UNIVERSITY OF BOTSWANA

Smithsonian Conservation Biology Institute

THE SIGNIFICANCE OF GRASSLAND DIVERSITY ON FUNCTIONAL DRY SEASON FORAGE FOR GRAZING HERBIVORES

Edwin Mudongo, Richard Fynn, Casper Bonyongo

Background

- Forage quality and quantity varies spatially and temporally in savanna rangelands (Walker, 1993; Owen-Smith 2002)
- Wet season – high quality and quantity of forage
  - Annuals - highly nutritious, fast growing (high green leaf quantity)
  - Perennials – less nutritious, slow growing
- Dry season – severe declines in nutritional quality and quantity (Sinclair, 1975; Heitschmidt *et al*., 1982)
  - Critical time (protein & energy deficit), senesced grass
  - Annuals absent
  - Perennials →selective grazing →decline of palatable spps

Temporal Variation

How do grazers overcome the dry season deficit?

- Several options:
  1. Diet expansion
     – adaptive foraging
  2. Movement or migration
     – large heterogeneous areas
  3. Mobilizing body storages
     – prolonged droughts?
  4. Supplementary feeds
     – costs!!

Observation

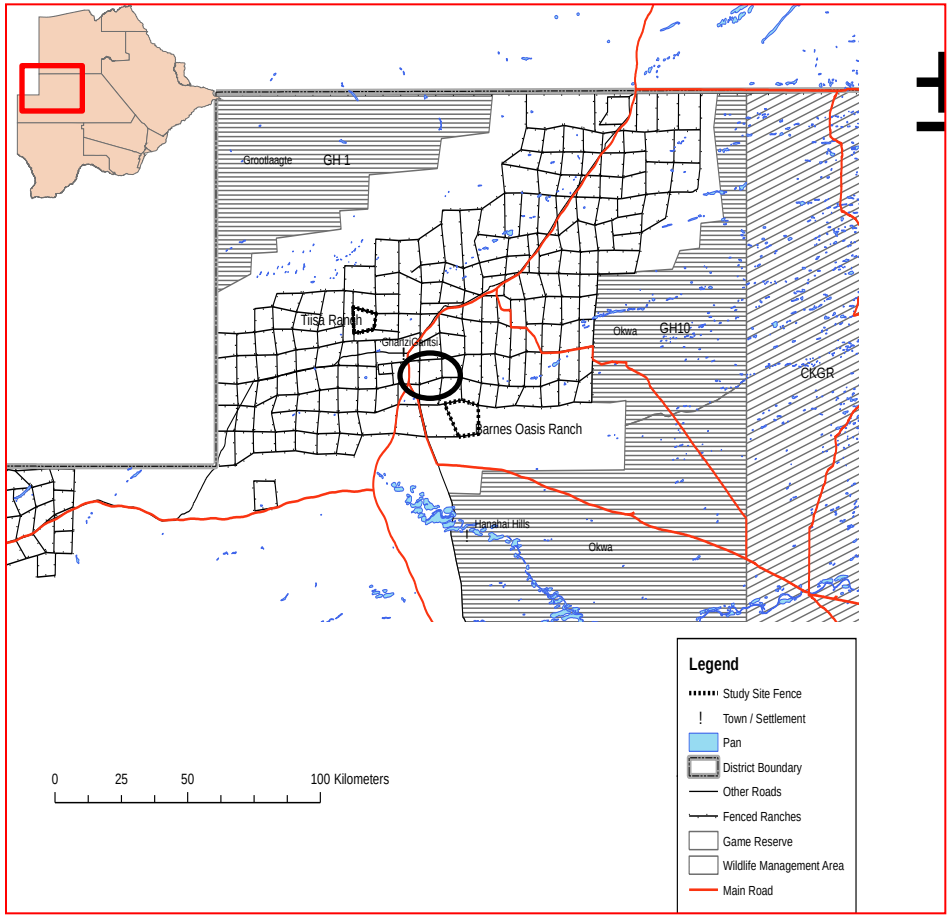
- Most rangeland mgt practices promote dominance of palatable species without consideration of their ability to respond to seasonal changes
- We hypothesized that a diversity of perennial grass species of different grazing value in a sward will provide more dry season foraging options than a sward dominated by few highly palatable species

Objectives

- To determine and compare dry season performance (green leaf and stem cover) of 6 perennial grass species
- To determine relationship between grass morphology (root depth and tuft area) and performance
- To determine relationship between sand soil moisture and soil depth

