

The Application of Remote Sensing Derived Products for Rangeland Management in KwaZulu-Natal

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KZN RANGELANDS

Extensive rangelands covers 70% of KZN or 7 million ha

Grassland 39%

Open woodland 8%

Closed woodland & Thicket 23%

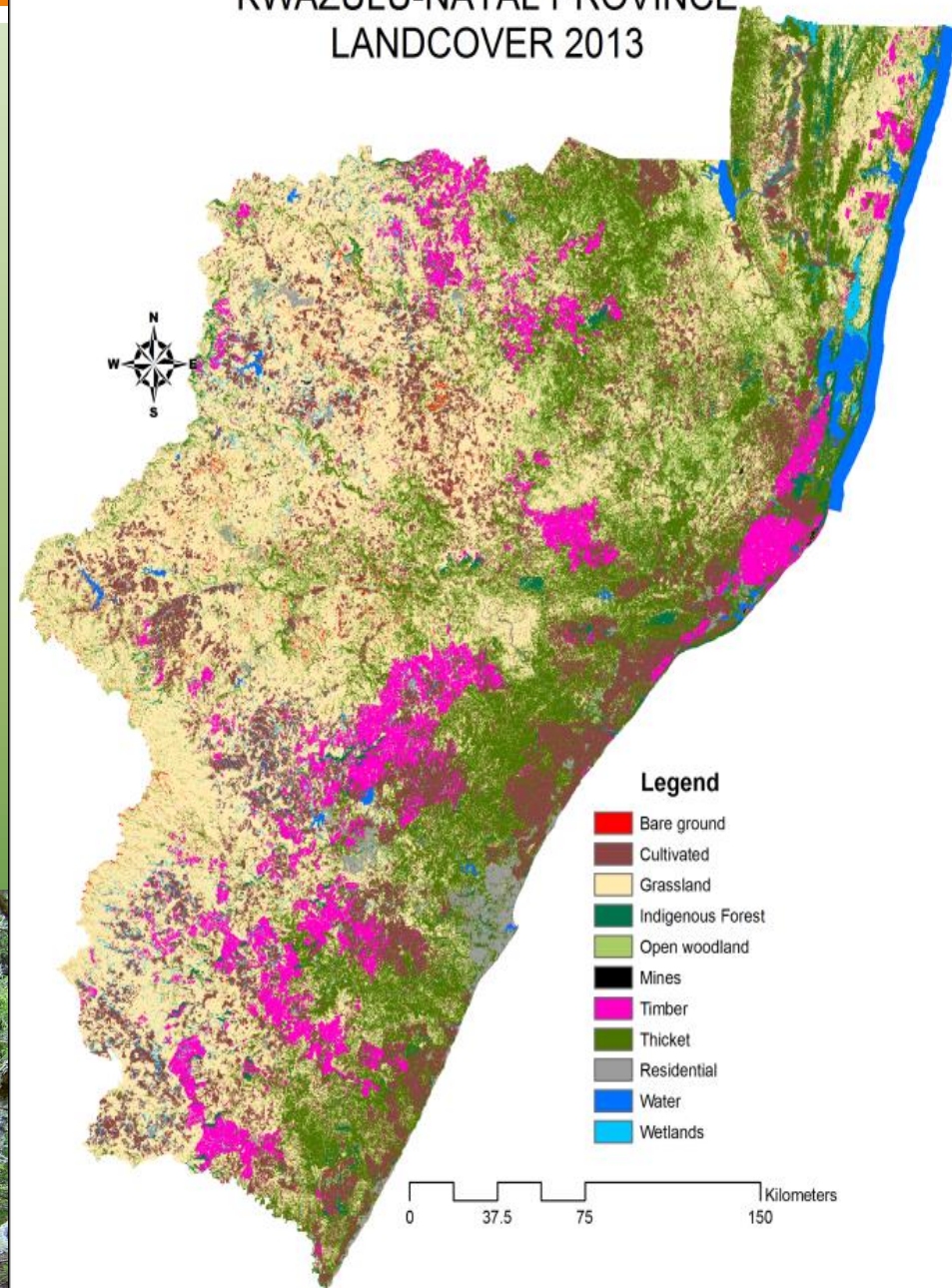
Important to:

- Formal & informal agricultural sectors
- Game farming & ecotourism
- Conservation & ecosystem services



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KWAZULU-NATAL PROVINCE LANDCOVER 2013



STANDARD OPERATING PROCEDURES

- Client driven projects:
 - Commercial agriculture & subsistence agriculture
 - Game farming sector
 - Conservation sector
 - Risk & Disaster
- Range condition, carrying capacity & management planning recommendations
- Type of data collected:
 - Herbaceous species composition
 - Standing herbaceous biomass
 - Woody vegetation composition, phytomass & browseable material
 - Soil properties
- Project areas: 50 – 50 000 ha
- 80 – 120 sites per annum covering between 20 000 and 80 000 ha

