



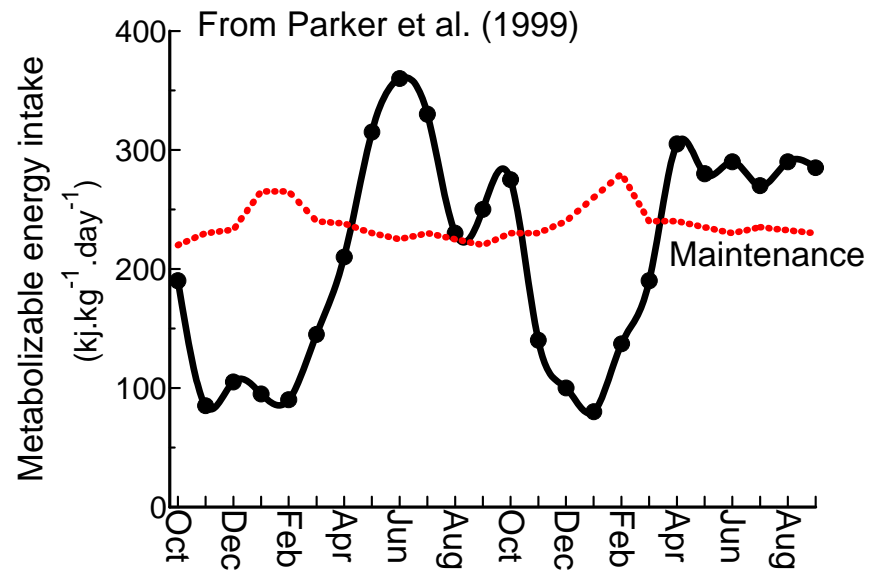
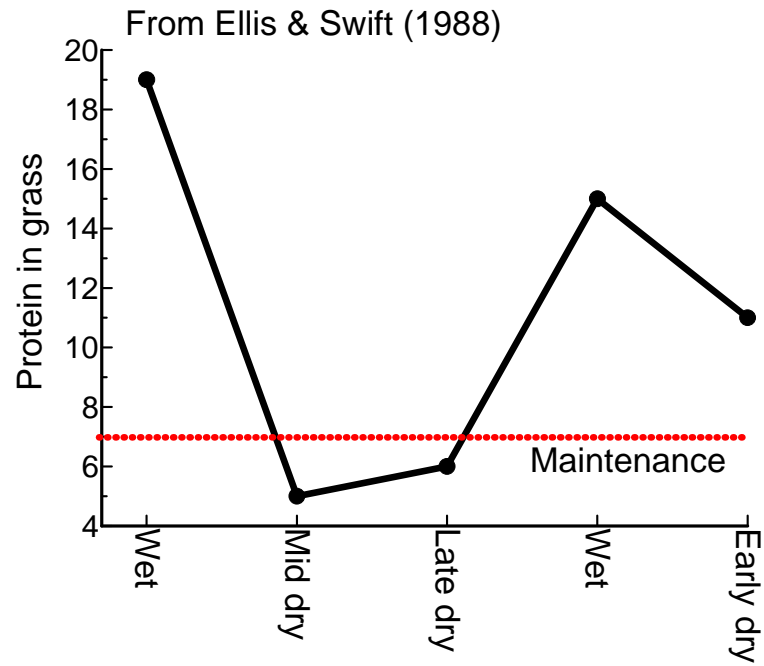
A FRAMEWORK FOR MANAGING WILDLIFE SYSTEMS

THE IMPORTANCE OF SCALE

RICHARD FYNN

UKZN/Colorado State/Yale collaboration
Savanna Convergence Experiment

Energy and protein bottlenecks



Multiplier effects on populations (White 1983)

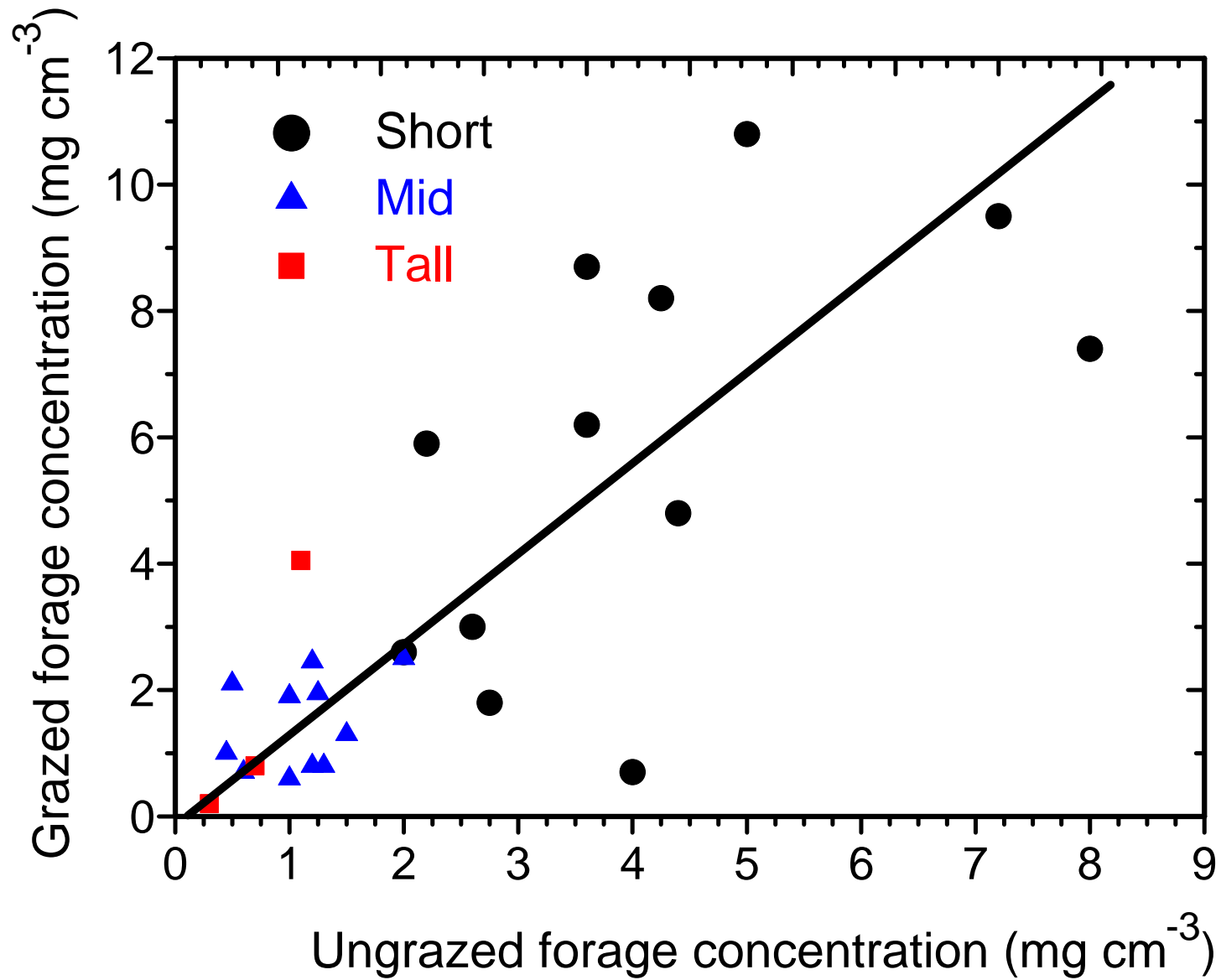
High quality growing-season resource (Na, P, Protein & Energy intake)

