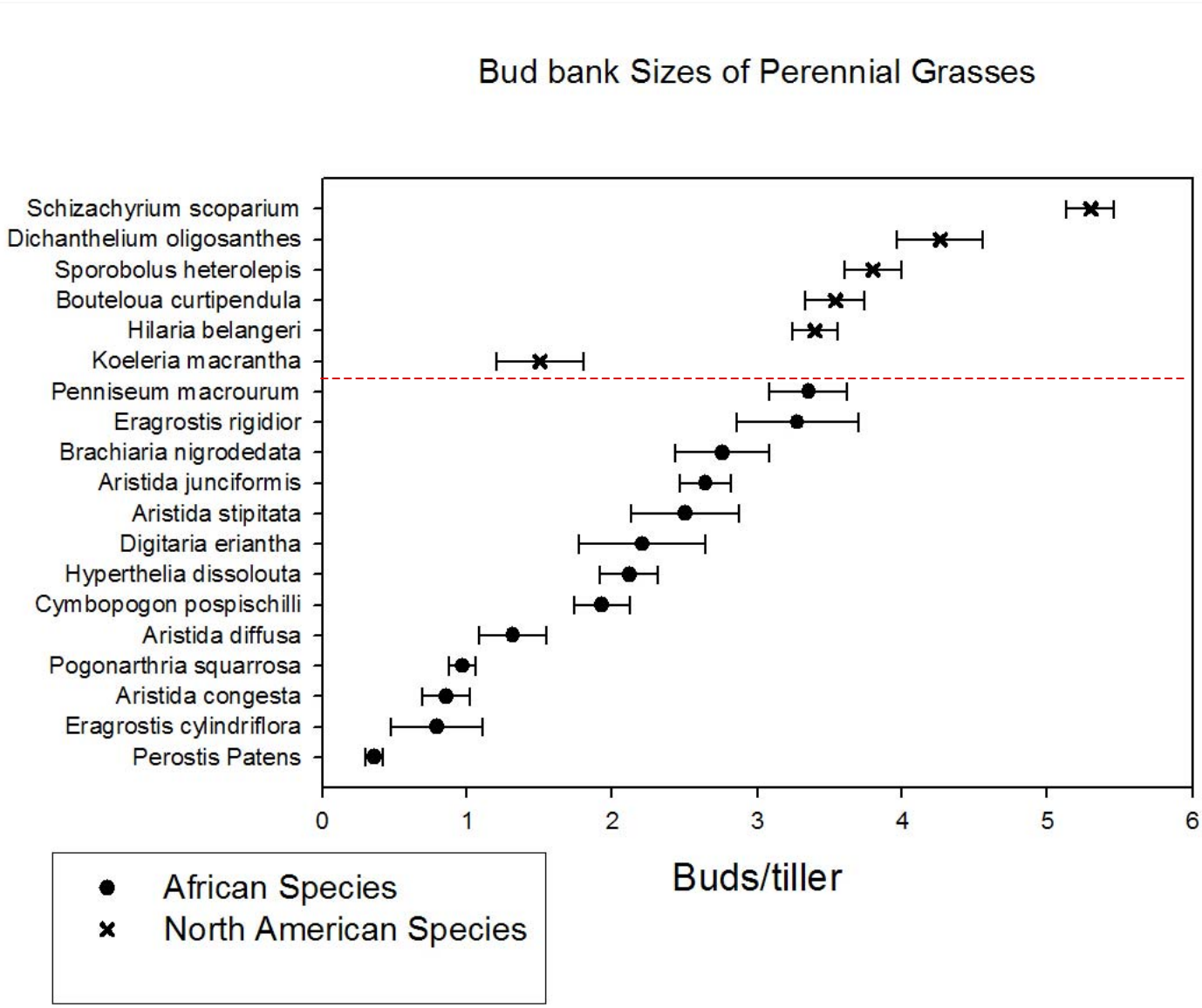
N'Guessan (2007)

Future Questions:

2. Patterns of inter-specific and inter-site variation in bud bank dynamics

Watershed R20A

Kalahari-Konza Comparative Study



Hartnett, Ott, & Dalgleish (in prep)

- Does bud bank size in African grass species influence their resilience to drought and grazing?
- Are seed production and bud production inversely related (trade-offs)?
- How does changing resource availability influence relative allocation to seed vs. vegetative reproduction?
- To what extent do seed banks and reserve bud banks buffer effects of environmental change on plant population dynamics?