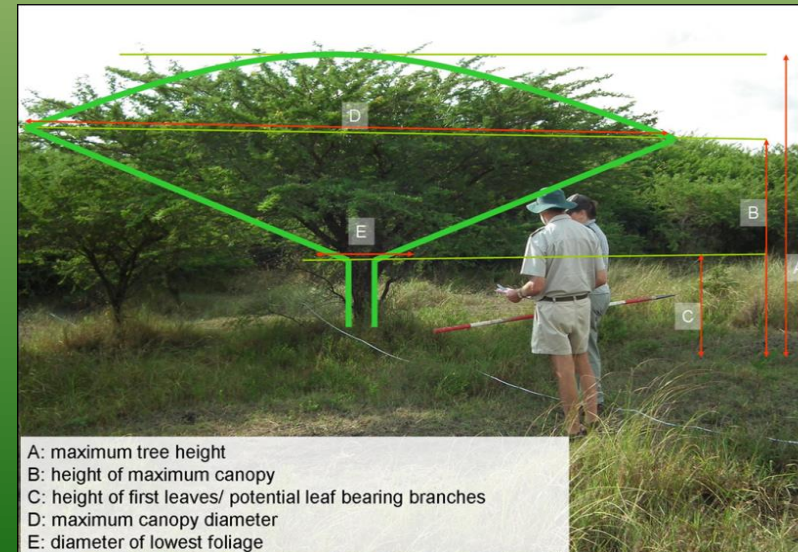
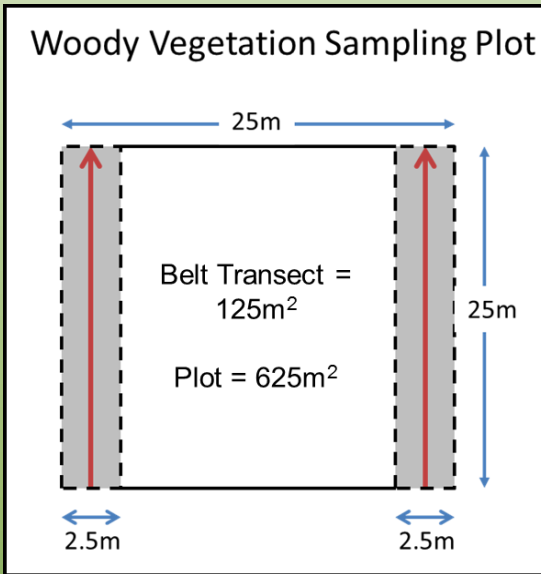


Illustration of measurements collected for BECVOL calculations

REMOTE SENSING INTEGRATION

- Constraints:
 - Time
 - Man-power
 - Extrapolation from survey site to landscape level
- Investigated an approach of integration of remote sensing and field data
- Points of departure - "Stick to our Core Business"
 - Based on sound, practical rangeland management data;
 - Use data collected for clients;
 - Used only freely available remote sensing datasets;
 - Develop spatial layers as input variables into carrying capacity modelling at landscape level;
 - Output needed to be useful for making management recommendations at farm level;