- Lactation
- Calf growth rates
- Age at first conception
- Size of adults
- Protein and fat storage (for dormant season)

Dormant-season buffer resource

- Minimize rates of use of body stores
- Maintain foetus
- Calf size at birth

Habitat quality



Habitat quality



Habitat quality



Habitat quality



Habitat quality



Habitat quality



Habitat quality



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Habitat quality




There are three main factors affecting herbivore populations

1) The resource heterogeneity effect

The resource heterogeneity effect

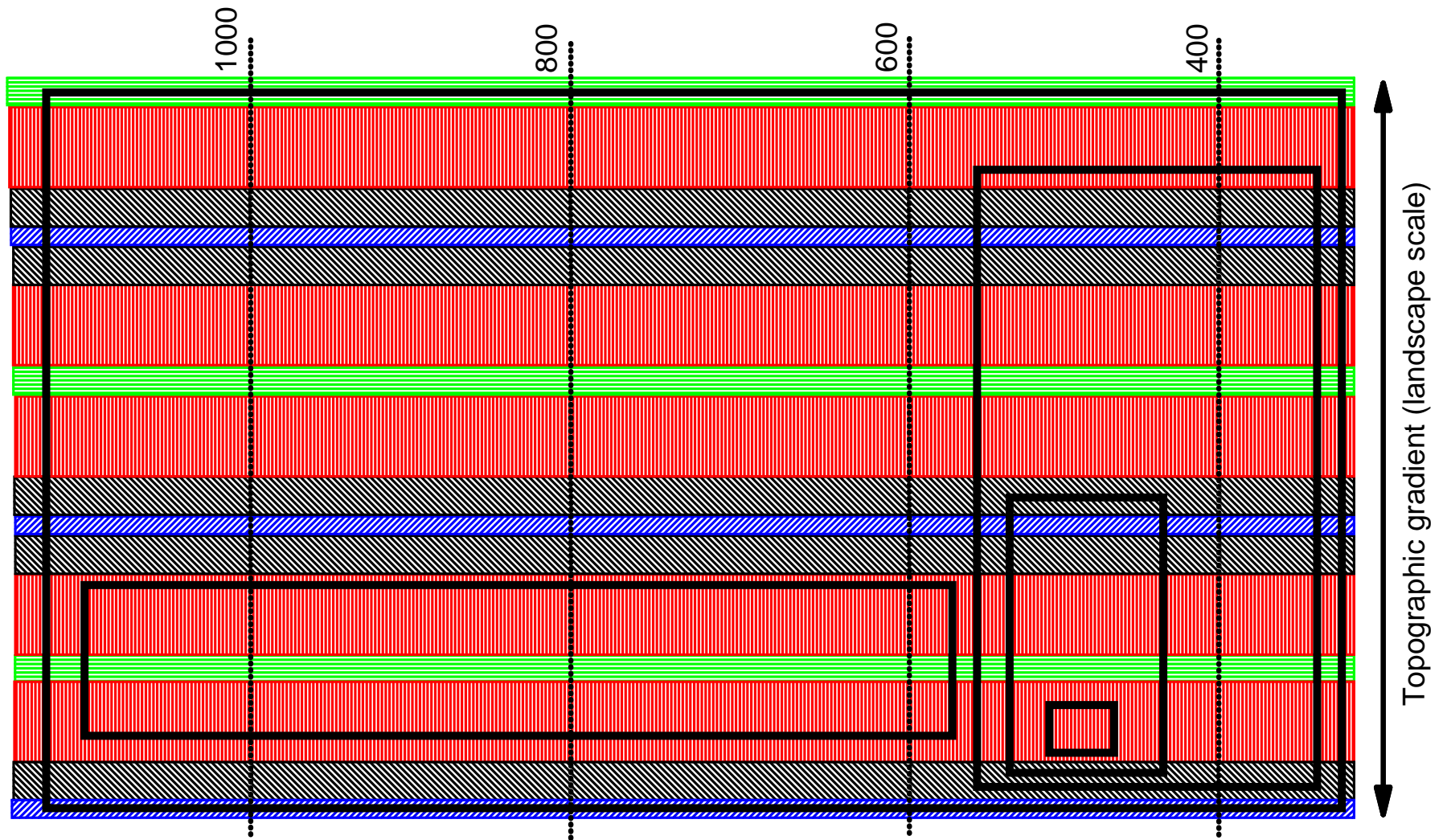
 Crests

 Mid slope

 Sodic

 Riverine

Rainfall gradient (regional scale)



The resource heterogeneity effect

- Greater spatial scale of movement allows greater access to resources:
- High quality short grass sites in summer
- Mid grass sites in early winter
- Key resources in the dormant period
- Migration on productivity/forage quality gradients
- Tracking patchiness of rainfall and fire
- Finding suitable mineral licks

