Towards understanding the impacts of water supplementation across heterogeneous landscapes



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Overview

- Water provision has a high degradation risk
  - Supplementation across properties
- Need a sound ecological basis for management
  - Piospheres are oversimplified
  - Alternative approach needs to consider the biophysical template
- Towards an alternative approach
  - Interaction between grazing patterns and the biophysical template
  - Some factors to consider

Artificial Waterpoints

- Why increase artificial waterpoints?
  - Lack of permanent natural water
  - Tourism
  - Biodiversity

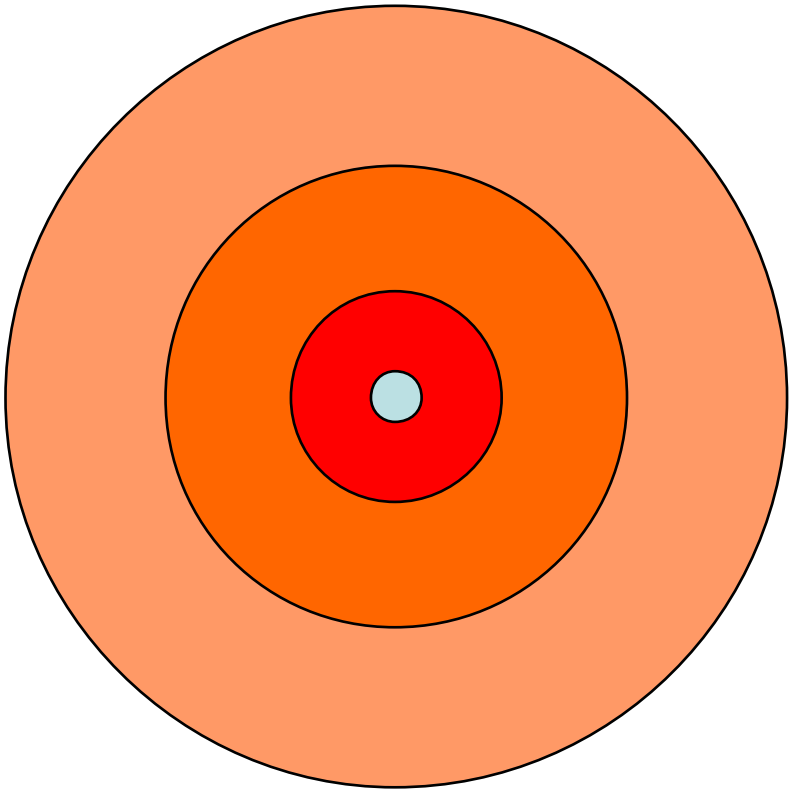
- Why not increase artificial waterpoints?
  - Degradation of soils and vegetation
  - Compromise sustainability objectives

Water Provision: Degradation Risk

- Artificial water provision varies across properties
- In the private reserves, artificial provision does not follow natural water patterns
  - Naturally wetter areas aren't simply topped up
  - Property size constrains available landscape area
- Catenal position of waterpoints is important
  - Need accurate data

Management

- Currently think of water in terms of concentric circular impact patterns



Management

- Currently think of water in terms of concentric circular impact patterns
- “Piospheres” – Lange 1969
- Piospheres were developed in homogeneous landscapes (Lange 1969, Graetz & Ludwig 1978)
- Vegetation type (Cridland & Stafford Smith 1993) and soil type (Turner 1999) cause problems

Savanna Piospheres

- Previous studies have concluded that piospheres are appropriate for modelling herbivore impact from waterpoints (Thrash & Derry 1999)
  - Fieldwork: sampling performed in homogeneous areas usually soil type constant (e.g. Thrash 1997)
  - GIS studies: remove variability within circles around waterpoints (e.g. Ryan & Getz 2005)
- Distance to water taken as the only important variable

Testing Piospheres

- Piospheres work in homogeneous areas…
- Do they work in heterogeneous areas?
- Can results be scaled up to properties?
  - 5 properties
  - 22 waterpoints
  - 23 variables
  - 218 sampling sites
  - up to 7km from water

Impact patterns?