GRAZING CAPACITY

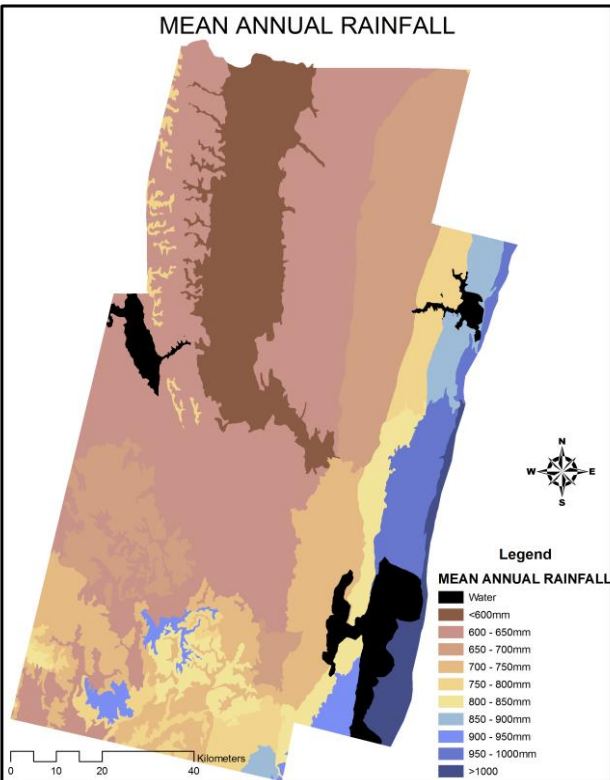
Grazing capacity (ha/AU) =

$D \times R$

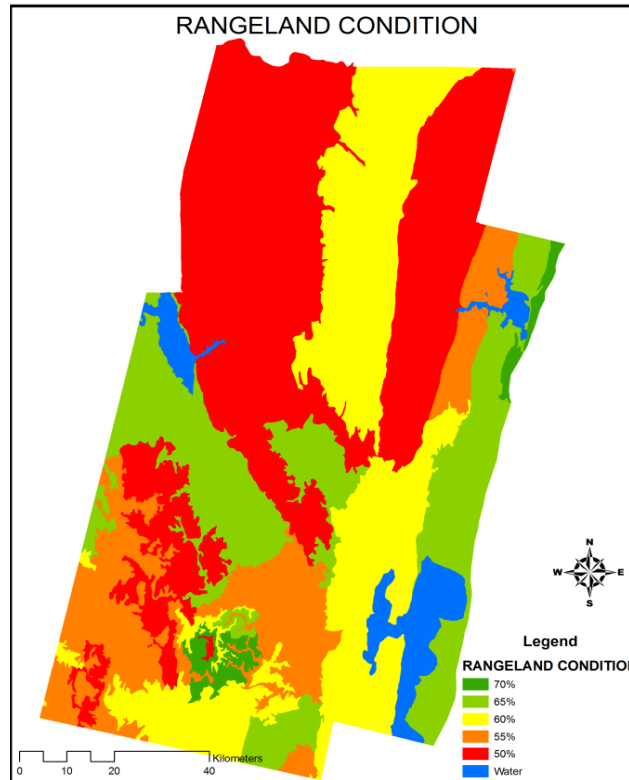
$$\frac{\{[(MAR \times 0.8) \times \frac{VC \times 5}{100}] \times W \times A\}}{2}$$

- D = Utilization period (Days)
- R = Requirement of the animal per day (1 Animal unit requires 10kgDM/day_
- MAR = Mean annual rainfall
- VC = Veld condition as percentage of the benchmark for the BRG
- W = Woody species impact factor.....(2)
- A = Accessibility factor.....(3)