The resource heterogeneity effect

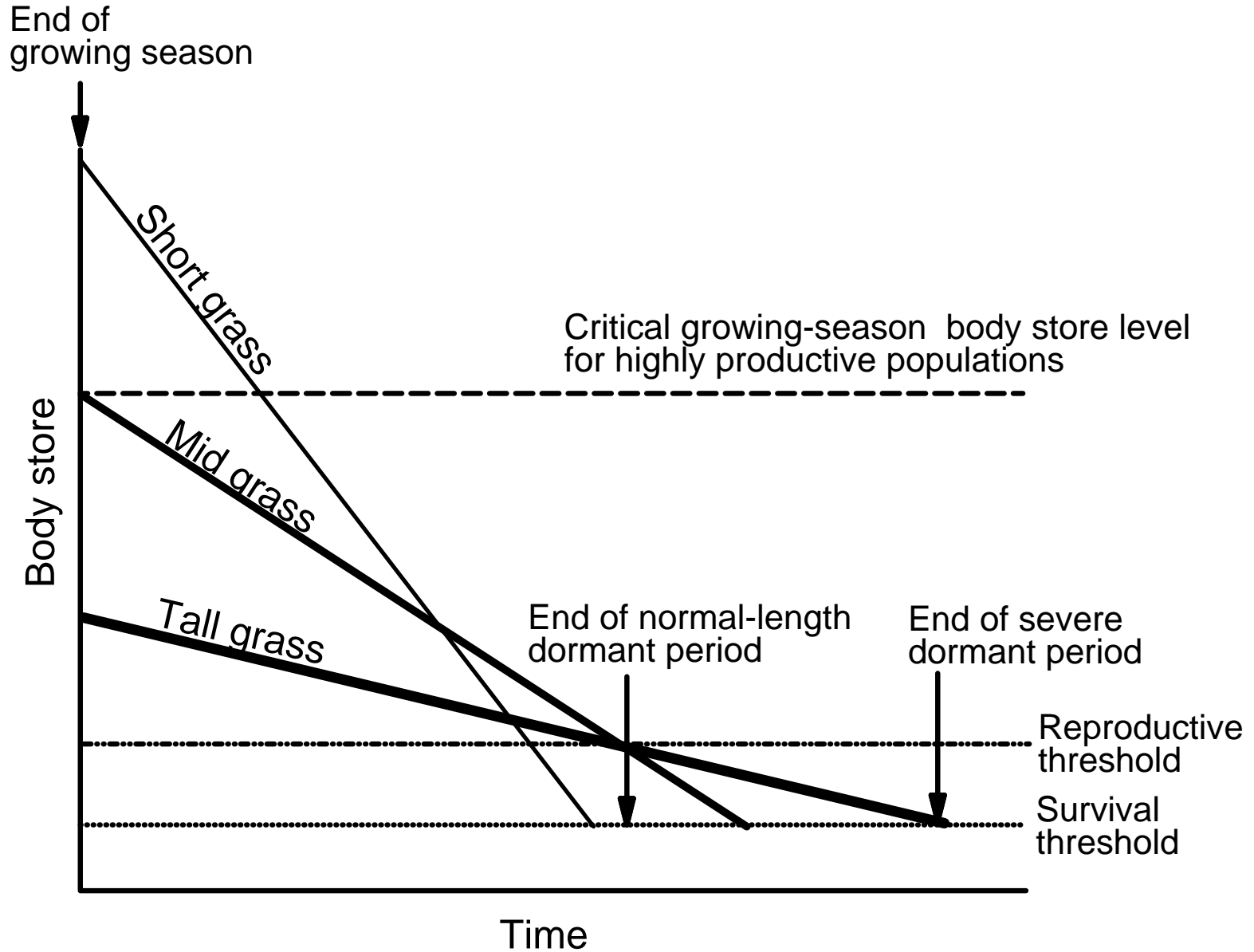
Tracking greenness associated with patchy rainfall events is a major strategy for many herbivores during the growing season:

- **wildebeest** (McNaughton 1979; Wilmshurst et al. 1999),
 - **Topi** (Bro-Jorgensen et al. 2008),
 - **Hartebeest** (Verlinden & Masogo 1997),
 - **Mongolian gazelle** (Mueller et al. 2008),
 - **Dorcas gazelle** (Carlisle & Ghobrial 1968), and
 - **livestock herders** in transhumance systems (Wilson 1977)
-
- **Also fire:** (Fuhlendorf & Engle 2004; Archibald et al. 2005)

