

Plant biochemical maps of forage quality

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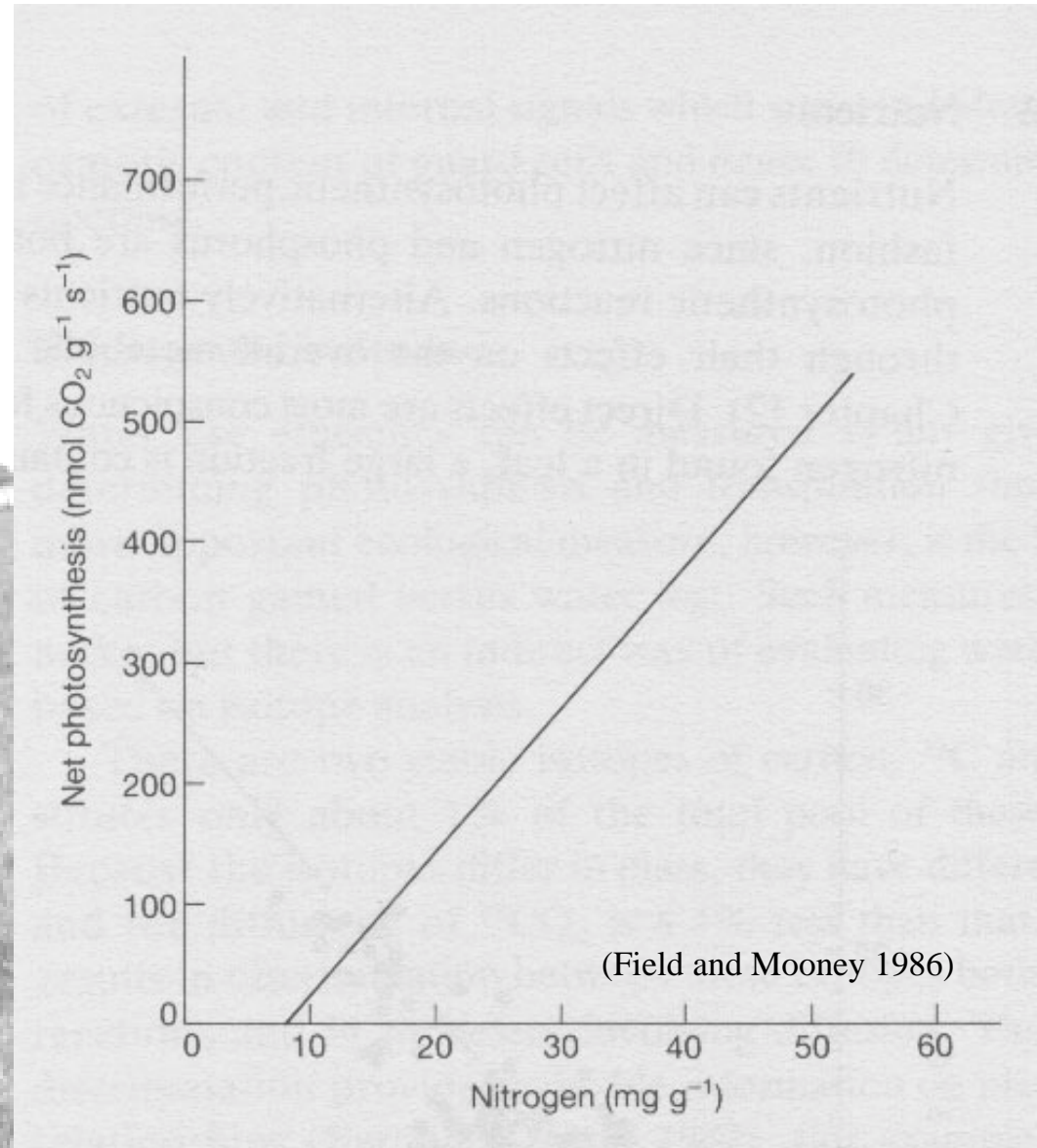
Introduction

- Resource
- Resource abundance
- Resource preference
- Resource quality
 - Attractant
 - Deterrents
- For a herbivore, ‘resource’ includes the grazing resource, as well as broader environmental factors

How do vegetation resources combine to create a habitat for herbivores?

