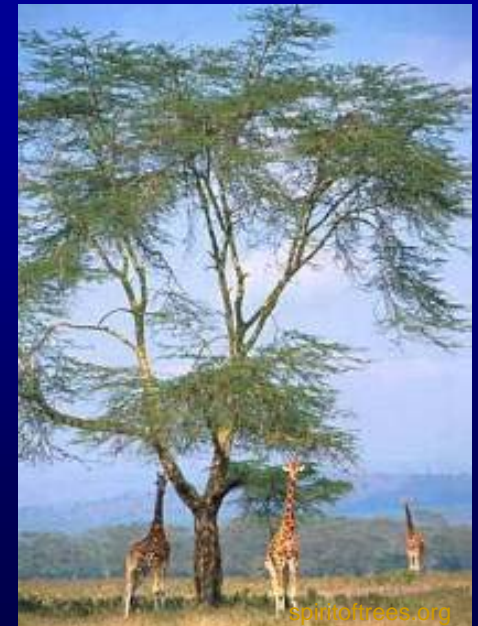


Do trees really matter?

Insights into sub-canopy grass quality in African savannas

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Current problem in African savannas:

Decrease in large tree cover

- Tree clearing for charcoal, timber, farmland
- Locally high elephant densities
- Decrease in woodland areas, habitat fragmentation



What effect does this have on the vegetation underneath and surrounding trees, and on the associated animals?



Large trees = “islands of fertility”

Several studies on soil but few and contradictory ones on the continuous grass layer underneath canopies.

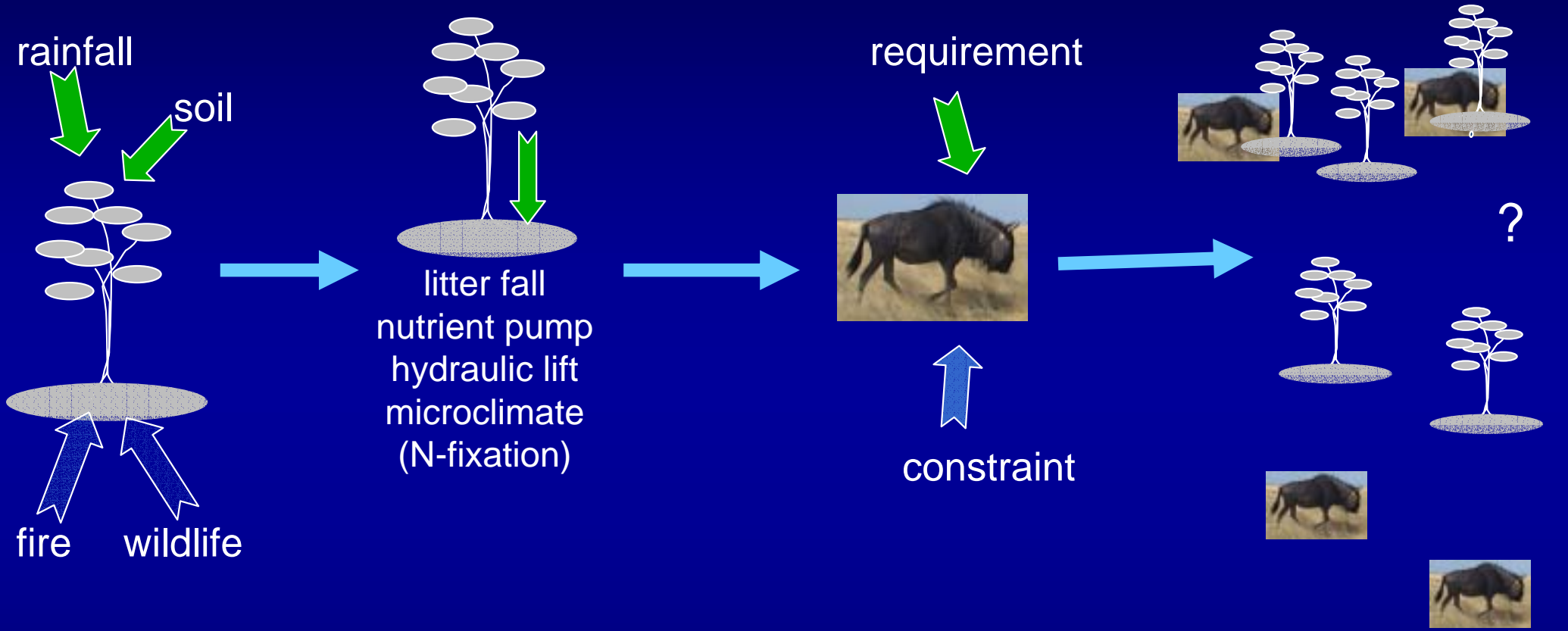
(Belsky et al. 1993, 1994; Ludwig et al. 2001, 2003; Scholes et al. 2003)