The resource heterogeneity effect



The resource heterogeneity effect

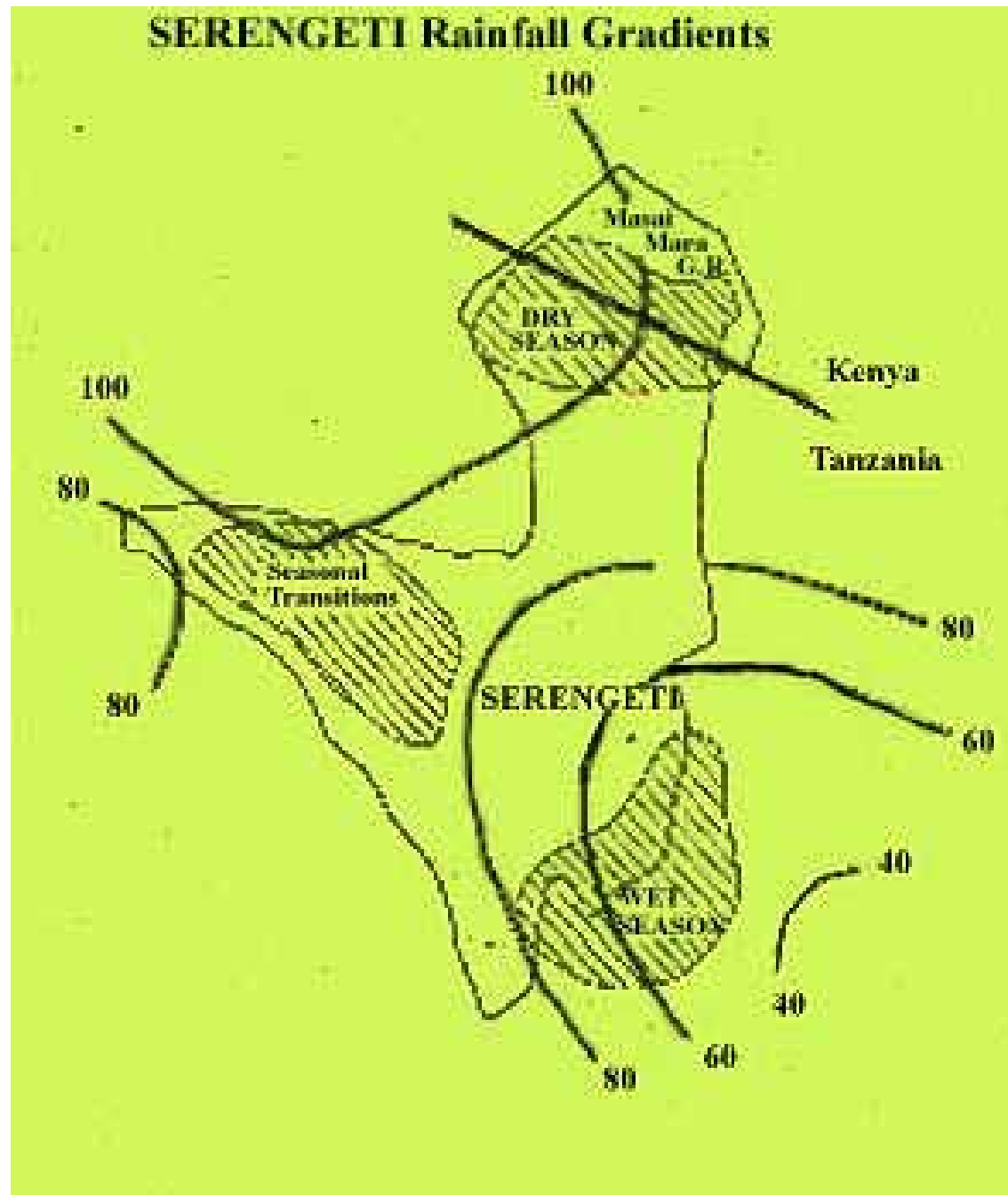


The resource heterogeneity effect

Factors affecting the ability of herbivores to make foraging decisions have the greatest consequences for their populations at the **regional scale**

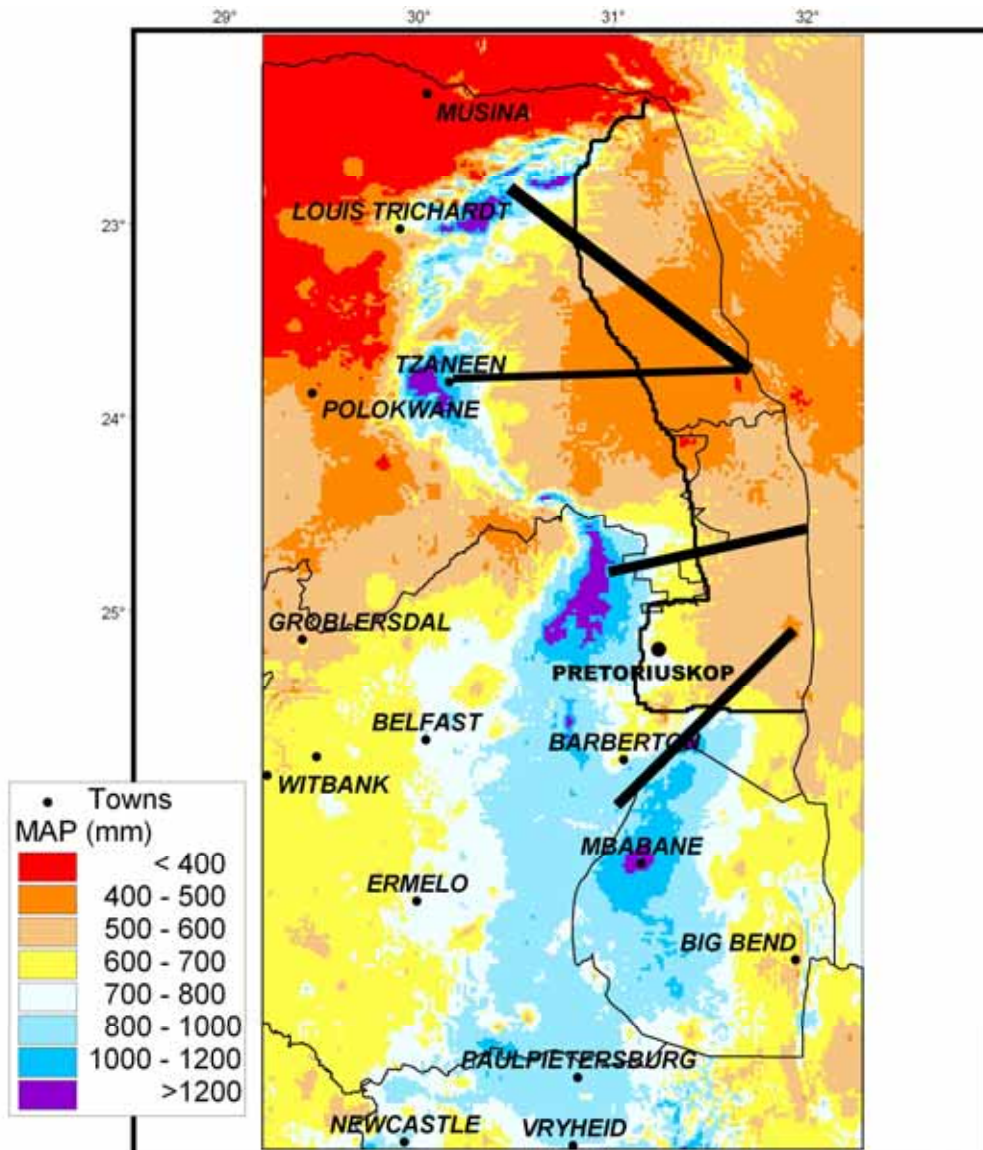
(Senft et al. 1987; Wiens 1989; Rettie & Messier 2000; Parker et al. 2009)