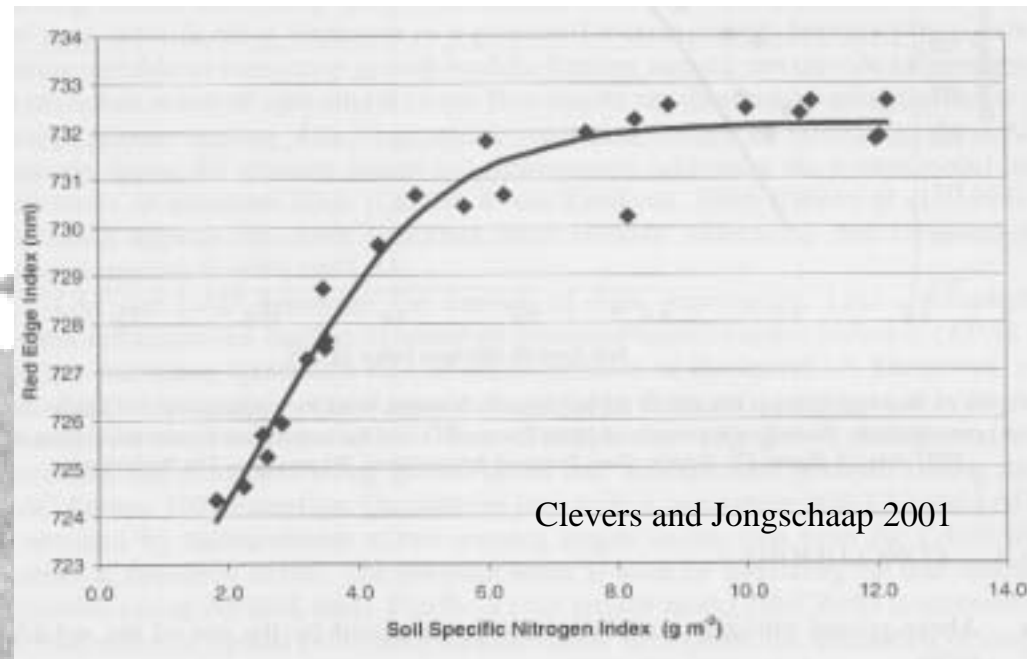
Quality of herbivore resource

- Increased N supply enhances dry matter production as well as protein
- Herbivore growth and abundance positively correlated to nitrogen content
- Leaf N correlates with photosynthesis