Savanna trees compete with grasses for light, nutrients, and water - but do they also facilitate growing conditions?!?



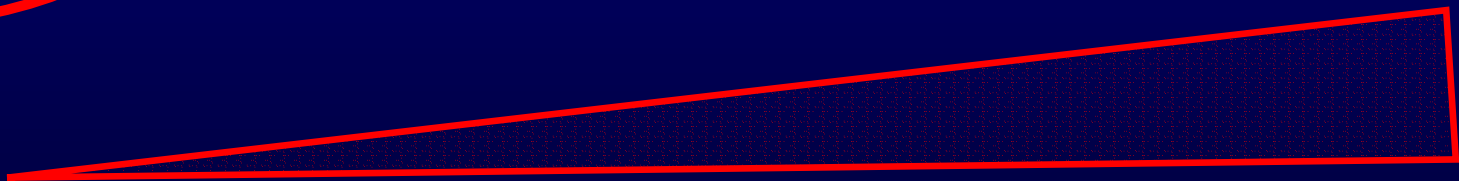
TREE

ANIMAL



quality + quantity
of grass

feeding behaviour
+ preferences



Trees and grass layer:

- 1) Forage quality of grasses beneath tree canopies is higher than in open savanna grassland.
- 2) Nitrogen-fixing trees amplify that difference.

- good growing conditions
- high grass quality
(N, P, OM, NDF contents, structure)
- mainly palatable species
(e.g. *Panicum* spp. and *Cynodon* spp.)



Trees and grass layer:

3) Along a raising rainfall and soil fertility gradient, the difference in forage quality of grasses below and beyond tree canopies will decrease.



- trees might not enhance grass quality under good growing conditions
- quantity of the improvement by trees might vary seasonally

Study sites

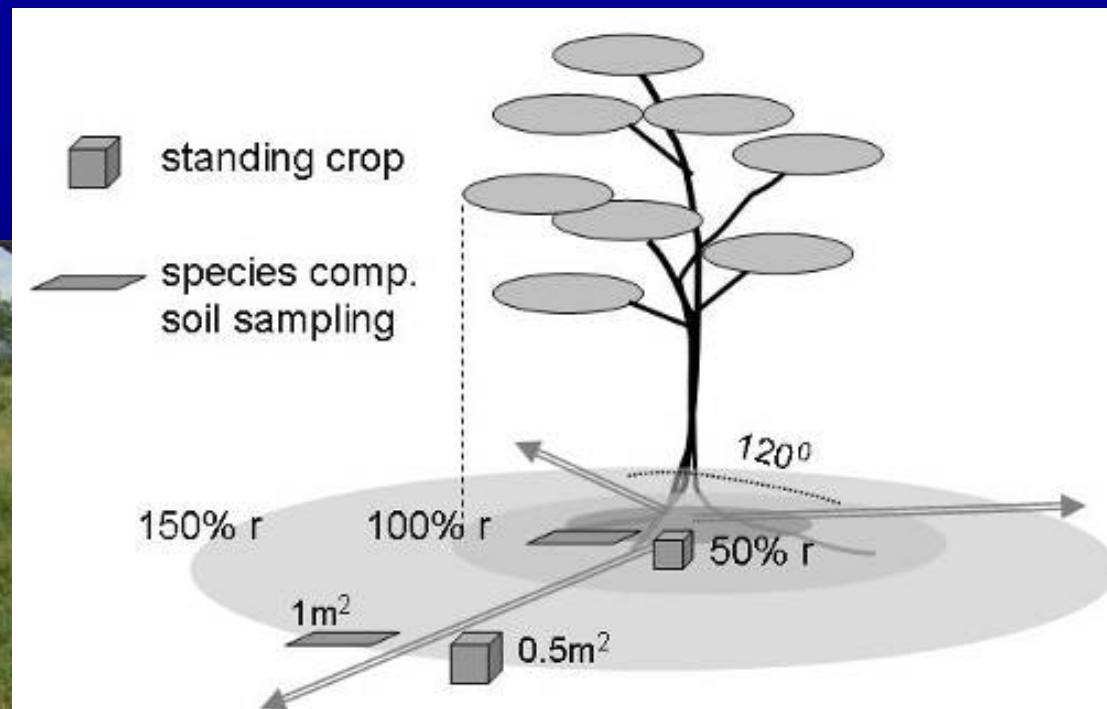
study site	rainfall	soil type	soil nutrients			
			OC		SC	
			N	P	N	P
Timbavati	450 mm	eutric regosols	0.08	0.01	0.12	0.02
Makalali	450 mm	ferric luvisols	0.10	0.01	0.17	0.02
Kruger	<500 mm	basaltic, melanic	0.18	0.09	0.26	0.09
Saadani	900 mm	rhodic ferralsols / chromic luvisols	0.34	0.09	0.37	0.11