The resource heterogeneity effect



The resource heterogeneity effect

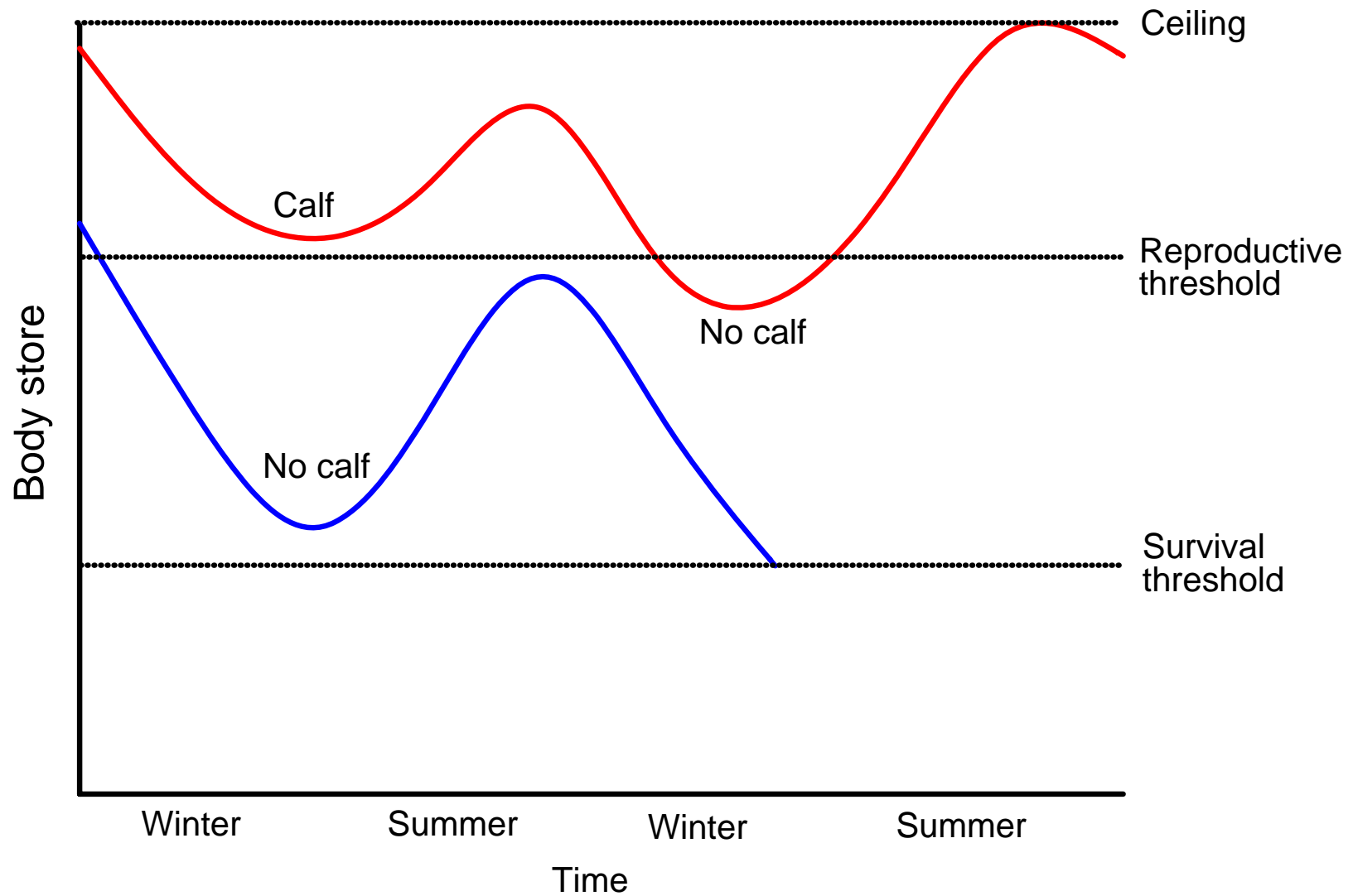
**Mean Annual Precipitation (mm)
Lowveld Region
(After Lynch 2003)**



The resource heterogeneity effect

*“In 1926, when the Sabi and Shingwedzi Game Reserves were united in the Kruger National Park, certain areas along the western boundary of the old Sabi Reserve were excised. In my own section, the Pretorius Kop area of the park, much of the area excised at the time of its removal from the park’s territory it was literally packed with game. In fact it is sad to relate that this portion covered some of our best game country, as it was well watered, and, with big vleis in most parts, **there was always early summer grazing**” (Wolhuter 1948).*

A nutritional balance framework – Parker et al. 2009



- 2) The herd impact effect and
- 3) the decoupling effect

The decoupling effect

Herbivore-resource decoupling increases with increasing spatial scale because herbivores are increasingly able to