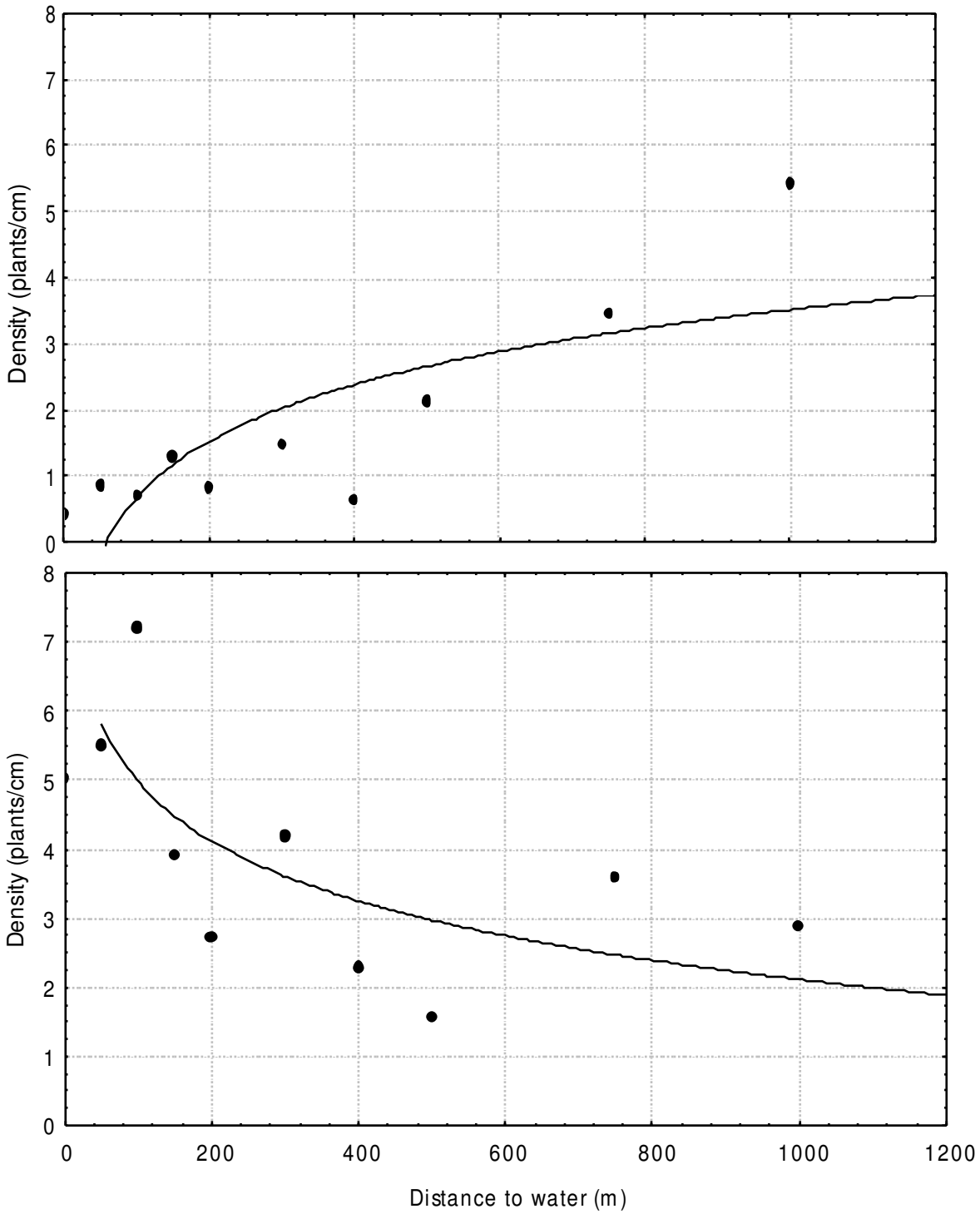
The effect of distance to water on

1. Herbaceous vegetation
2. Woody vegetation
3. Soil functionality

Test	**No. significant**	**% significant**
Linear regressions	37	10
Logistic regressions	68	19
Ordinations	1	5