- Rainfall
- Soil fertility
- Lightly wooded savannas
- Tree & grass species
- Animal species

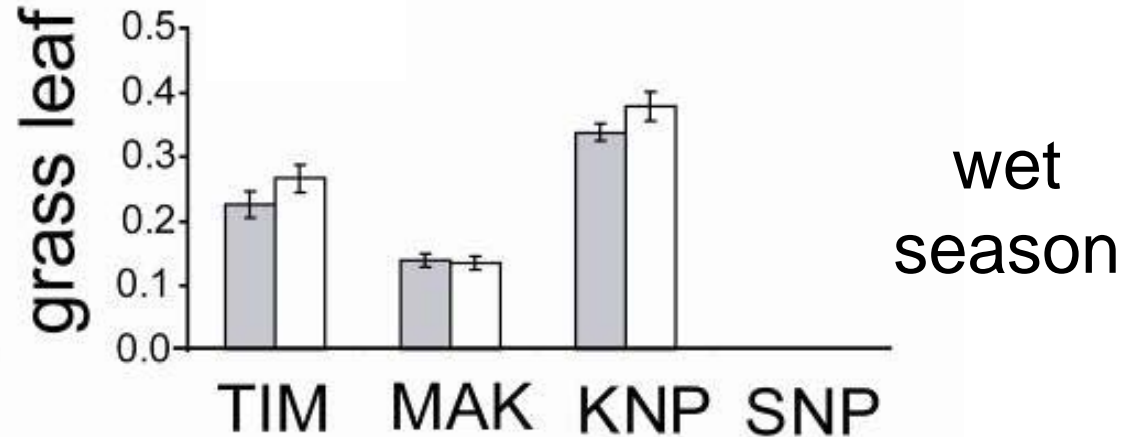
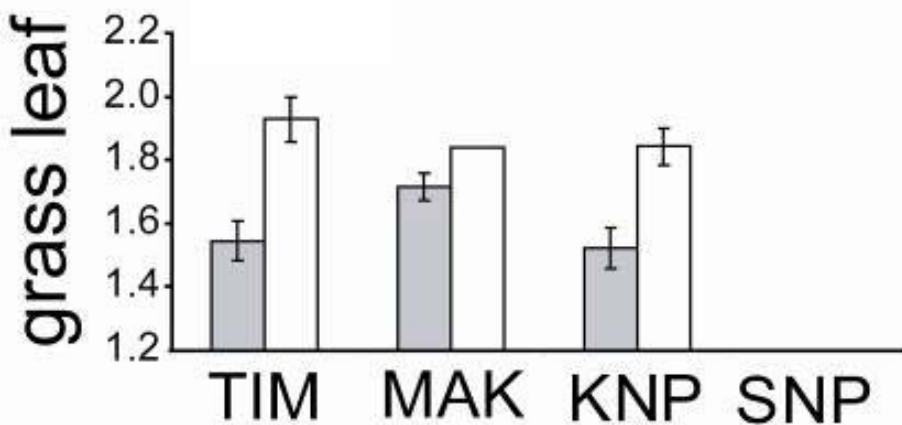
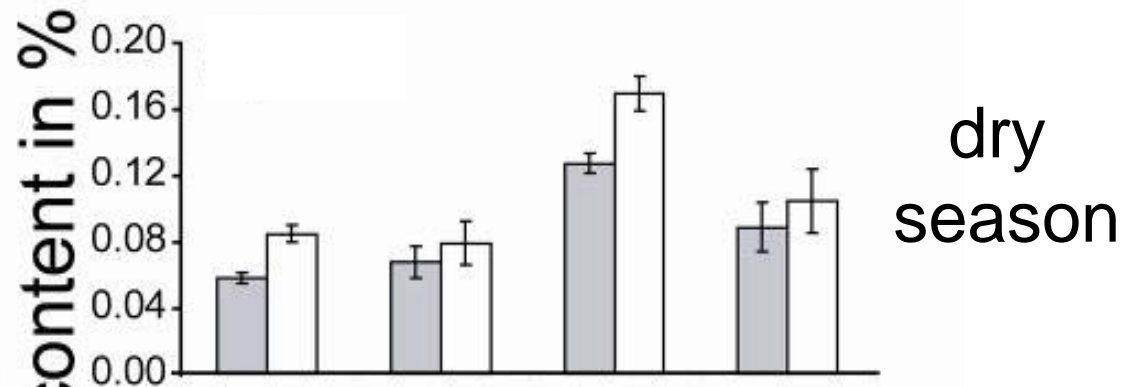
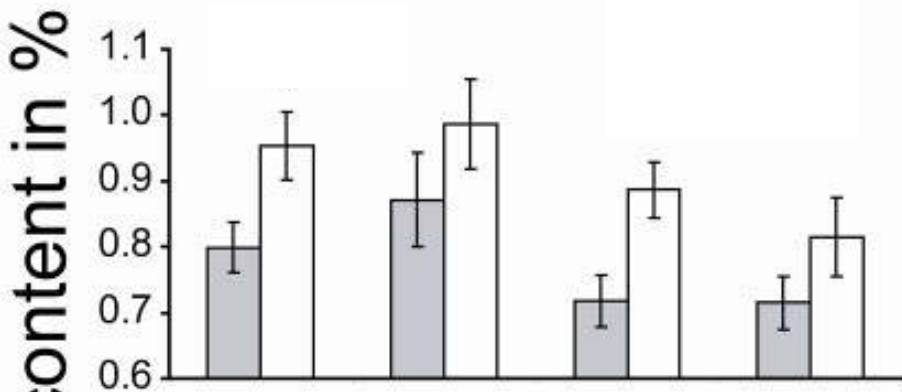
Methods

- Select suitable trees (species, N-fixer, and structure)
- Sample plots underneath and outside of tree crowns
- Grass layer species composition and structure
- Standing crop (stem : leaf, dead : alive)
- Soil samples
- N, P, NDF content of bulk sample and of single species