➤ Avoid drought

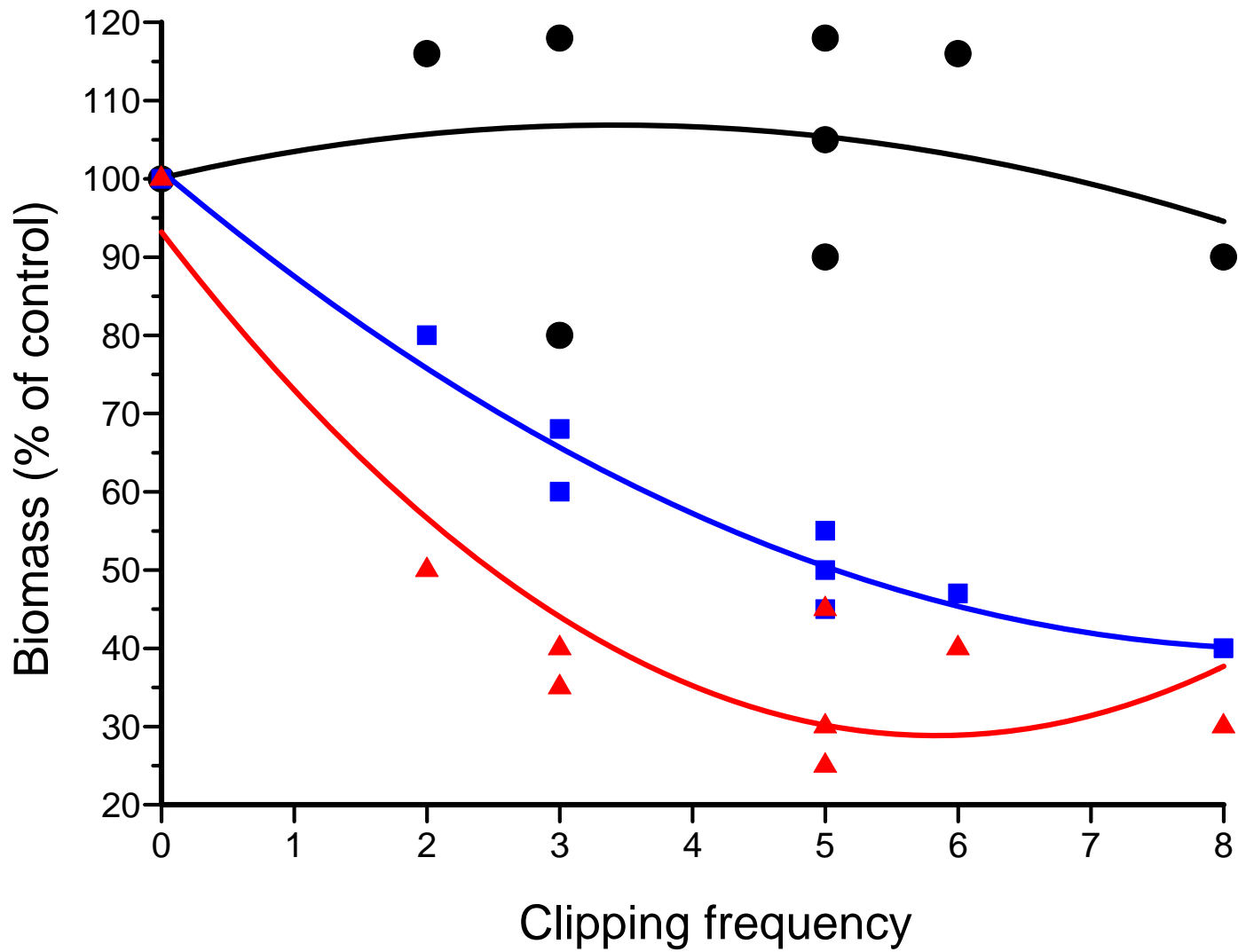
- Prevents grazing damage of drought-stressed forage