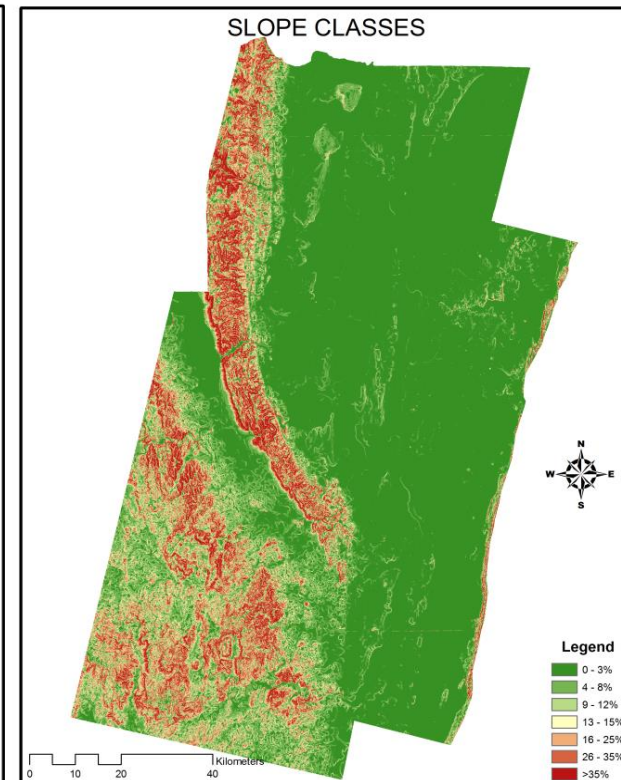
MEAN ANNUAL RAINFALL



RANGELAND CONDITION

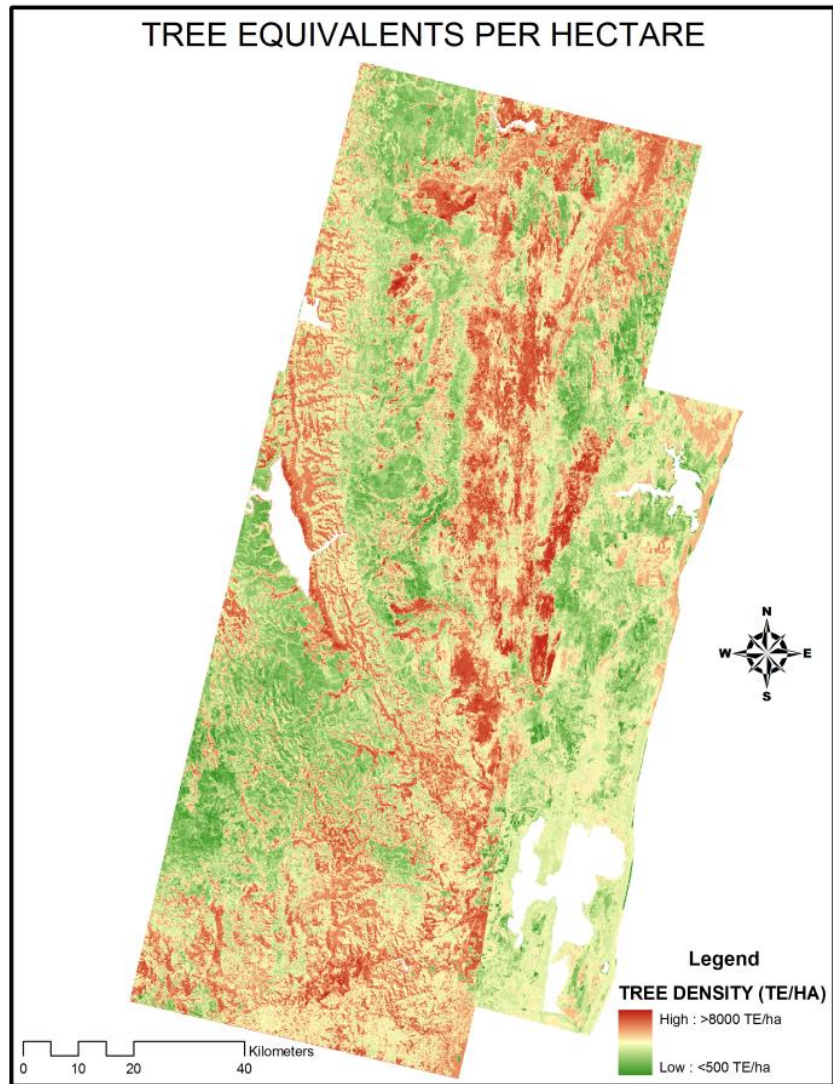


SLOPE CLASSES



GRAZING CAPACITY

- Develop tree density (TE/ha) spatial layer – woody plant data from 209 plots – correlated to NDVI & SR of SPOT5;
- Tree density corrected grazing capacity model Zululand Lowveld.



ADDITIONAL APPLICATIONS - TREE DENSITY LAYER

- Mapping & Tracking Bush Encroachment;
- Mapping, Tracking & Quantifying Mega Herbivore Impact;
- Limitations



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BROWSE CAPACITY

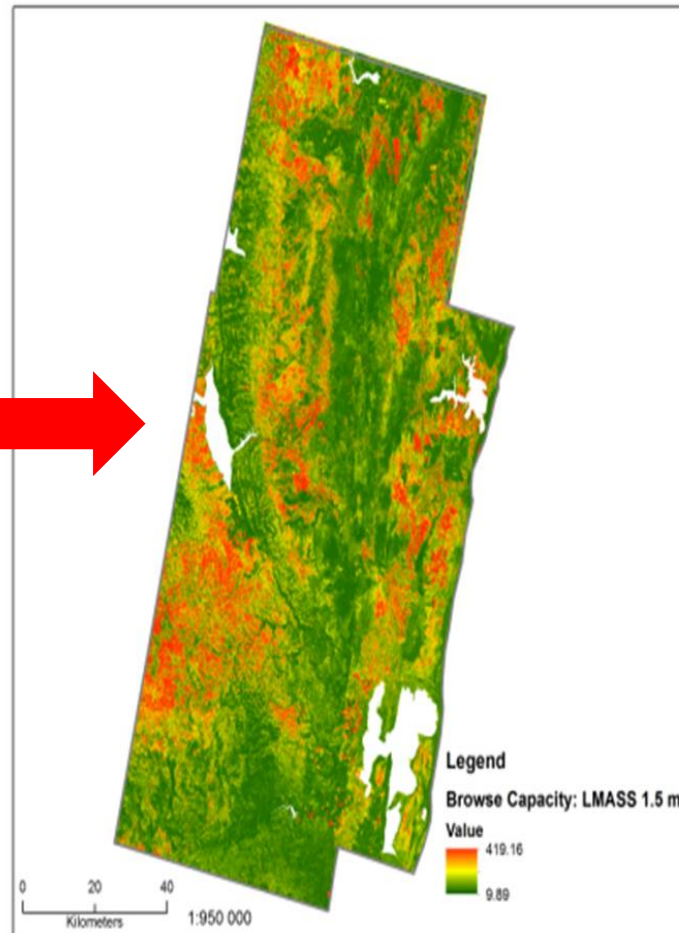
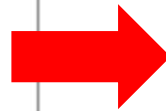
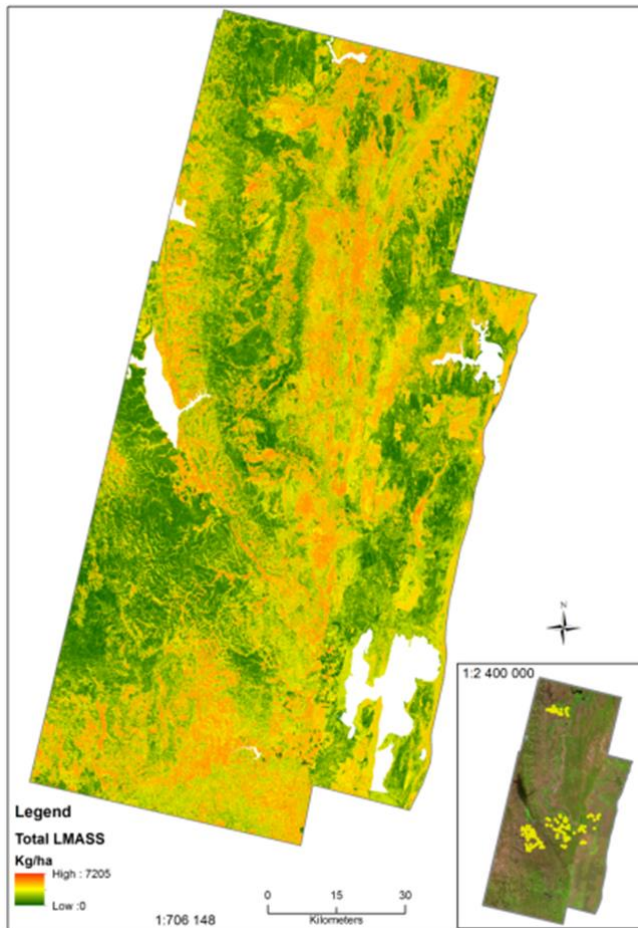
$$\text{Browse capacity (ha/AU)} = \frac{D \times R}{LM \times F \times P}$$