Methods

- Location – Barnes Oasis cattle ranch (western Botswana)
  - 18,808 ha, 64paddocks
  - 3554LSU
  - 1 wk grazing & 3mts rest
- Semi-arid climate
  - Mean annual rainfall 400mm
- Sandveld
  - Kalahari sand



Sampling

- October 2012 (late dry season)
- Previously grazed paddocks
- 6 common species (10 tufts of each spp)

Species	Palatability
Anthephora pubescens	High
Brachiaria nigropedata	High
Eragrostis lehmanniana	Low
Eragrostis rigidior	Low
Schmidtia pappophoroides	High
Stipagrostis uniplumis	Low

Sampling…

- Root depth

  Hole around tuft base (about 50cm wide)

Vertically growing from tuft base to root tip

Sampling…

Green/brown leaf and stem cover

-Vissual percentage estimate

Tuft area

- Diameter at base

Sampling…

- Soil moisture
  - 5 sites
  - 5 depth categories per site; 0-20, 20-40, 40-60, 60-80, 80-100cm
  - i.e 5 samples per site
  - Ziploc plastic bags & ice cooled
  - Wet mass and dry mass taken

Data Analysis

- Non-parametric tests on grass morphology and performance
  - Kruskal-Wallis – multiple comparisons
- ANOVA – soil moisture per soil depth
  - Tukey's Post Hoc test – multiple comparisosns
- Pearson's correlation and regression analysis for relationship between grass performance and morphology.

Results

	Eragrostis lehmanniana	*Anthephora pubescens*	*Schmidtia pappophoroides*	*Eragrostis Rigidior*	*Stipagrostis uniplumis*	*Brachiaria nigropedata*
Tuft area	**17.6^{a}** 2.19	**19.7^{ab}** 1.92	**19.5^{ab}** 1.98	**18.9^{a}** 1.88	**20.7^{ab}** 2.6	**30.5^{b}** 3.11
Root Depth	**29.9^{a}** 1.8	**32.1^{a}** 1.76	**40.8^{ab}** 2.9	**48.8^{b}** 3.17	**50.3^{b}** 2.28	**58.4^{b}** 4.03
% Green Leaf	**19.8^{a}** 4.01	0	0	**39.5^{a}** 6.56	**17^{a}** 4.29	**21.8^{a}** 5.9
%Green Stem	**17.2^{ab}** 2.63	0	**3.4 ^{a}** 1.6	**11.5^{ab}** 1.5	**31^{b}** 4.52	0
Total Greenness	**37^{b}** 4.9	0	**3.4^{a}** 1.6	**51^{b}** 6.5	**48^{b}** 6.3	**21.8^{b}** 5.9
% Brown Leaf	**35.2^{b}** 2.84	**9.5^{a}** 0.40	**26.5^{b}** 2.59	**12.5^{a}** 1.86	**10^{a}** 1.83	**6.4^{a}** 0.9
% Brown Stem	**27.7^{ab}** 3.13	**18.3^{a}** 1.32	**70.1^{c}** 3.24	**36.5^{bc}** 5.87	**42.5^{bc}** 5.28	**13.2^{a}** 1.4
Total Brownness	**62.9^{bc}** 4.9	**27.8^{a}** 0.93	**96.6^{c}** 1.65	**49^{b}** 6.5	**52.5^{bc}** 6.25	**19.6^{a}** 1.5