Future Questions:

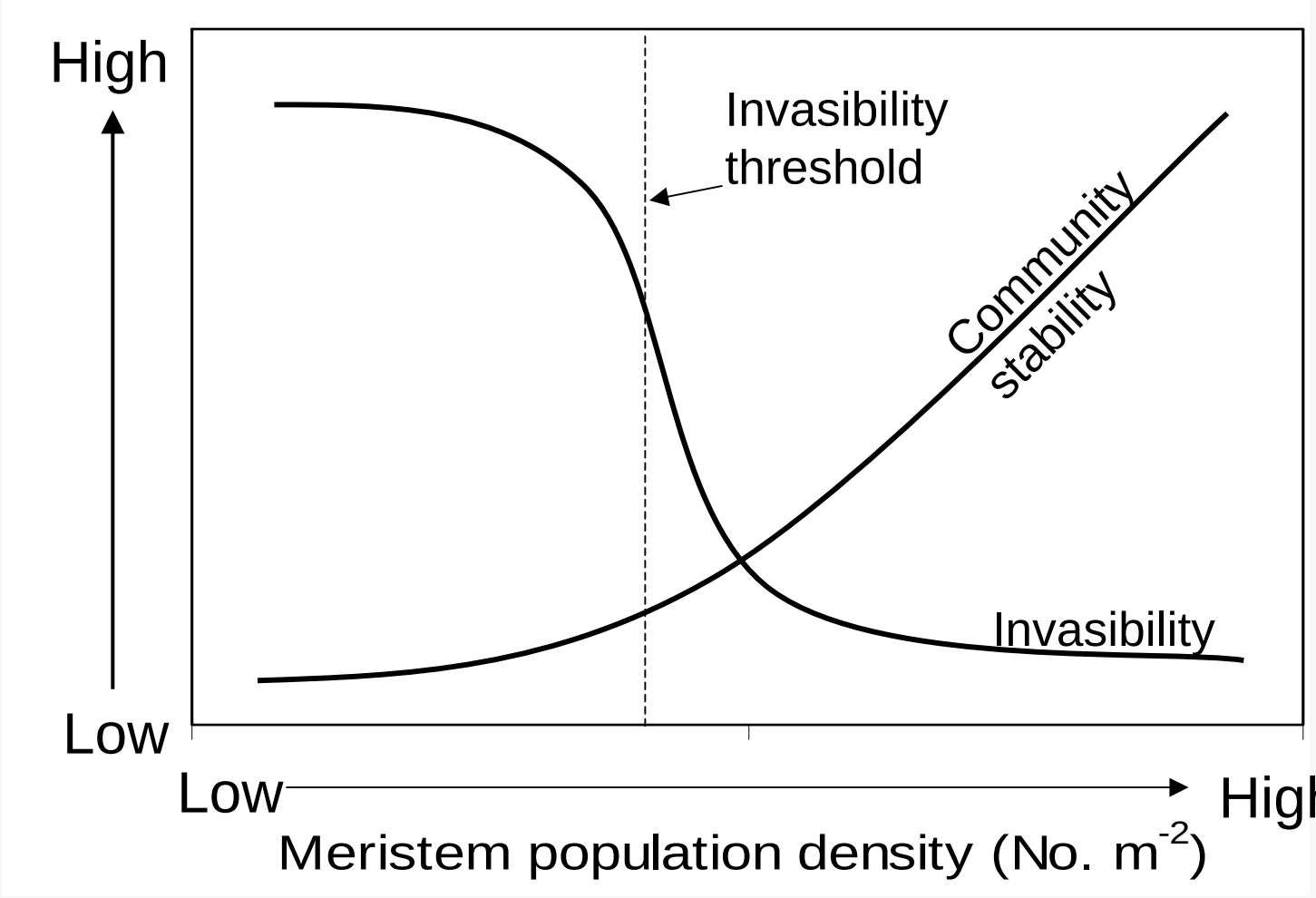
3. Long-term study of factors driving population dynamics of dominant, sub-dominant, and rare species