D	=	Utilization period (Days)
R	=	Requirement of the animal per day (1 Animal unit requires 10kgDM/day_
LM	=	Leaf Mass at 1.5m, 1.5m-2.0m and 2.0m-5.0m (kg)
F	=	Utilization factor (25%)
P	=	Phenology factor (0.744)

- Develop LMAS spatial layer using BECVOL data for 209 sites;

Spatial distribution of Leaf Mass

Browse Capacity @ 1.5m (ha/AU)



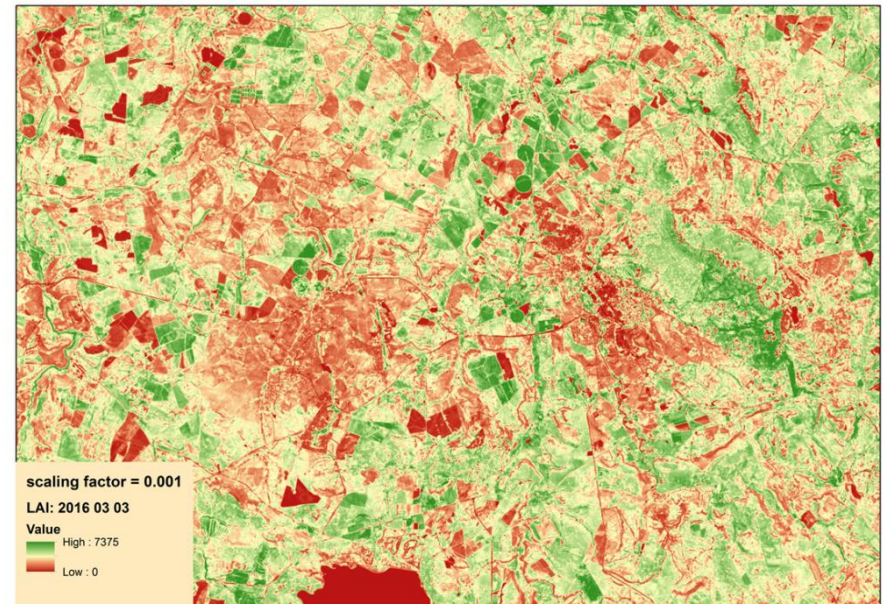
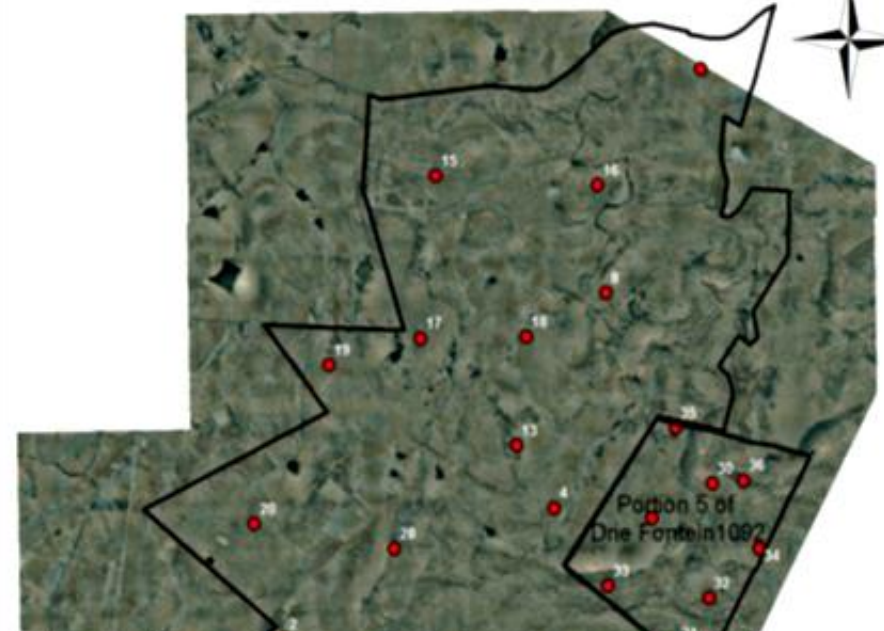
- Use LMAS as input variable into Browse Capacity model for the Zuluand Lowveld.
- Phenology still limiting input variable but possible solution in LAI