Results

Nutrients all sites

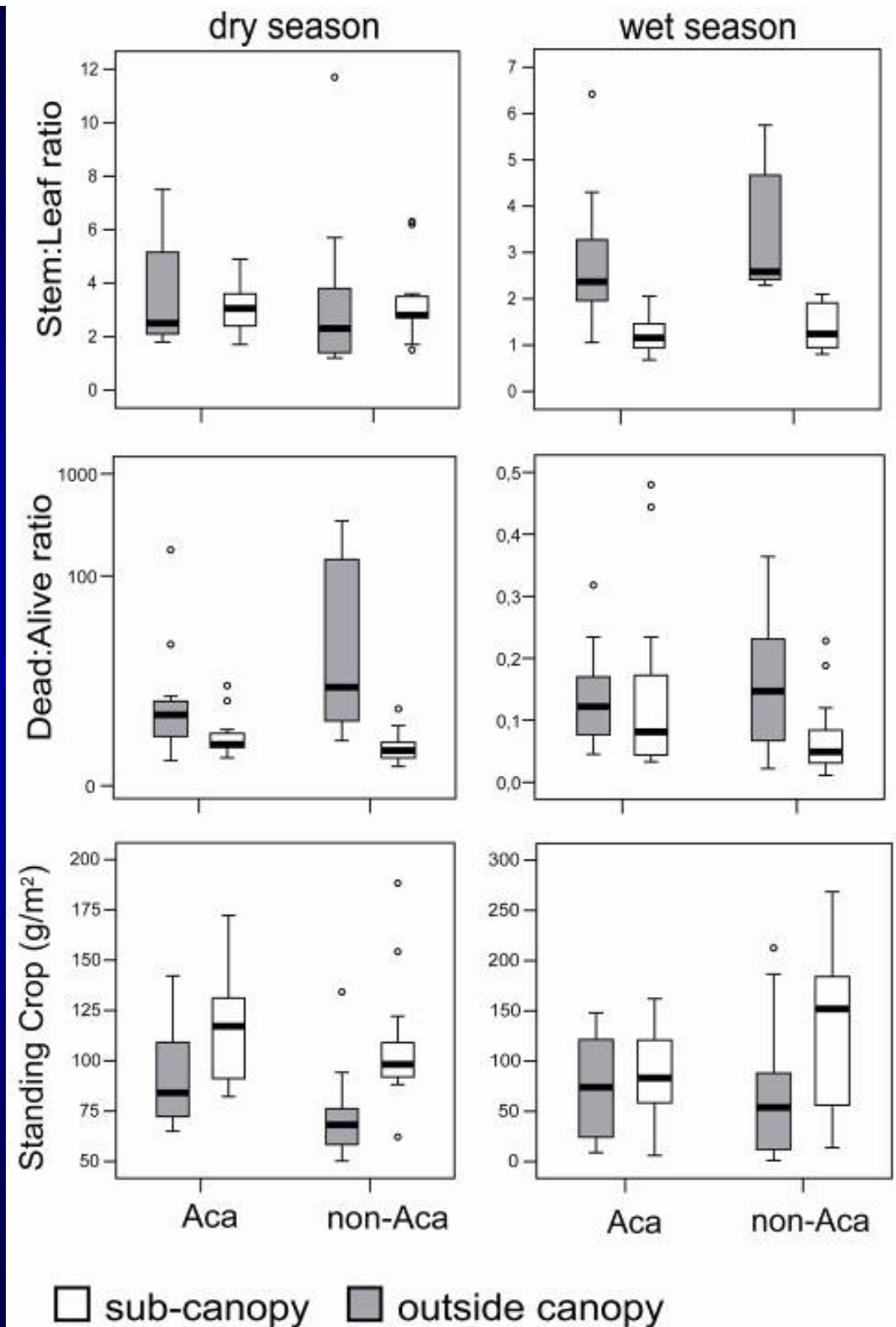


→ increasing rainfall and soil fertility

□ sub-canopy ■ outside canopy

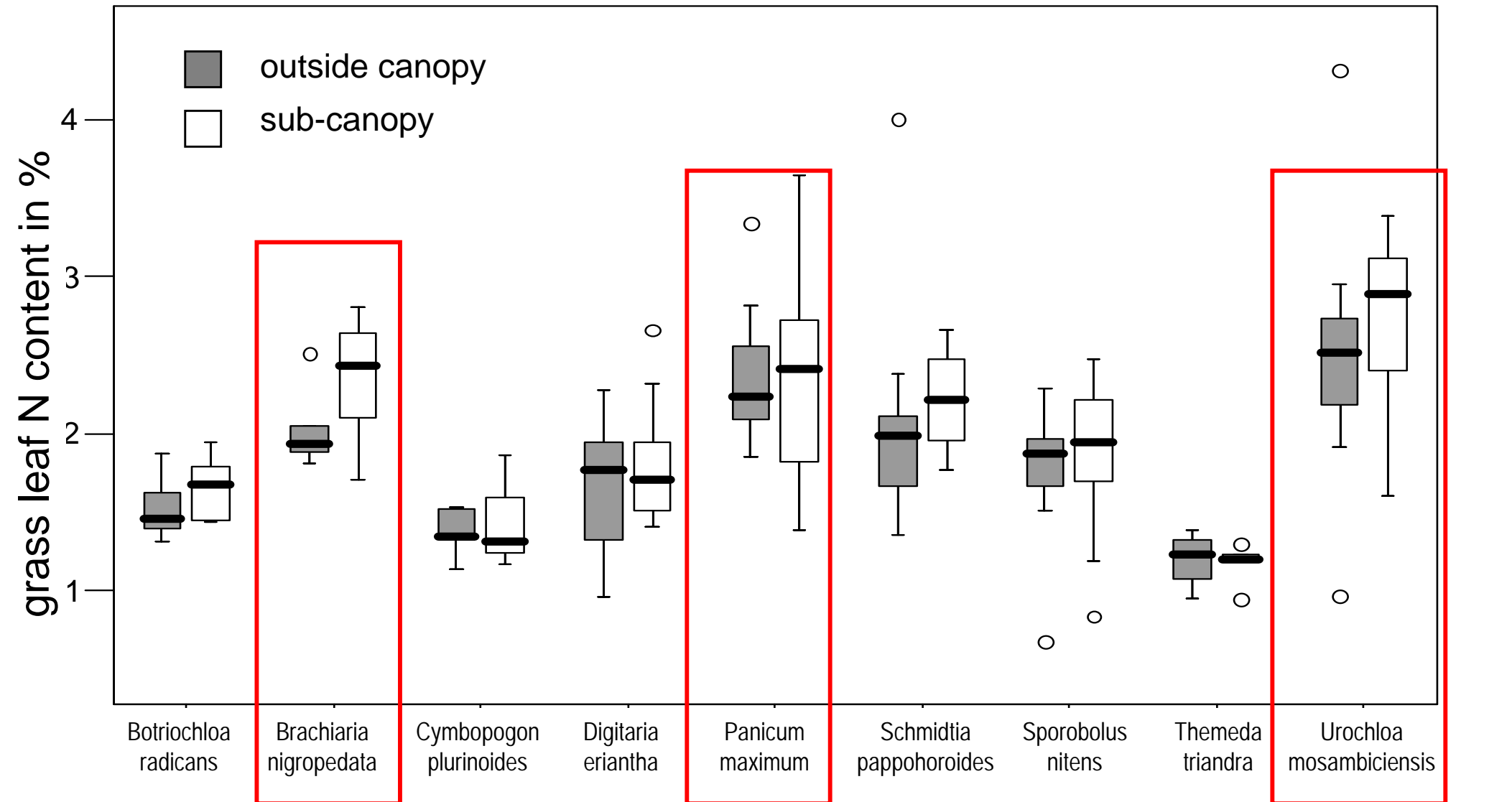
Results

Structure KNP (Roan enclosure)



Results

Nutrients grass species MAK



Results and Discussion

- 1) Canopy improves forage quality
 - Up to 25% higher N and P grass leaf contents sub-canopy
 - *Panicum maximum* almost exclusively, *Cenchrus ciliaris* and *Digitaria eriantha* mainly found sub-canopy at all sites
 - Grass structure: improved, particularly during wet season
- 2) N-fixing capacity of trees does not add to positive canopy-effect
- 3) Low rainfall and low soil fertility site - and the Roan enclosure (KNP) - show highest improvement through trees



Discussion

Environmental conditions (rainfall and soil fertility) determine tree-induced differences in grass quality

⇒ but also grazing and fire regime might play an important role

The importance of trees differs locally but not with species

⇒ probably tree age (shape) is more crucial

- Many different grazer species (wildebeest, zebra, roan...) might be attracted to sub-canopy grass
- Plant quality and subsequently some grazer species might suffer severely from tree loss
- Grass species communities and grazer assemblages will show species shifts when trees are removed



Management implications

- Local communities are faced with decision of logging for firewood or leaving trees as grass improvers (for livestock and wildlife)
- Common practice for livestock grazing in Australia: keeping trees in certain densities for higher pasture quality
- For African savannas: Identify areas where tree presence is most beneficial (dry and nutrient poor savannas)
- Ensure tree conservation: strictly protect larger and older trees or maintain a certain tree density
- Provide alternative areas for logging and for afforestation



Ongoing and future research

Direct observation

Feeding behaviour, habitat selection
van der Beek et al. (2007) in prep.