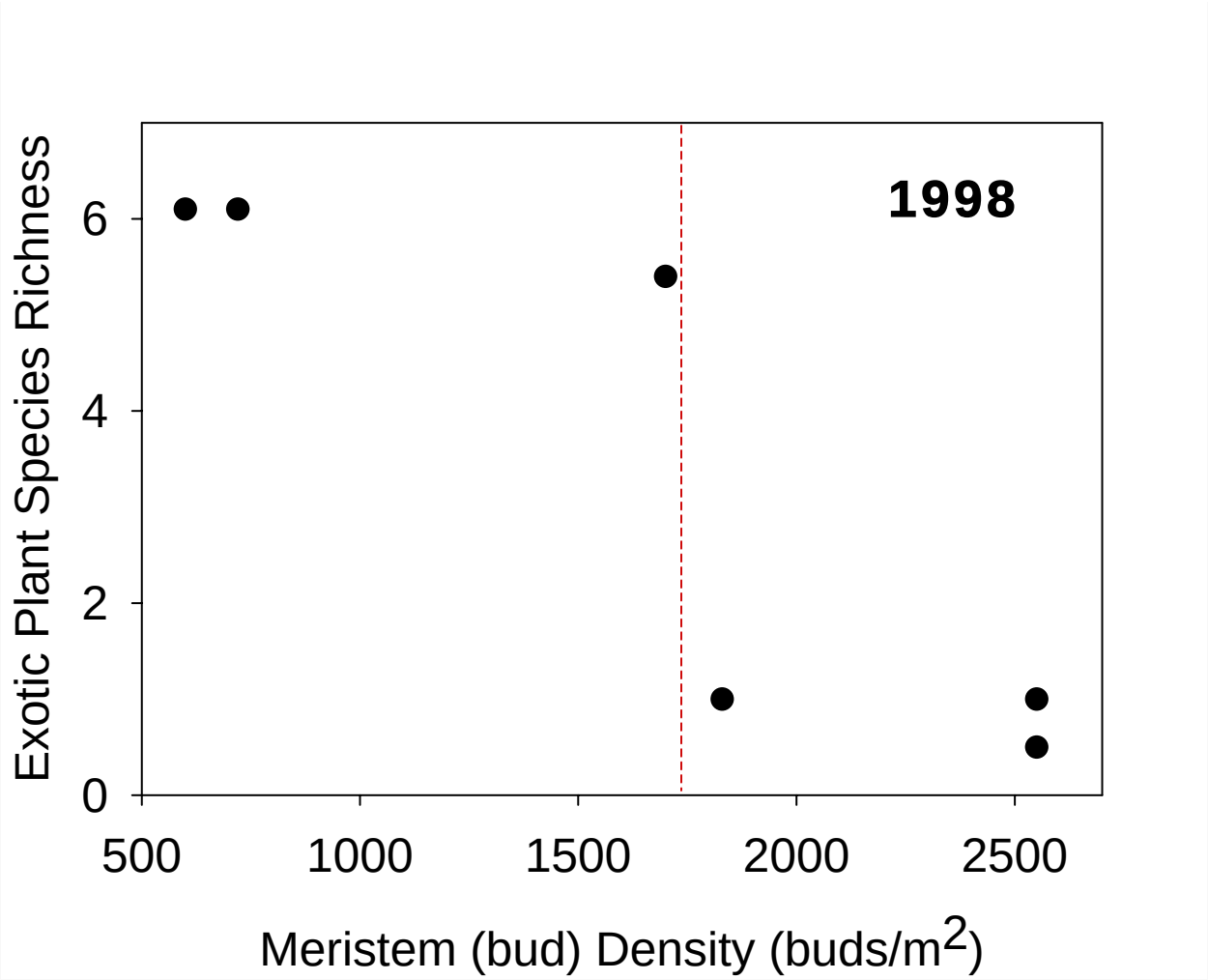
- Role of intrinsic and extrinsic factors on population dynamics of grass guilds (C_4, C_3, caespitose, rhizomatous grasses)
- Relative influence of weather, fire, and grazing on population dynamics