Piospheres & Degradation Patterns

- In some cases there are gradients of impact with distance to water (piospheres)
- No consistent patterns between variables or waterpoints (14%)
- Can get contradictory patterns within variables

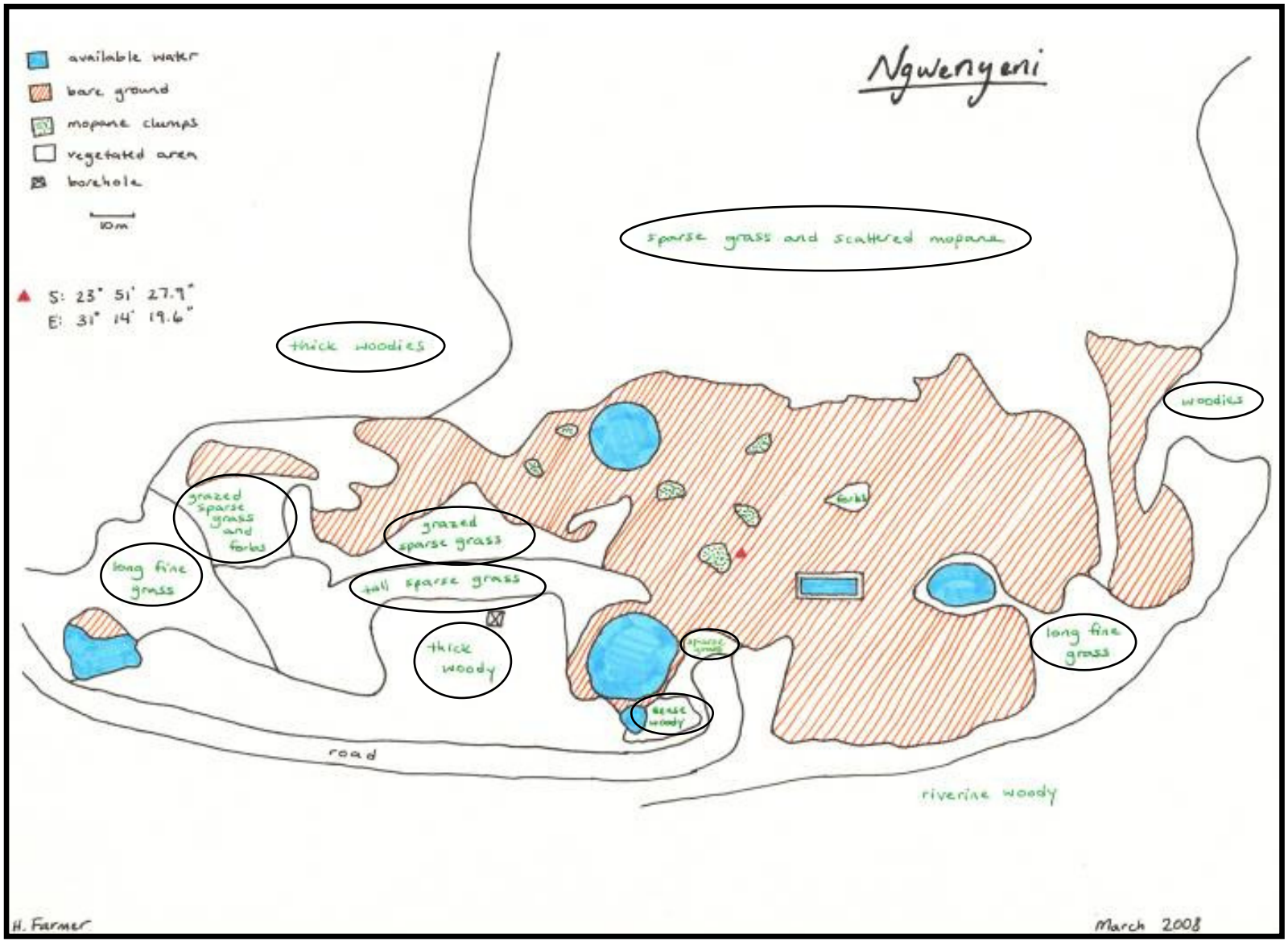

Density (plants/cm)
0
1
2
3
4
5
6
7
8
Density (plants/cm)
0
1
2
3
4
5
6
7
8
0
200
400
600
800
1000
1200
Distance to water (m)

Piospheres & Degradation Patterns

- There are gradients of utilisation
- No consistent patterns between variables or waterpoints
- Can get opposite patterns within variables

- Biophysical template presents a problem for piospheres
- Sheep in a field – grazing superimposes on a homogeneous template
- Animals in a savanna – grazing/browsing superimposes on a biophysical template

Impact and the Biophysical Template



Towards an Alternative Approach

- Animal behaviour and the biophysical template interact to determine the herbivore impact of an area (Bailey *et al.* 1996)