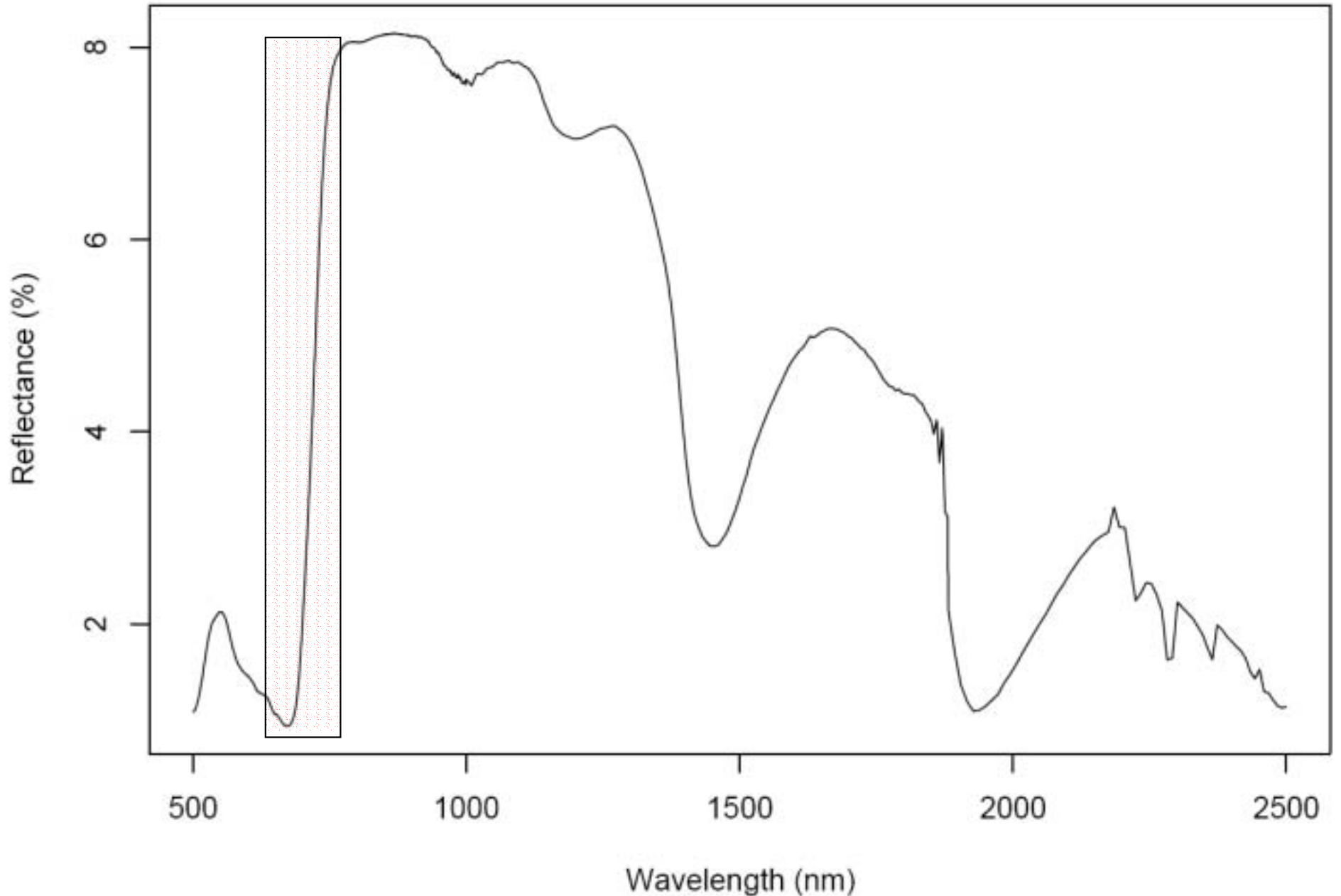


Quality of herbivore resource: results with potato

- Above ground N strongly related to the red edge index
- At higher concentrations of N, red edge shifts to longer wavelengths