(c.f. Jonas and Joern 2007 synthesis on grasshopper dynamics)

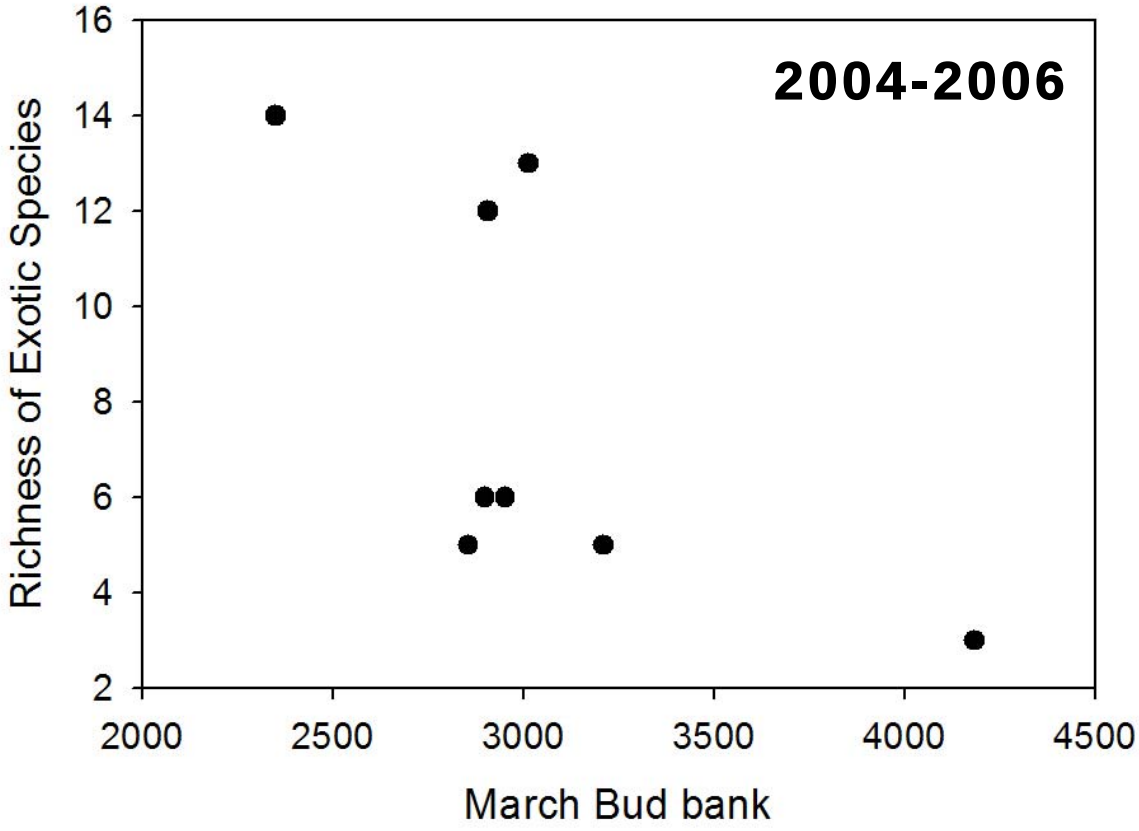
Future Questions:

4. Influence of belowground demography (bud bank densities) on invasibility of grasslands





Data from: Benson & Hartnett 2004,
Dalgleish & Hartnett (unpublished)


2004-2006
Richness of Exotic Species
16
14
12
10
8
6
4
2
2000
2500
3000
3500
4000
4500
March Bud bank