Results…

High palatability

Low palatability

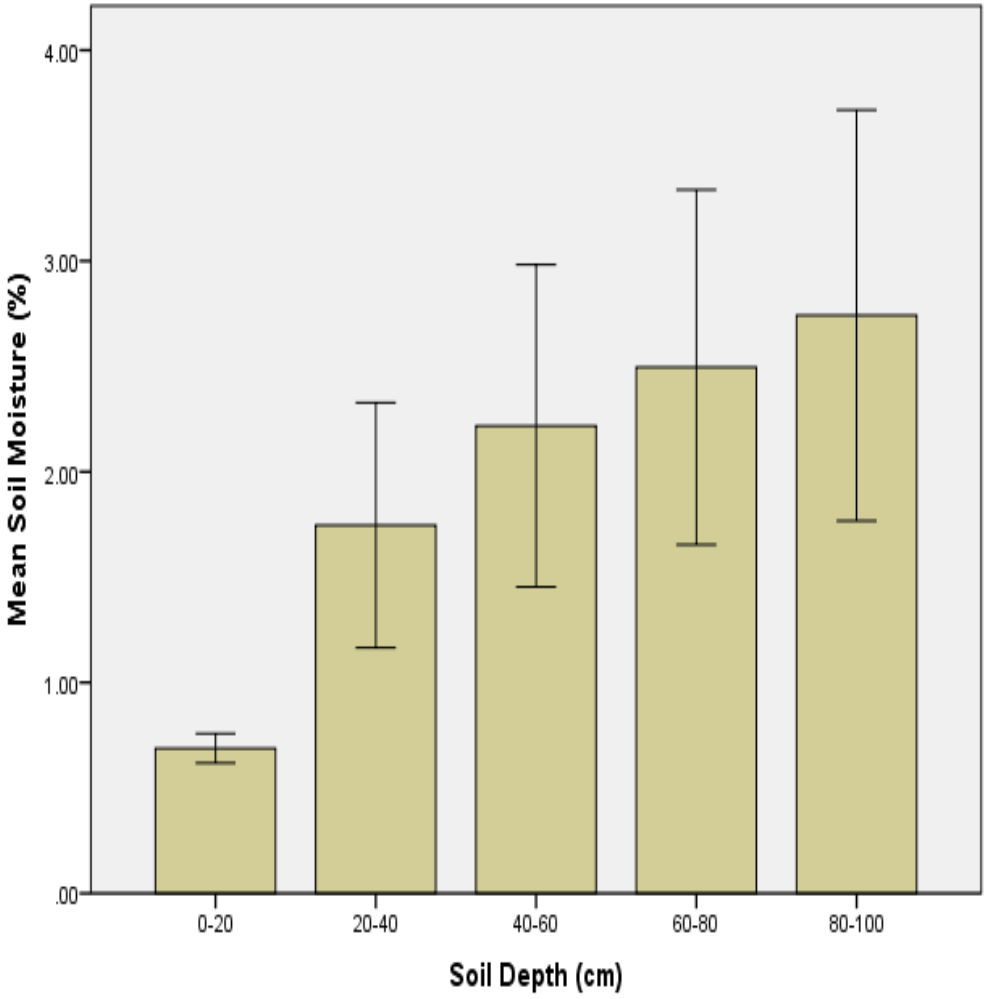
Results…

- Green leaf production not influenced by root depth and tuft area within & between spp's
- Significant positive correlations between root depth and tuft area;

Species	Pearson's correlation	R^2	$F_{1, 8}$	*P* – value
E. lehmaniana	0.93	0.86	47.9	**0.0001**
A.pubescens	0.88	0.76	26.0	**0.001**
S.pappophoroides	-0.07	7.7E-07	6.2E-06	1.00
E. rigidior	0.87	0.76	24.8	**0.001**
S. uniplumis	0.12	0.018	0.15	0.73
B.nigropedata	0.85	0.72	20.6	**0.02**

Results…

- Soil moisture lowest on top soil category BUT not significantly different between deeper categories



Discussion

- All perennial species surveyed had deep root systems to access subsoil moisture
- Thus conversion of grassland to short-lived shallow rooted perennial species by overgrazing practices results in these species failing to access subsoil moisture
- Less palatable species retained green leaf and stem from previous wet season while highly palatable species did not retain either green or brown leaf

Discussion…

- This is a result of selective grazing as animals grazed down and depleted highly palatable spp's as shown by Illius et al. (1999)
- But less palatable species provide a lower quality bulk reserve forage supporting grazers for most of the dry season (Owen- Smith, 2002).
- Foraging theory; declining food supply means either increase search time or expansion of diet (O'Reagain et al., 1995; Owen-Smith, 2002)
- Thus absence of lower quality species eliminates the diet expansion option forcing animals to either move or starve to death.

Discussion…

- It shows therefore that declining palatable species would be substituted by less palatable spp's (e.g *E. rigidior, E. lehmanniana, S. uniplumis*) that carry large quantities of leaf and stem in to the dry season
- This maintains a more stable seasonal carrying capacity and reduces costs of supplementary feeding

Conclusions

- Our results suggest that managing rangelands for homogeneity of palatable spp's may not be beneficial come dry season
- Also conversion of perennial to annual or weak perennial grasslands will not benefit dry season foraging
- A grass sward that has an intermediate mix of high quality low fiber species and lower quality bulk species that persist in to the dry season provides a key dry season resource.


THANK YOU