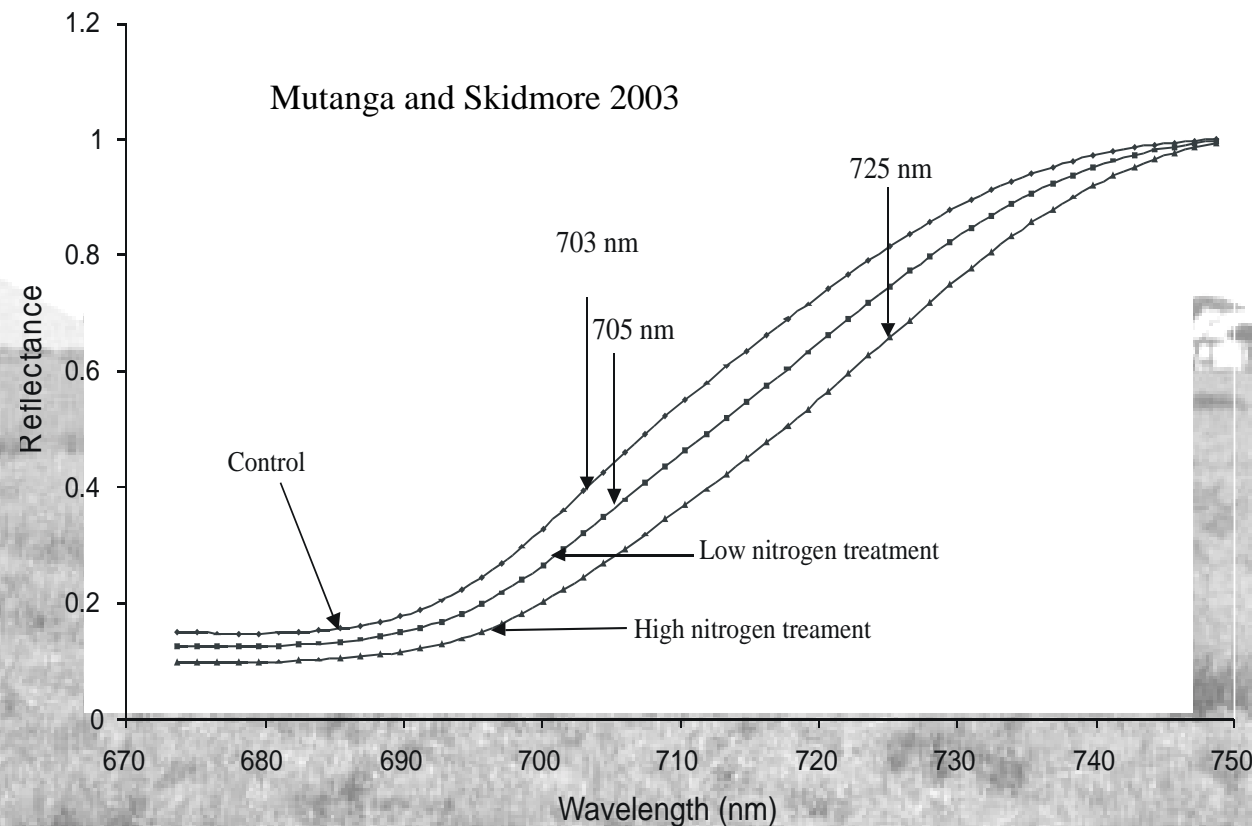


Green Vegetation Spectrum



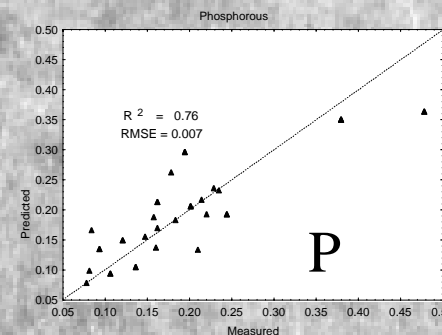
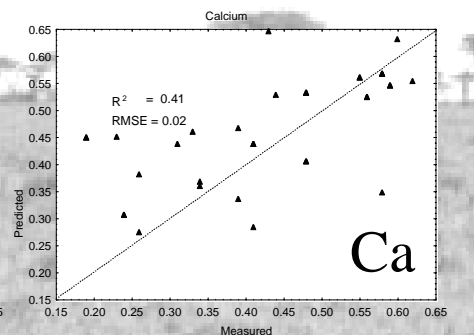
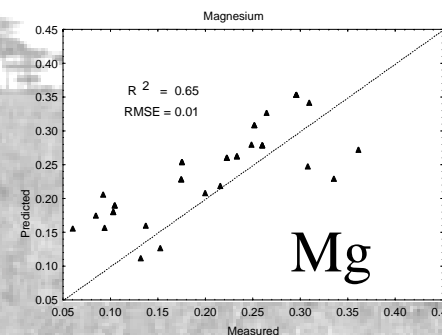
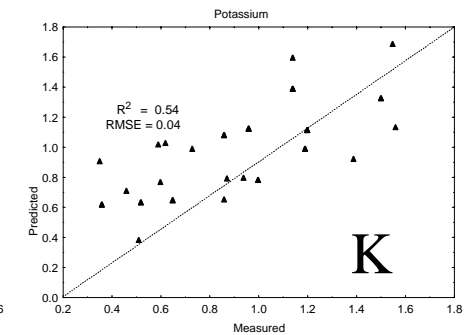
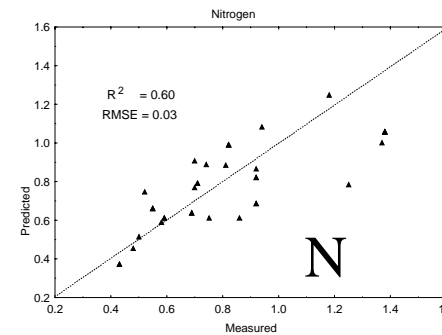
Quality of herbivore resource: African native grasses

- Higher N related to a shift in the red edge to longer wavelengths
- E.g. Holly Dublin (1995) “*Elephant diet shifts from grass to woody species as protein in grass decreases during the dry season*”



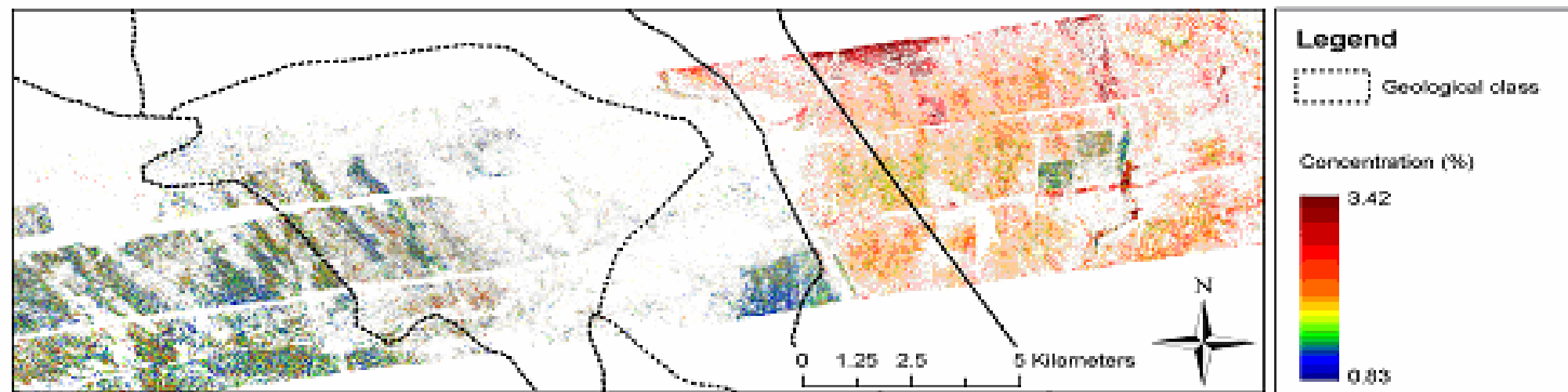
Quality of herbivore resource: modeling N in native grasses

