

# Spatial refuges buffer landscapes against homogenization and degradation by large herbivore populations and facilitate vegetation heterogeneity

SIANGA, K\*, VAN TELGEN, M, VROOMAN, J, FYNN, R.W.S & VAN LANGEVELDE, F.

keosianga@gmail.com\*Corresponding author

SASSCAL

Southern African  
Science Service Centre for  
Climate Change and  
Adaptive Land Management

## Introduction

Environmental heterogeneity across savanna landscapes may play key roles in determining plant (MacFayden *et al.* 2016), large mammal and bird diversity (Harrington *et al.* 1999; Fuhlendorf *et al.* 2006; Krook *et al.* 2007). This heterogeneity also determines the strength of density-dependent feedbacks on large herbivore population growth and their viability (Hobbs *et al.* 2008; Hopcraft *et al.* 2010).

The Savuti-Mababe-Linyanti ecosystem, northern Botswana is a relatively pristine region of the northern conservation area containing extensive savanna woodlands sandwiched between the permanent water sources of the Okavango Delta and Linyanti Swamps, where large areas of woodland may occur > 20 km from permanent water sources, beyond the maximum movement distance of the more mobile bull elephants during the dry season.

## Objective

To determine the effect of herbivory on plant composition, structure and diversity with distance from permanent water.

## Study site

The study was conducted in Savuti-Mababe-Linyanti ecosystem, northern Botswana (Fig. 1)

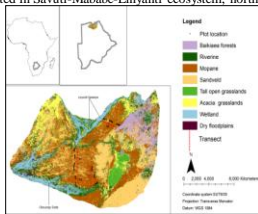


Fig. 1: Savuti-Mababe-Linyanti ecosystem

## Materials & methods

Vegetation structure, Composition and richness Sampled in Mopane and Sandveld at three distance Zones (Fig. 2)

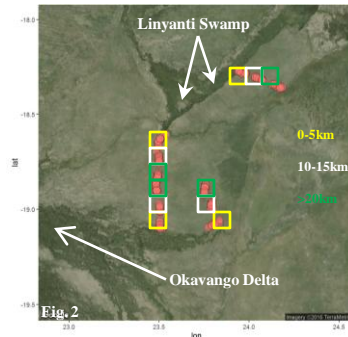


Fig. 2

## Results

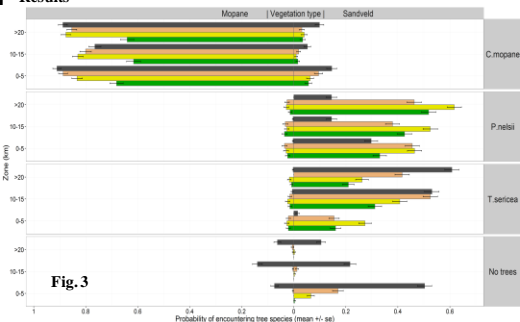


Fig. 3

Fig. 3: Relationship between height structure of dominant tree species of the study area and distance zone from permanent water. HC = Height class (1: 0-1 m, 2: 1-2 m, 3: 2-4 m and 4: > 4 m). C. mopane = Colophospermum mopane, P. Nelsii = *Philenoptera nelsii* and T. sericea = *Terminalia sericea*.

Trees favoured by elephants during the dry season occurred as immature, pollarded populations within 5 km of permanent water sources while mature tall populations of these species were found far from water (> 10-15 km, Fig 3 & 5). Short high-quality grazing grasses were higher in abundance within 5 km of permanent water whereas taller high-quality perennial grasses peaked in abundance beyond 20 km from permanent water (Fig 4).

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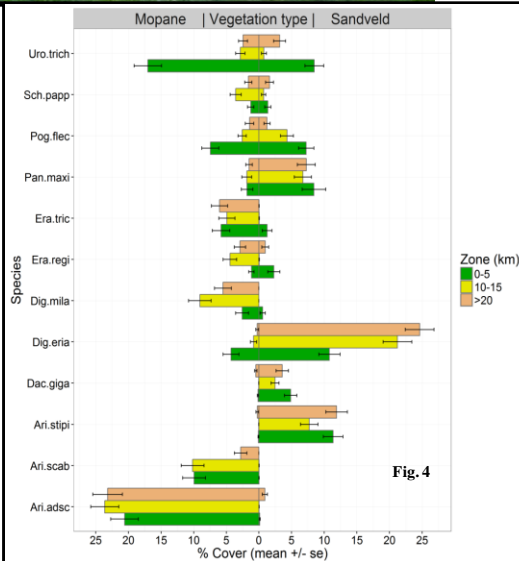


Fig. 4

Fig. 3: Relationship between cover of the major grasses of the study area and distance zone from permanent water. Uro. trich. = *Urochloa trichopus*, Sch. papp. = *Schmidia pappophoroides*, Pog. flec. = *Pogonarthria fleckii*, Pan. Maxi = *Panicum maximum*, Era. tric. = *Eragrostis trichophora*, Era. regi. = *Eragrostis rigidior*, Dig. mila. = *Digitaria milanjiana*, Dig. eria. = *Digitaria eriantha*, Dac. giga. = *Dactyloctenium giganteum*, Ari. stipl. = *Aristida stipitata*, Ari. scab. = *Aristida scrubivialis*, Ari. adsc. = *Aristida adscensionis*.

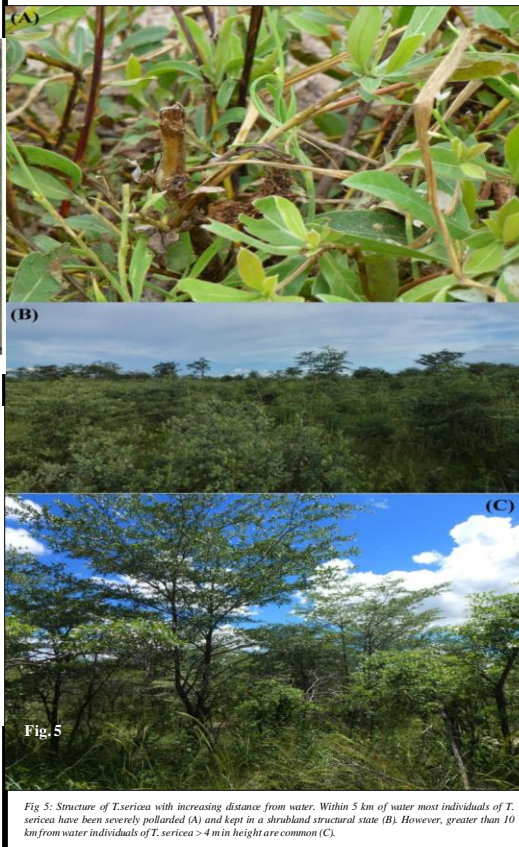


Fig. 5

Fig. 5: Structure of *T. sericea* with increasing distance from water. Within 5 km of water most individuals of *T. sericea* have been severely pollarded (A) and kept in a shrubby structural state (B). However, greater than 10 km from water individuals of *T. sericea* > 4 m in height are common (C).

## Discussion

Herbivory on the large distance gradients away from permanent water (>20 km) in the SMLE has created key diversity, compositional and structural heterogeneity in grass, forb and woody species that is likely to result in greater niche diversity and adaptive foraging options that will enhance biodiversity and herbivore population stability and productivity.

In this regard, our findings show that spatial refuges for both grass and woody species operated beyond 15 km from permanent water with the implication that managers should avoid artificial water provision in backcountry woodlands, because water points will reduce the distance to available water during the dry season and consequently eliminate spatial refuges for plants and animals.

## Acknowledgements

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