- Piosphere approach does not recognise the importance of the biophysical template

- Biophysical template has a strong influence
- Needs to be incorporated in understanding herbivore impact

Alternative Factors

- Need to have a look at what's important in determining herbivore impact

- Considered two general aspects
  - Management: current and historical waterpoint impact, type of nearest waterpoint, artificial waterpoint density, property size, fencing

  - Environmental: aspect, slope, catenal position, landscape type, natural water availability, distance to drainage line and distance to perennial river

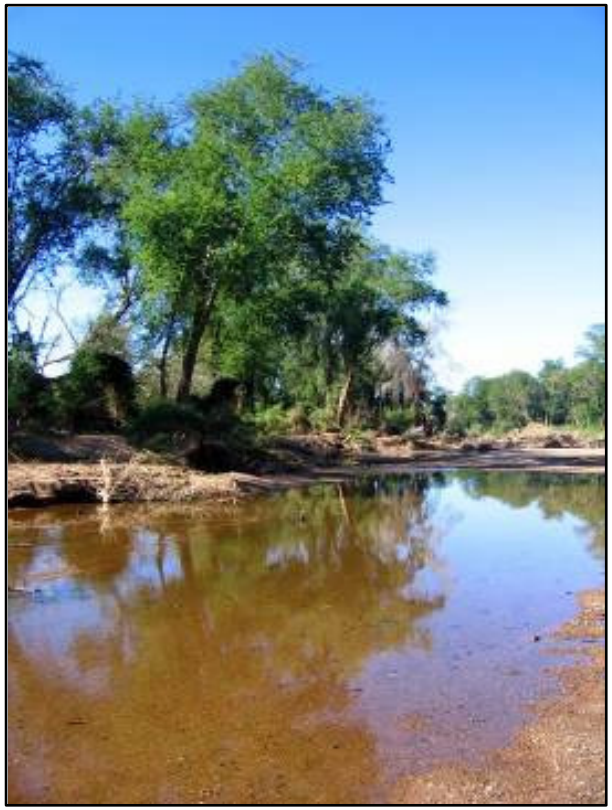
Affecting…

- Species composition
  - Herbaceous and woody vegetation

- Degradation variables
  - Herbaceous vegetation: density, tuft size, grazing value, annual:perennial
  - Woody vegetation: density, canopies, height variation
  - Soil: bare ground, stability, infiltration, nutrients

What affected impact?