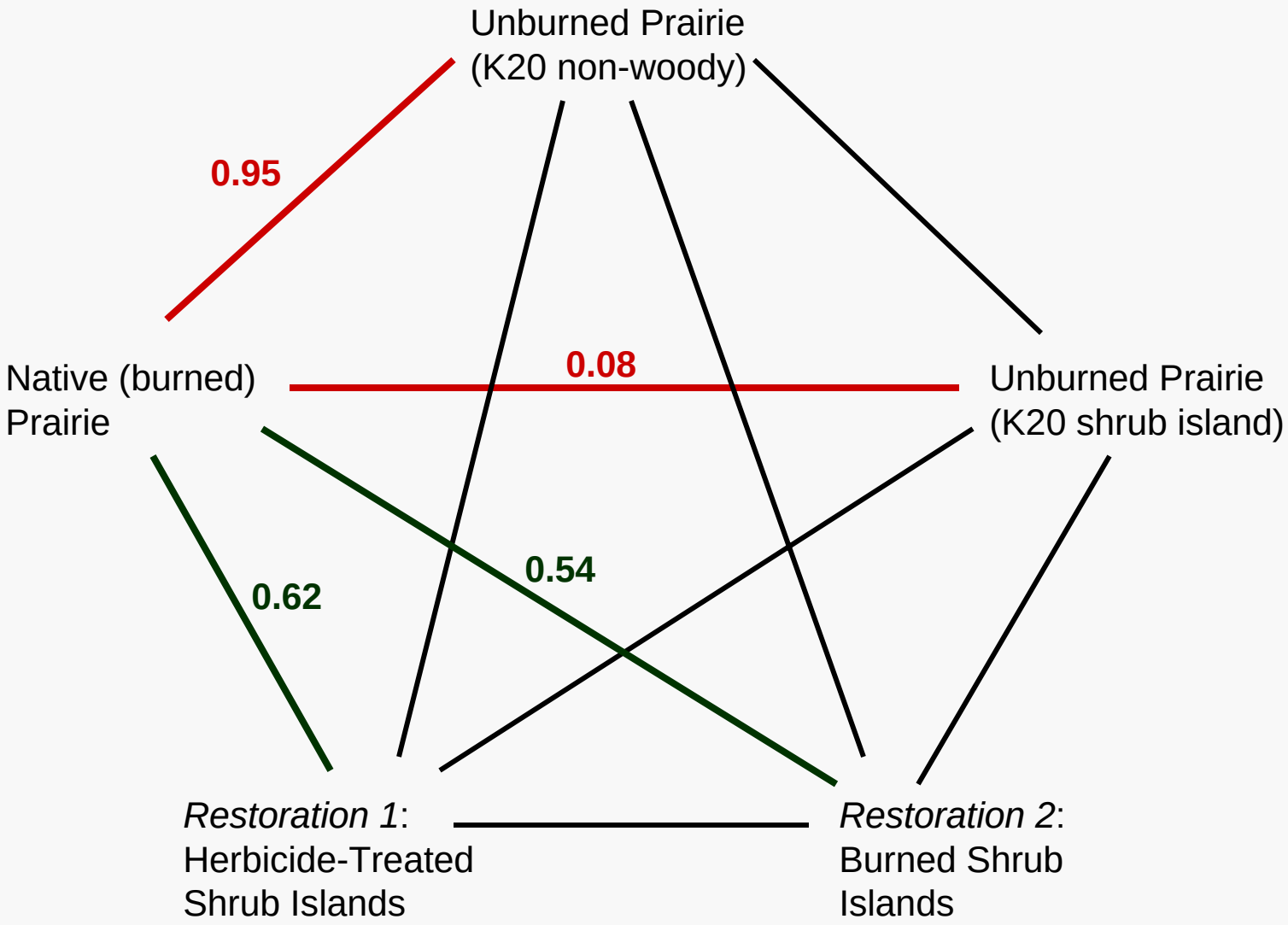
Future Questions:

5. De-coupling effects of fire suppression and woody plant invasion.

1. Split plot study on unburned watershed

- K20A, 20C, N20A, N20B
- Mechanical removal of woody vegetation on one portion of unit

2. Comparison of population dynamics and community trajectories in replicate“wooded” and “un-wooded” sites within unburned watersheds



Herbaceous community similarity (Morisita's Index) between tallgrass prairie sites.

Andrade (2007)