LEAF AREA INDEX AS PROXY FOR WOODY PLANT PHENOLOGY

- Client driven woody plant phenology study
- Relatively homogenous microphyllis dominated deciduous woodland
- Monitor 4 different age groups of 5 dominant browse forage species;
- Monthly observations over two full growing seasons
- Determine critical forage deficiency periods for browsers

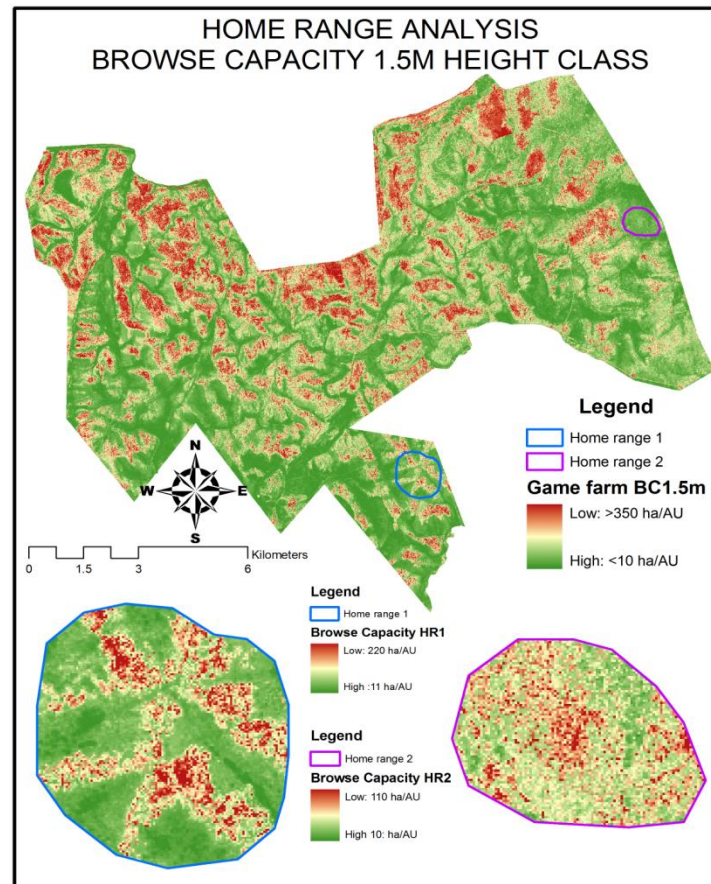
Opportunity to:
Investigate relationship between field observations and LAI derived from RS

Woody Plant Phenology Monitoring Study



APPLICATIONS OF BROWSE CAPACITY SPATIAL LAYER

- Browse Capacity recommendations for livestock and game;
- Home Range Analysis
 - Priority Species Conservation – Black Rhino Expansion Program
 - High Value Species Management – Nyala
- Limitations – Temporal analysis – Fire & Browse Availability



HERBACEOUS BIOMASS

- Falling plate data for herbaceous biomass >650 sites;
- Accounts for heterogeneity in vegetation type, woody plant density & moisture regimes;
- Establish relationship with Landsat 8 indices
- Purpose:
 - Biomass accumulation over growing season
 - Drought monitoring
 - Fire hazard prediction
 - Quantify relationship between biomass production & woody plant density at landscape level