- All ordinations were highly significant
- Environmental variables were stronger than management variables
- Important variables:
  - Natural water availability
  - Artificial water availability
  - Property size
  - Distance to perennial river
  - Landscape type



Environmental Variables

- Important environmental variables relate to the ability of the area to withstand herbivore impacts

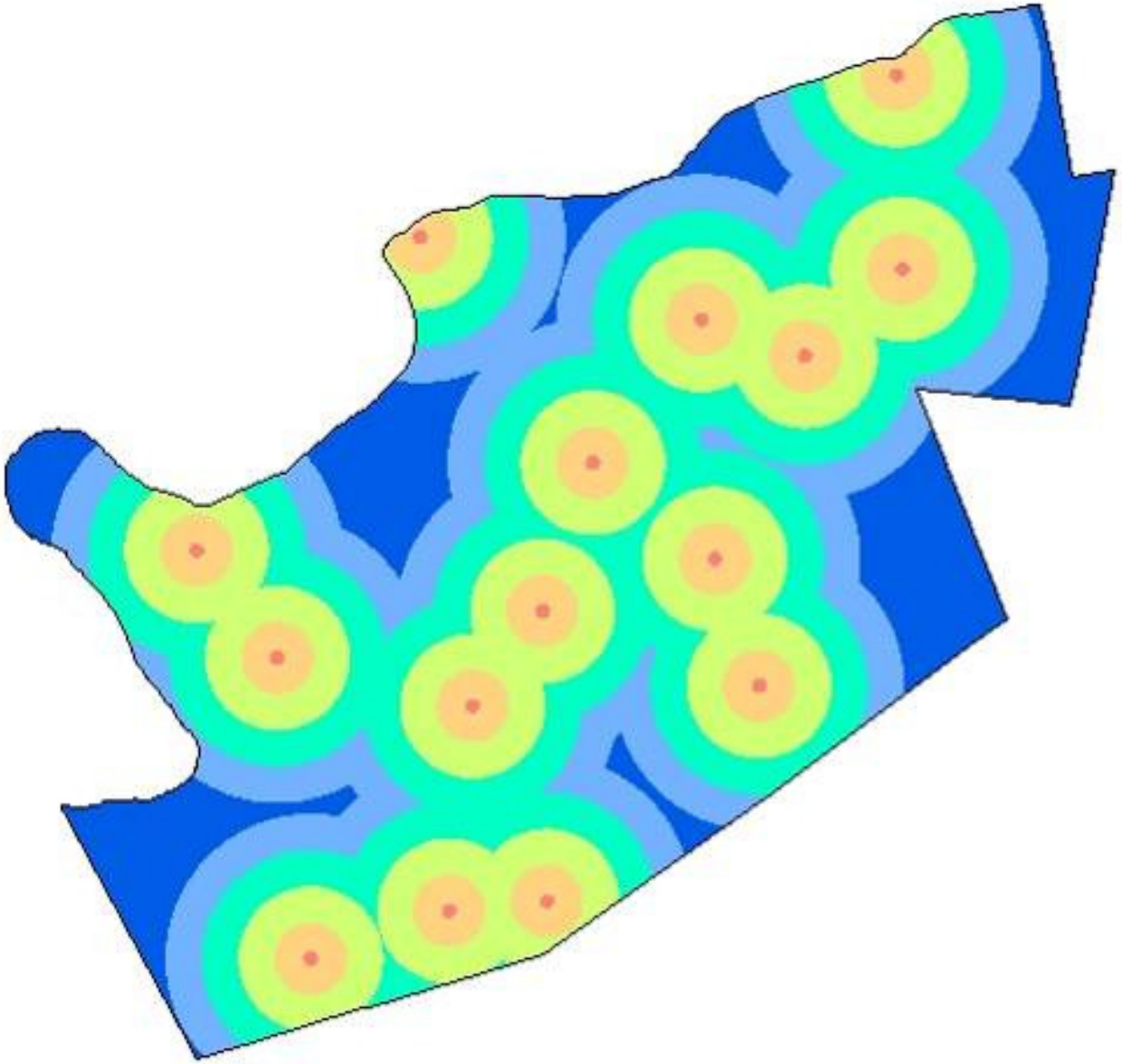
- Natural system - areas of the landscape with permanent water would have received higher utilisation pressure from herbivores during the dry season (Chamaillé-Jammes *et al.*, 2007)
- Vegetation of the drainage lines is characterised by adaptations to handle consistent herbivore pressure (Milchunas *et al.*, 1988)