- Four different hyperspectral indices tested
- Canopy N, K, Mg, Ca, P modeled
- $R^2 = 0.80$ for in situ grass quality (N) concentration
- Invert regression models

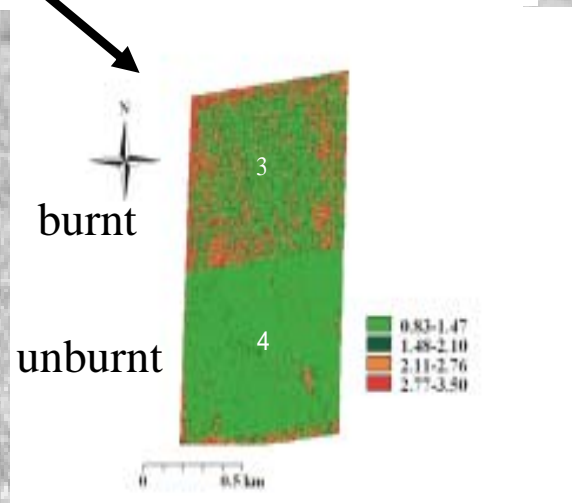
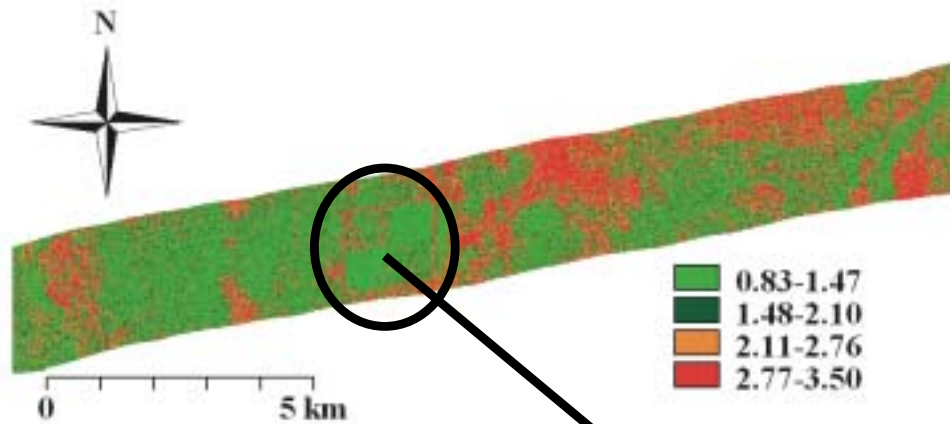