➤ Use different regions each year

- Allows greater rest and recovery periods for forage

The decoupling effect

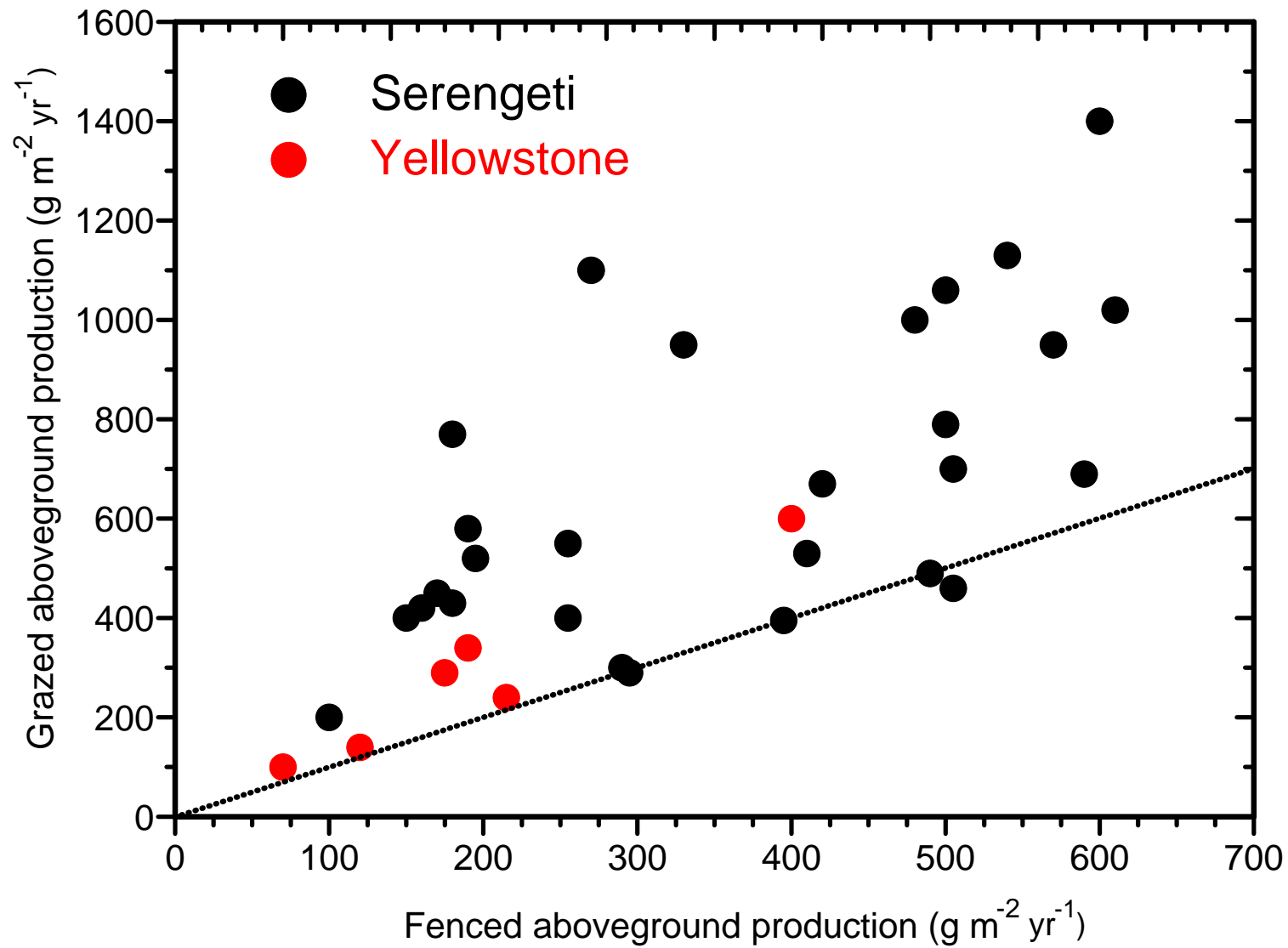
—●— year 1 —■— year 2 —▲— year 3



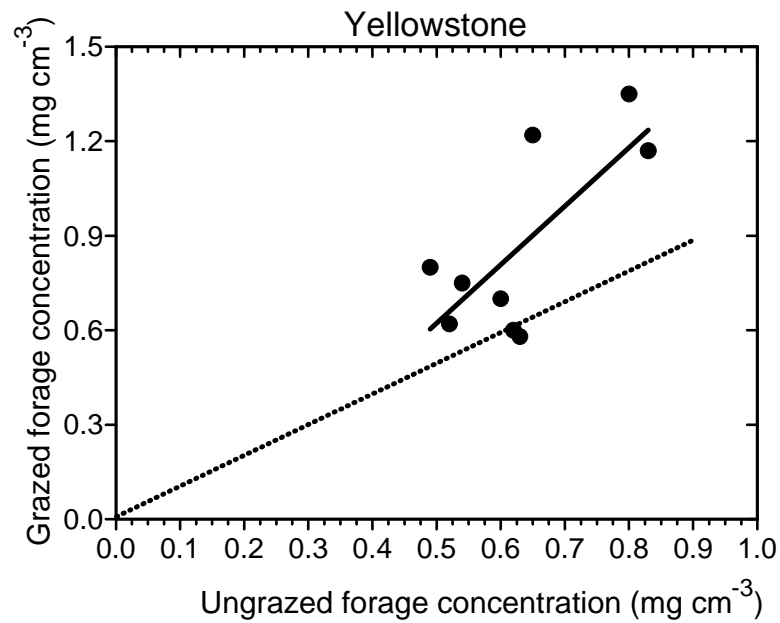
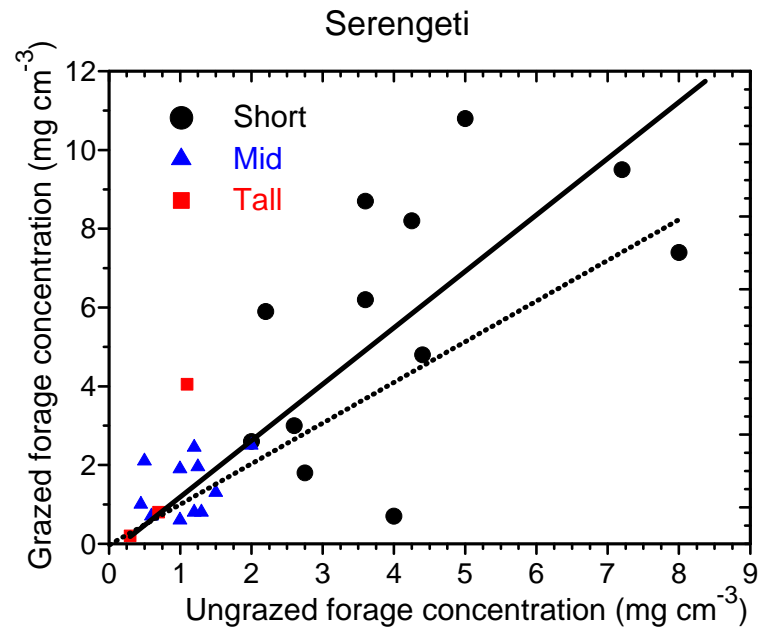
The decoupling effect

Herbivore-resource decoupling creates a vigorous and healthy forage base which is able to respond positively to herd impact

The herd impact effect



The herd impact effect



The herd impact effect

Many studies show that lack of grazing impact results in low plant density and large bare spaces:

- Fuhlendorf & Smeins 1999;
- Fuhlendorf et al. 2001;
- Guevara et al. 2002;
- Gonnet et al. 2003;
- Derner & Whitman 2009

The herd impact effect

Large-scale migratory grazing systems result in:

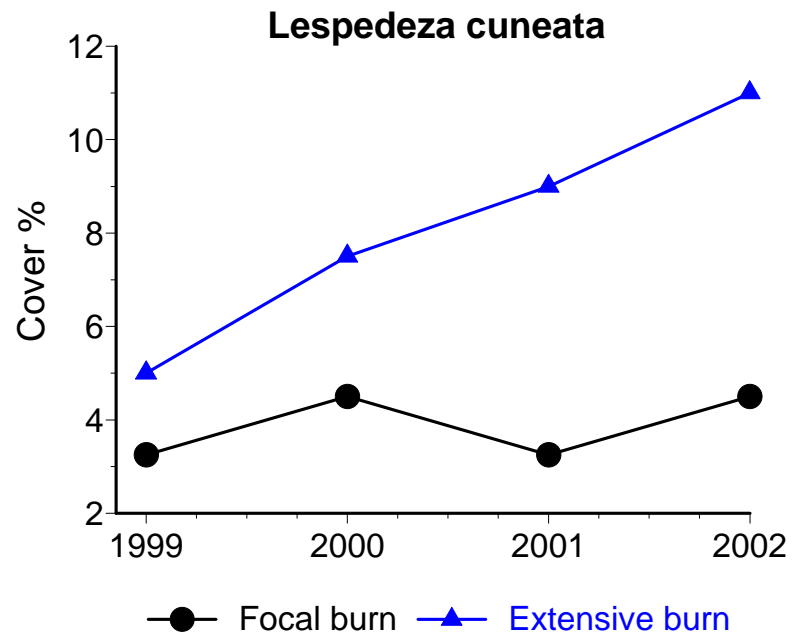
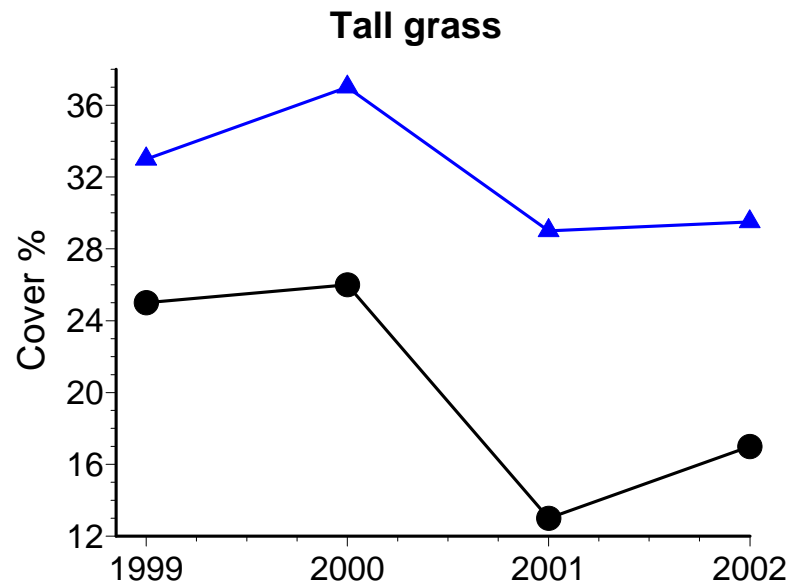
- Greater density of grasses
- More productive grasses
- Greater biomass concentration