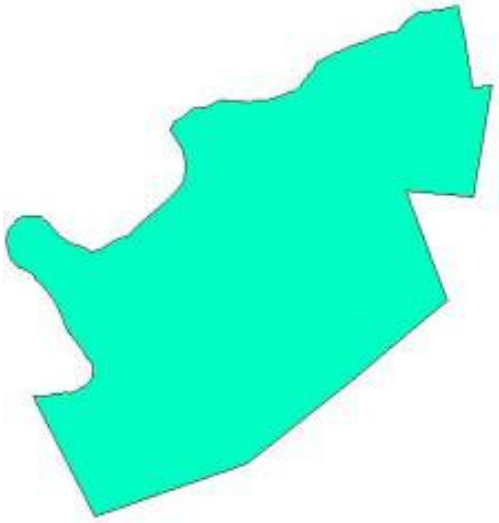
Management Variables

- Important management variables relate to stocking rate and intensity of management

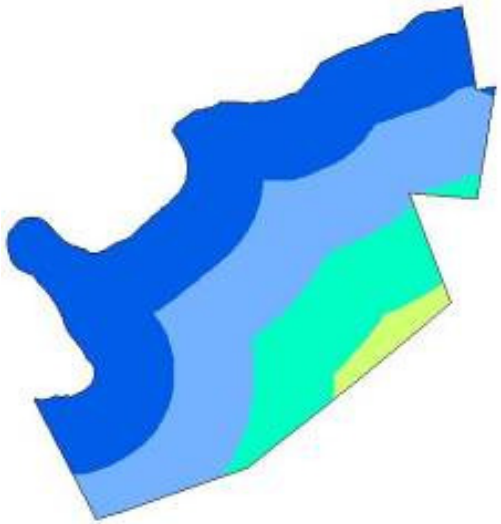
- Stabilising water availability reduces variability in access to forage resources and therefore reduces the likely natural cause of fluctuations in herbivore abundance (Cronje *et al.*, 2005)
- As properties get larger there is greater scope for more natural and broader scale management regimes (Peel *et al.*, 1999)