Mutanga et al. 2003

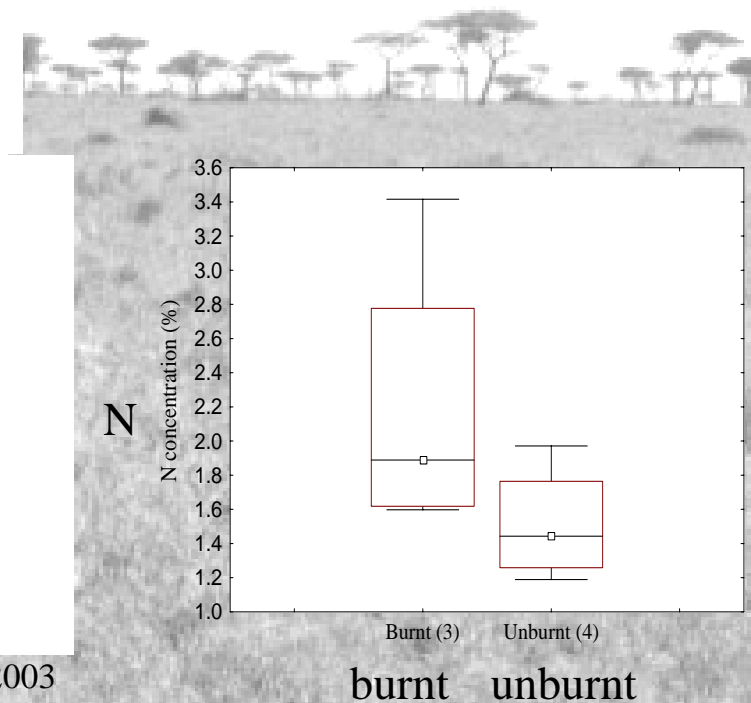
N concentration



Quality of herbivore resource: mapping N



Mutanga and Skidmore 2003

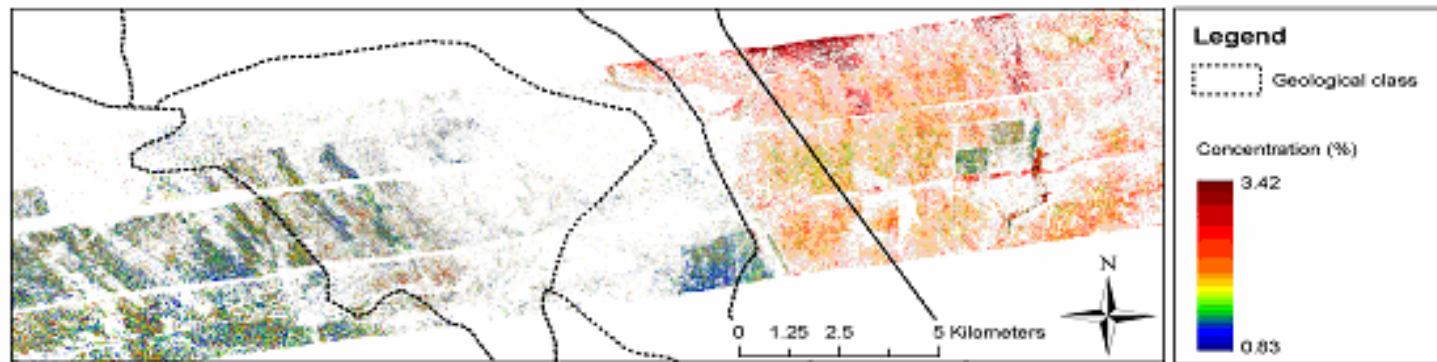


Total polyphenols

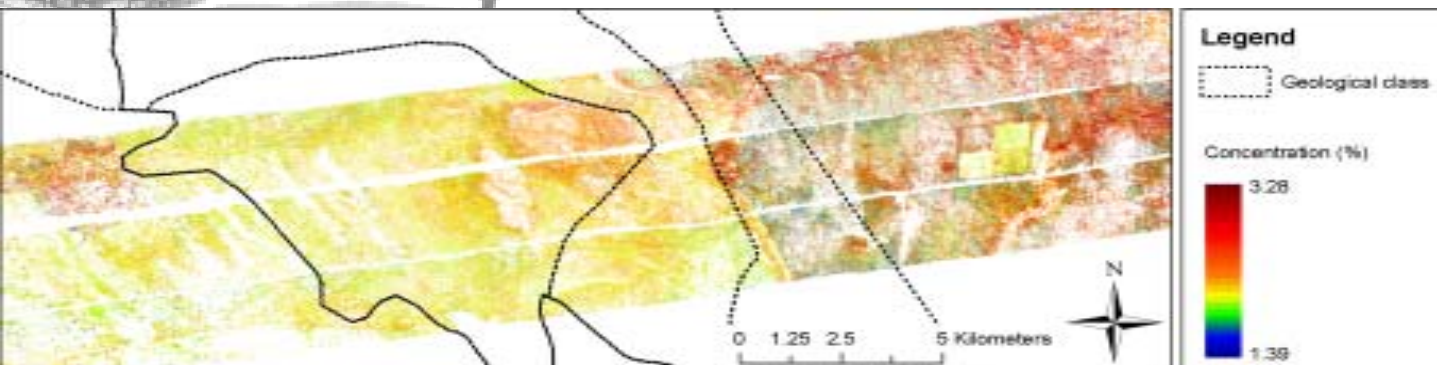
- Repeated lab measurements for polyphenols and reflectance
- Key wavelengths linked to concentration of foliar nitrogen and total polyphenol (583, 679, 710, 2091, 2128, 2146 nm and REP for nitrogen)
- These wavelengths were selected to run a neural network.
- Image flown at the end of the wet season (2003) -- red edge position was dominated by the foliar biochemical signal
- Mopane trees were binary-sliced (ENVI, 2005)