Consequently, greatly reduced tree invasion

The herd impact effect

In the Kruger National Park, the r^2 in the relationship between bush cover and fire return period (3.5 – 17 years), **was 4% and 6% for the granites and basalts, respectively** (Eckhard et al. 2000, Afr. Jnl. Ecology 38:112)

The herd impact effect



The herd impact effect



The herd impact effect

Changing the scale at which animals graze (herd size, density and mobility) has large effects on the degree of selective grazing (see Norton 2003)

The herd impact effect



The herd impact effect



The herd impact effect



The herd impact effect



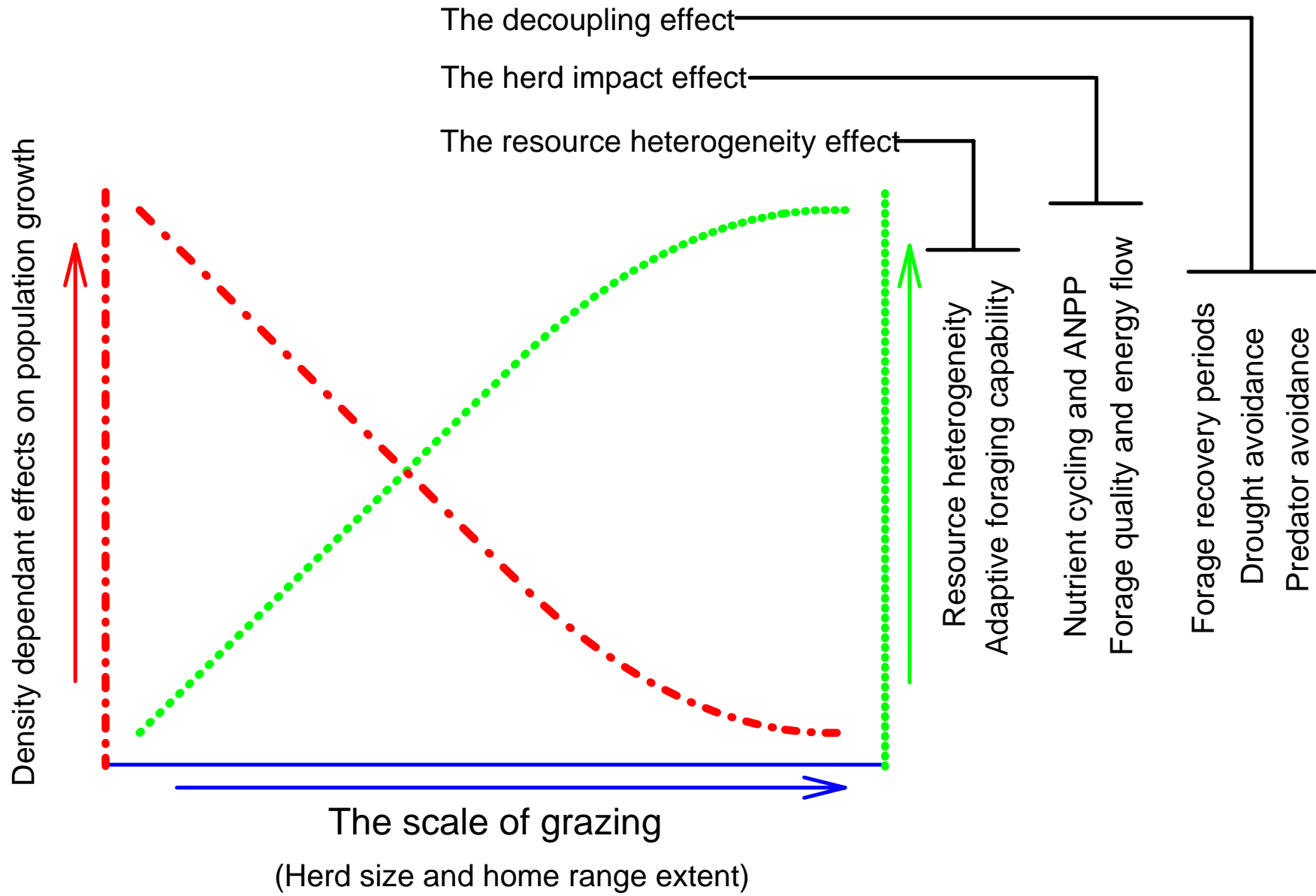
Herbivore-predator decoupling

Herbivore-Predator decoupling

At large spatial scales herbivores are able to select regions (**regional scale selection**) that allows them to minimize predation risk without severe tradeoffs in forage quality/quantity

(Smuts 1978; Fryxell et al. 1988; Rettie & Messier 2000)

Scale-based determinants of herbivore population performance



Thank you!