Linear programming

Use food requirements, constraints,
and availability to predict feeding
preferences

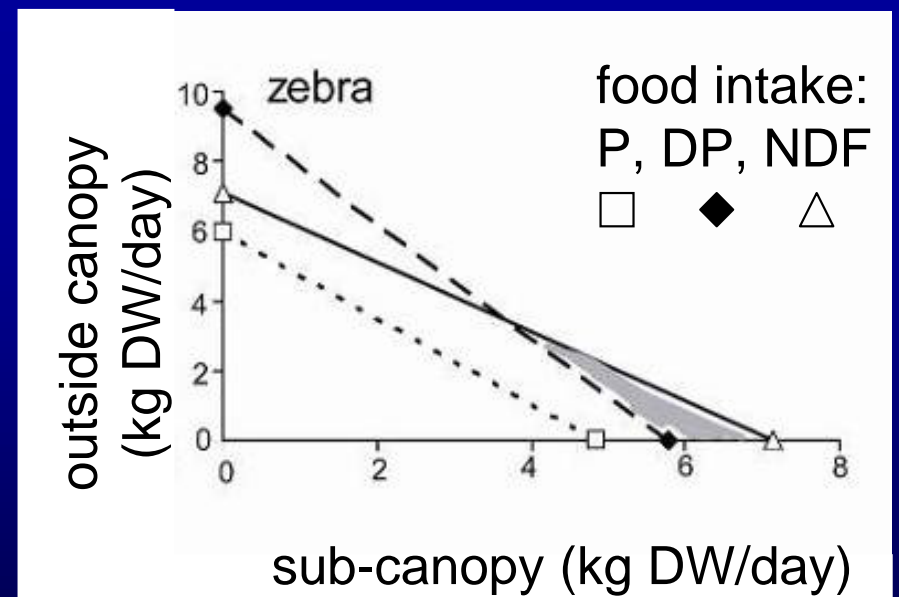
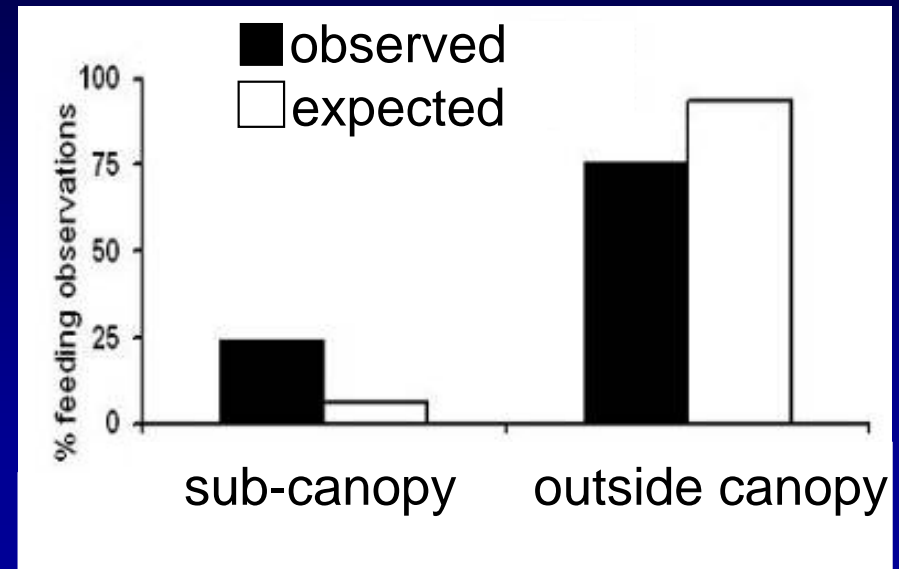
Treydte et al. (2007) in prep.

Enclosure experiments

Differences in sub- and outside
canopy grass under varying herbivory
and fire regime (in and out Roan)

Extrapolate data to other savanna systems:

Overall tree cover can predict grass
quality and grazer abundance (GIS)



Thank you!

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Benjamin

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DFG SNF GTZ SANPARKS TAWIRI TANAPA