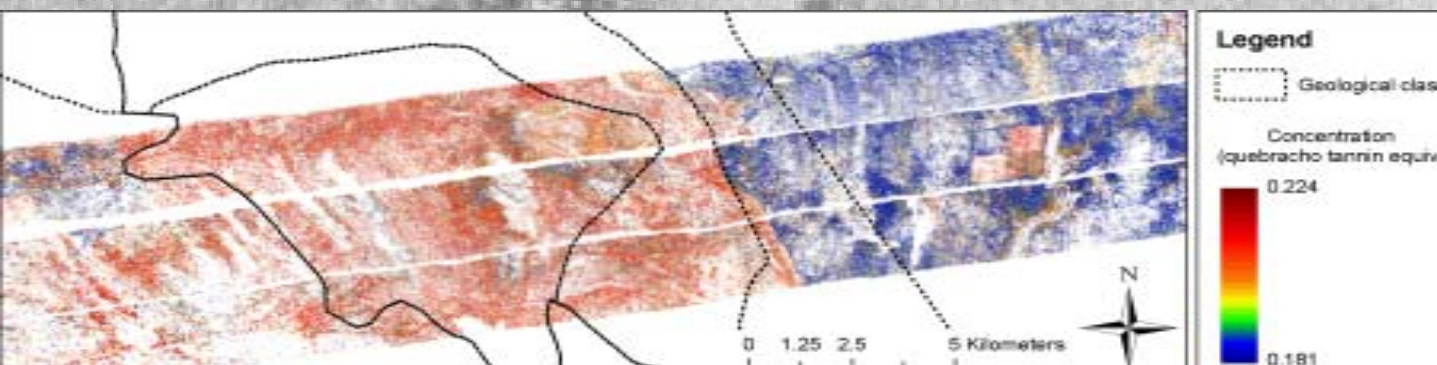
Geology



Foliar nitrogen grasses



Foliar nitrogen mopane



Tannin mopane



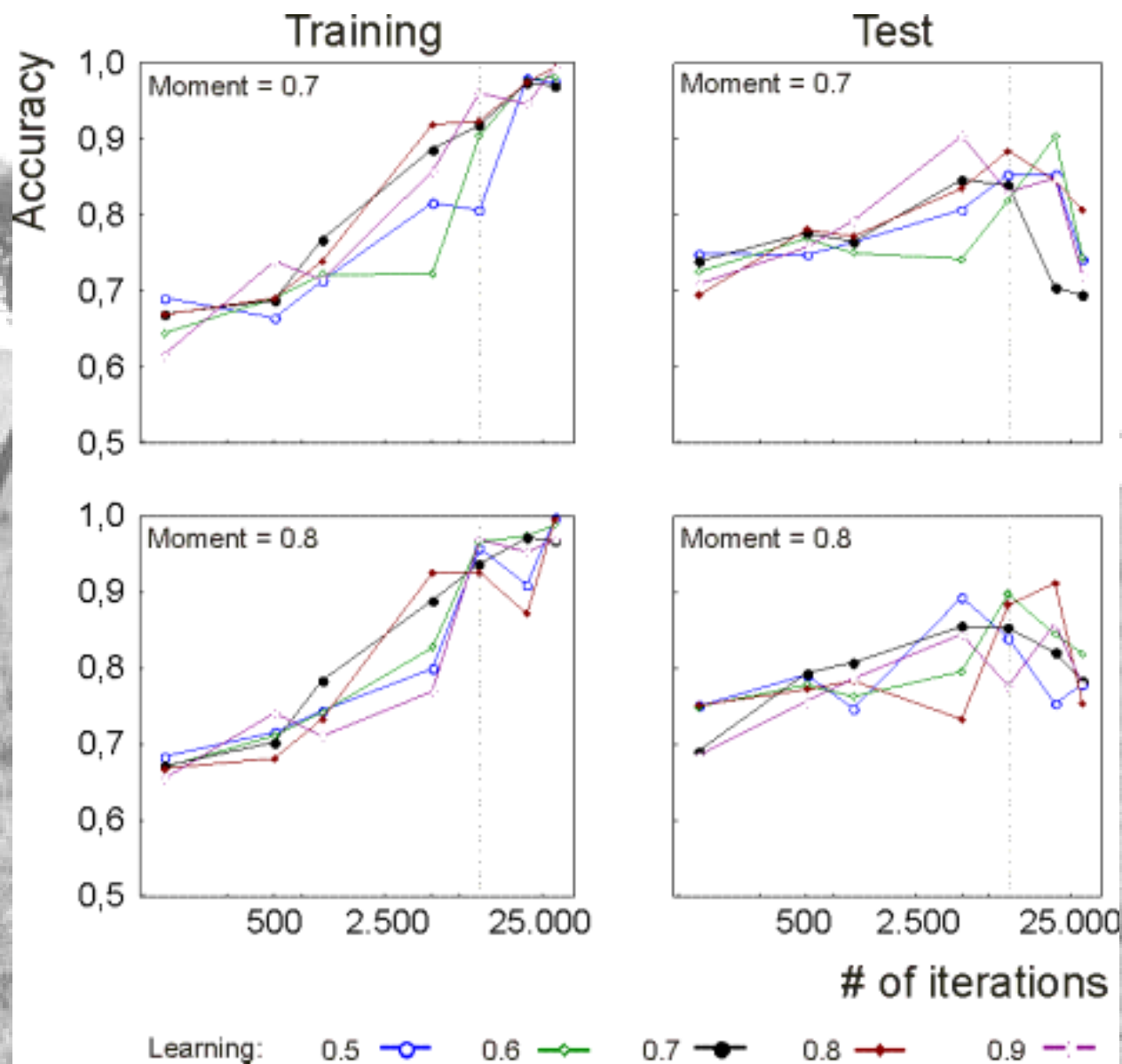
Where now...?