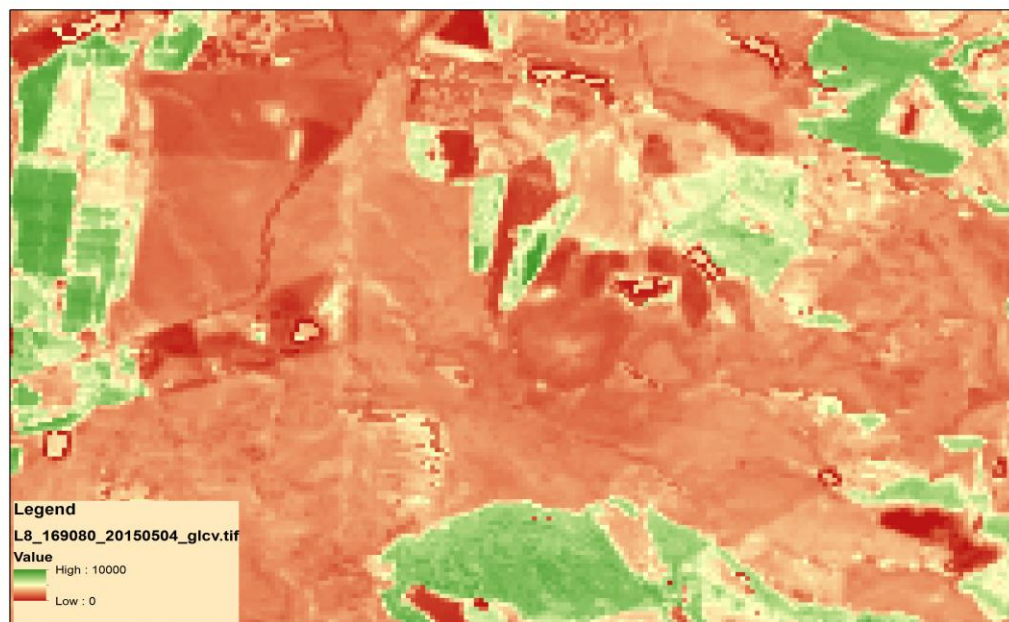
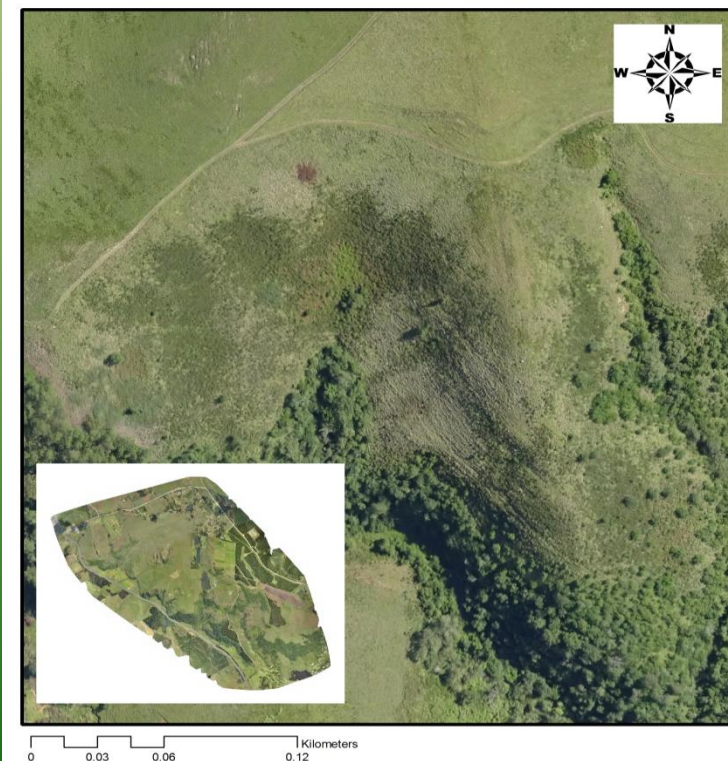


HIGH RESOLUTION DRONE IMAGERY

- Mapping distribution and extent of C3 herbaceous species encroachment into C4 grassland.
- High resolution imagery generated from drone platform
- Non-growing season NDVI data to distinguish C3 from C4 species