Moving forward

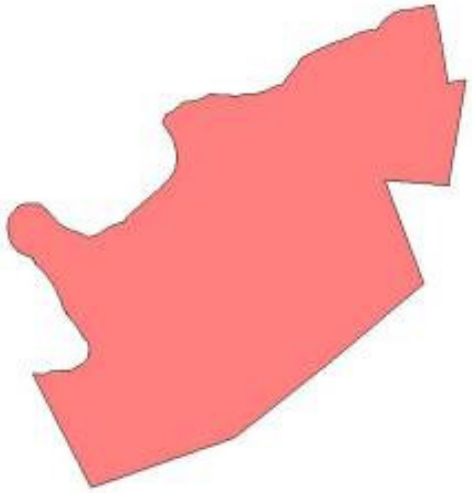




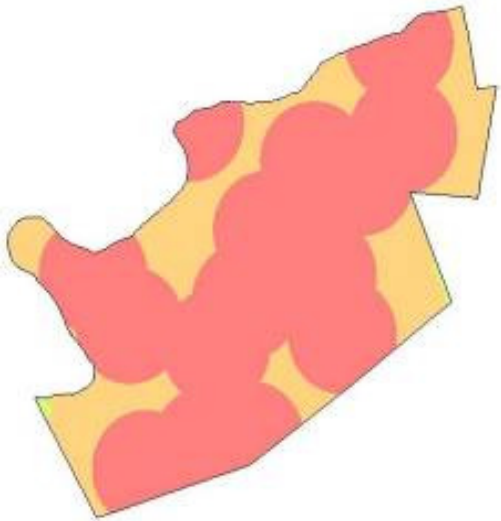
Artificial Water availability



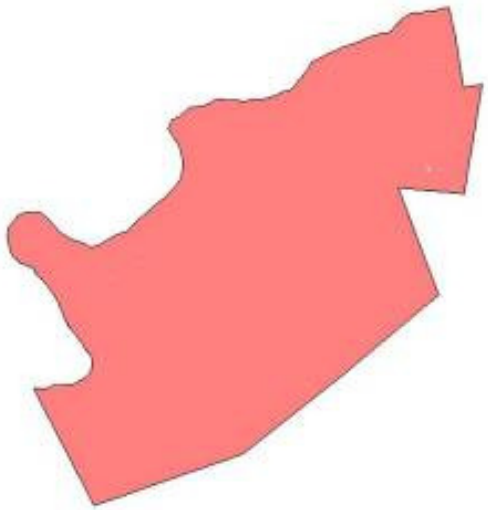
Distance to Perennial River



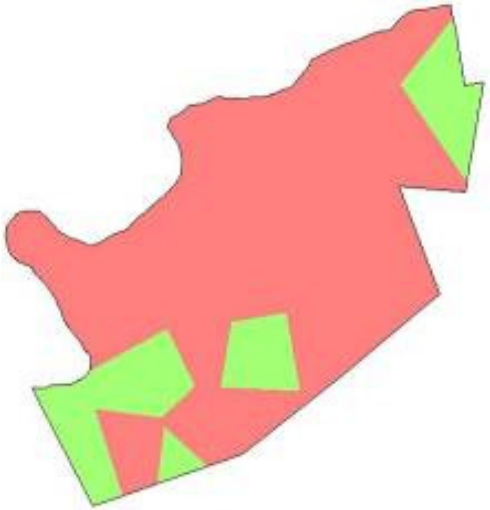
Property Size



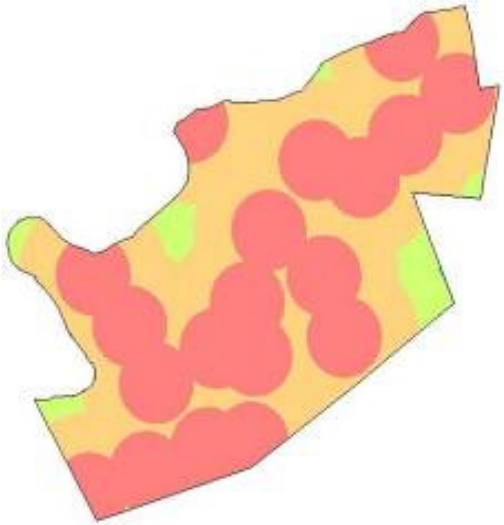
Distance to open waterpoint



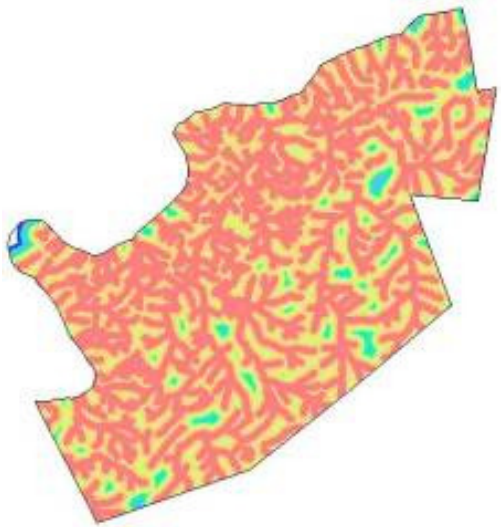
Natural water availability



Waterpoint type



Distance to any waterpoint



Distance to drainage line

Conclusions

- Water provision is high degradation risk so needs a sound ecological basis for management
- Piospheres are oversimplified
- Need to take account of the biophysical template

- Work in progress… depth of understanding of biophysical template still increasing
- Gives a basic idea of importance of other factors in determining impact of water provision across properties

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