- Extrapolating protein and polyphenol maps for the entire KNP and surrounding game reserves
- Extending study to include mapping of other vegetation quality indicators
- Link results with animal census data
- Temporal scale

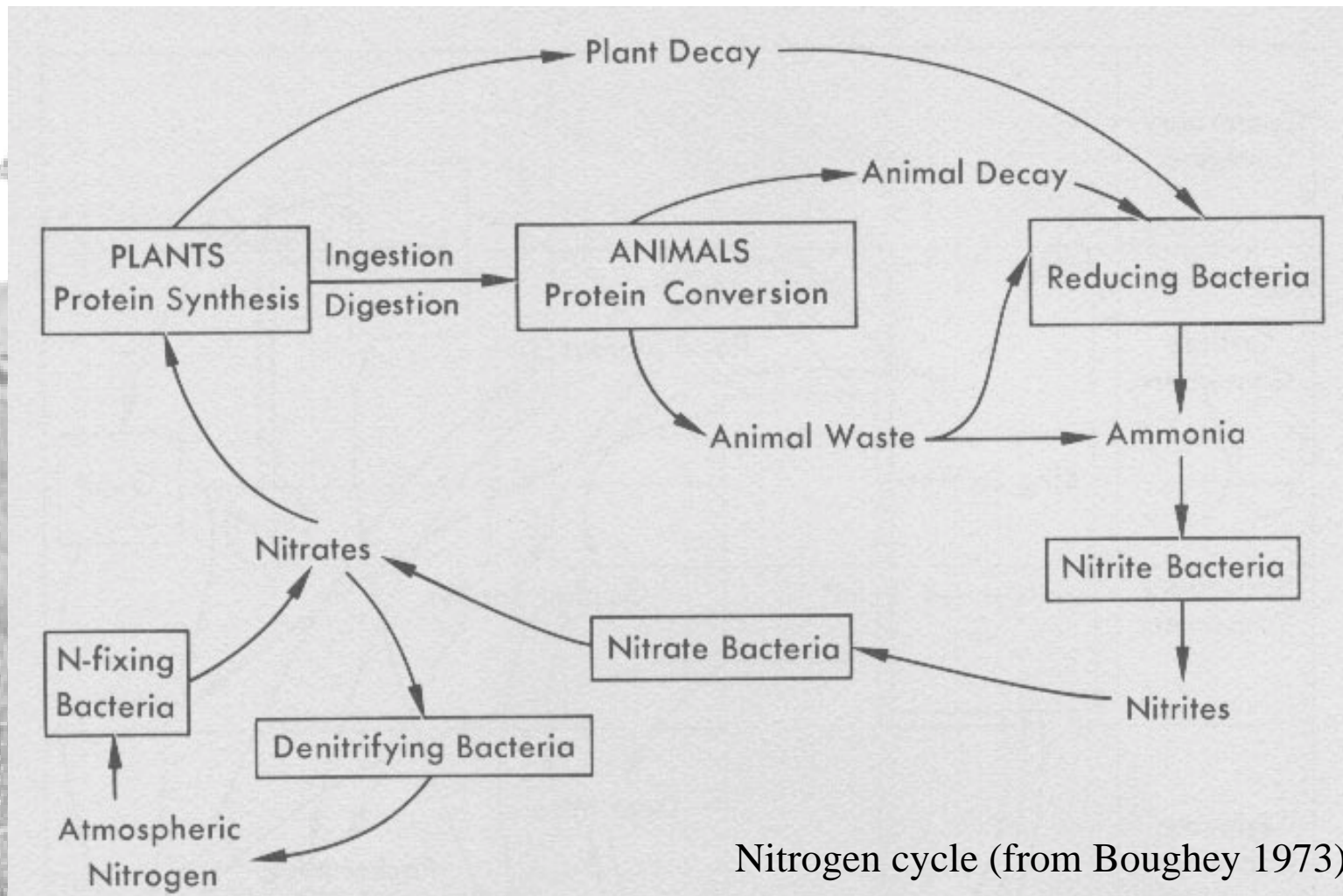
A black and white photograph of a savanna landscape. In the foreground, there is a field of tall grass. A single, prominent acacia tree stands on the left side. In the background, a line of smaller acacia trees stretches across the horizon, with a low, rounded hill visible behind them. The sky is bright and clear.

Thank You

Neural Network



Quality of herbivore resource: nitrogen cycle



Modeling herbivores from knowledge of resources

- East African mammals show a similar unimodal curve when plotted against productivity
- Groups of E African mammals have different responses to productivity