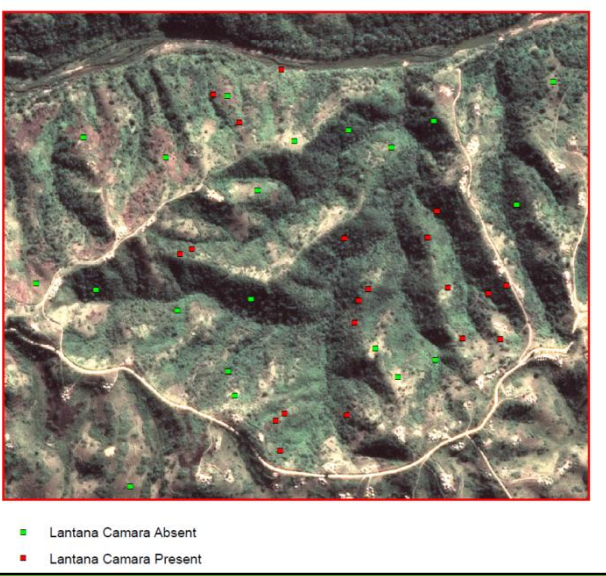
HIGH RESOLUTION DRONE IMAGERY



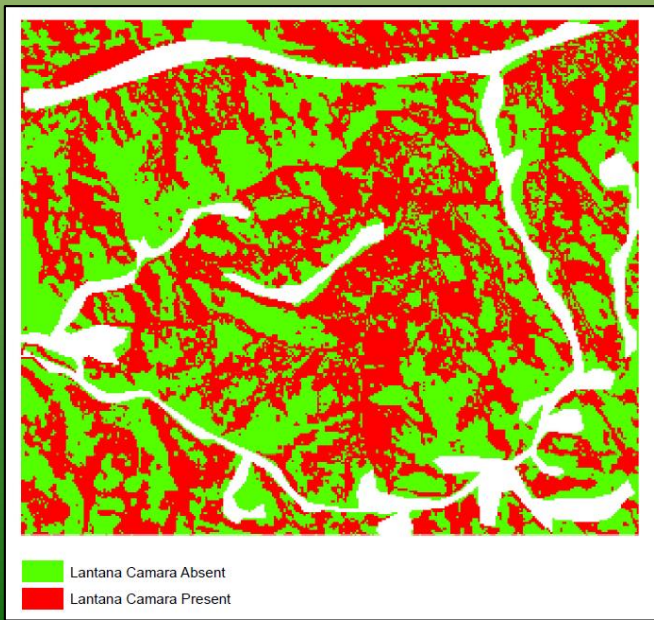
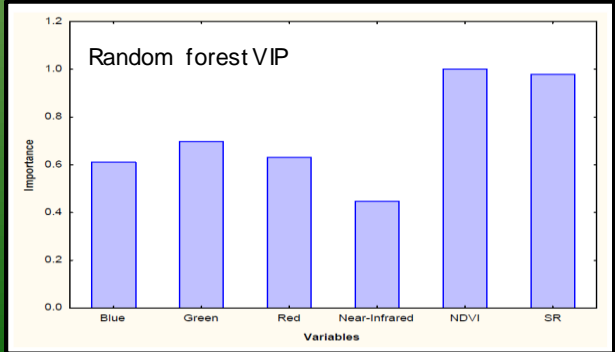
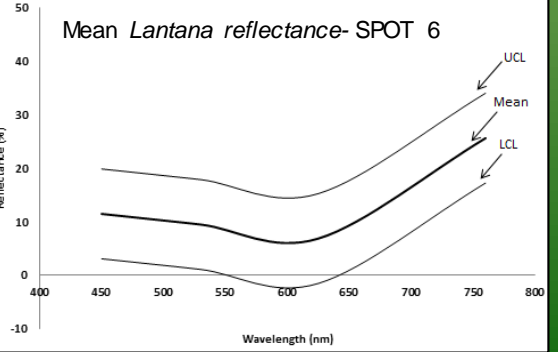
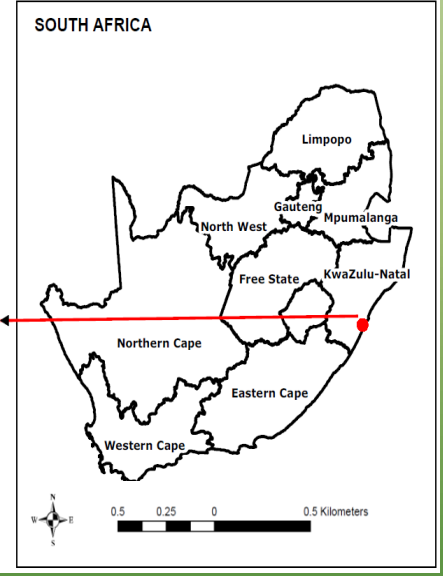
Lantana camara mapping in KZN using SPOT 6

- *Lantana camara* severe negative impact on rangeland productivity.
- SPOT 6 multispectral imagery (6 X 6 m),
- Broadband vegetation indices (NDVI and SR).
- Random forest algorithm used for classification.
- Backward feature elimination technique – to select best subset of bands.
- Classification accuracy of 83.33 % on an independent test dataset;

Highlight potential of remote sensing in weed detection and mapping in using readily available multispectral data



■ Lantana Camara Absent
■ Lantana Camara Present



LESSONS LEARNED

- Remote sensing products based on practical rangeland monitoring data can effectively be used as input variables into carrying capacity modelling at landscape level;
- User driven field data and freely available remote sensing data can be used in product development;
- High resolution field data triumphs high resolution imagery, more wavebands or better processing power;
- Constrains to this “low key” approach include:
 - Lack of processing power
 - Slow rate of field data generation
 - Lack of standardization in data collection techniques and database design
- Initiatives like GEOGLAM RAPP can provide an important platform for discussion of innovation and best practise relating to remote sensing and rangeland management interface.



Thank You