Forage Biomass Estimation and Grass Species Composition: Comparison between Protected Areas and Communal Grazing Systems Using Machine Learning and Remote Sensing Techniques

Presented by
Gladness M. Khoza

PhD Geoinformatics Candidate
ARC-Natural Resources and Engineering (ARC-NRE)
University of Pretoria

Supervisors: Prof JG Chirima, Prof A Ramoelo & Dr PL Tsele

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Rangeland Monitoring

Grass biomass and species composition are key indicators of rangeland health, essential for sustaining livestock and wildlife.

Communal grazing systems face overgrazing and reduced forage quality.

Protected areas exhibit higher biomass but require monitoring for conservation.

Lack high-resolution spatial data and a need for scalable, precise techniques to guide rangeland management.

AIM

To quantify the relationship between grass species diversity and biomass in protected and communal grazing areas

OBJECTIVES

- To estimate forage biomass and assess grass species composition during the senescence period.
- To compare on dry season protected areas and communal grazing systems using UAV Lidar and machine learning for rangeland management

Figure 1: Image of KNP Granite Grazing Area

Figure 2: Image of Communal Granite Grazing Area

Study Areas

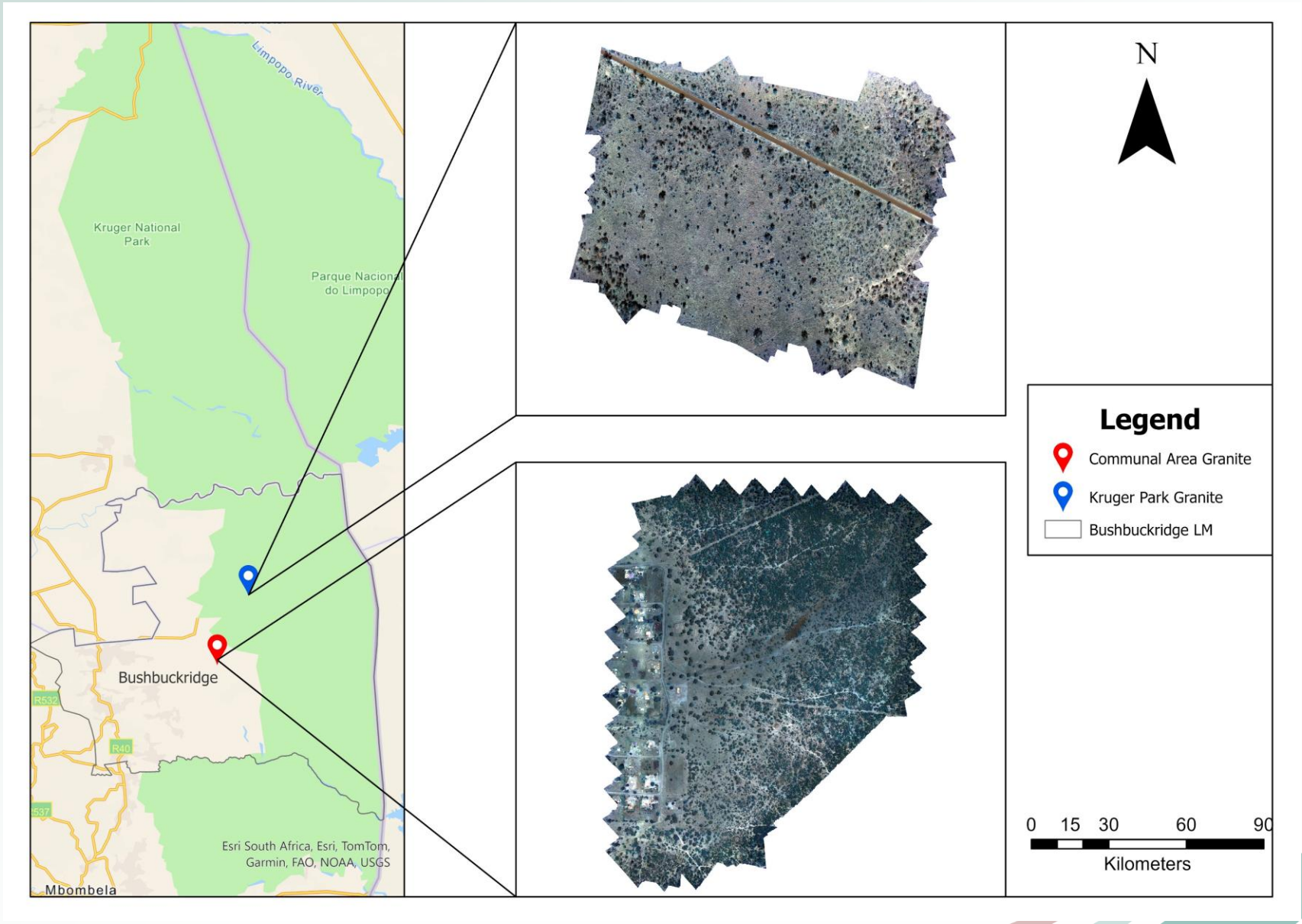


Figure 3: Map showing Granite Study sites in Kruger National Park (KNP) and Thorndale Communal Area

Methodology

Figure 4: Quadrat for grass clipping

Figure 5: DJI M300 UAV, Lidar Sensor

- **Data Collection:**
  - UAV DJI M300 Lidar collected in June 2024.
  - Field measurements
    - 4 samples per plot, with a total of 15 plots across study areas.
    - Grass biomass clippings were collected in a 0.5mx0.5m quadrant.
    - Grass species identification
  - **Date of collection**: Senescence period between May-July 2024.
- **Analysis Tools:**
  - Machine learning (Random Forest) for biomass estimation.
- **Comparison:** Statistical analysis to identify differences between Communal and KNP Grazing Areas.

Statistical Analysis: Biomass Distribution

Figure 6: Box Plots

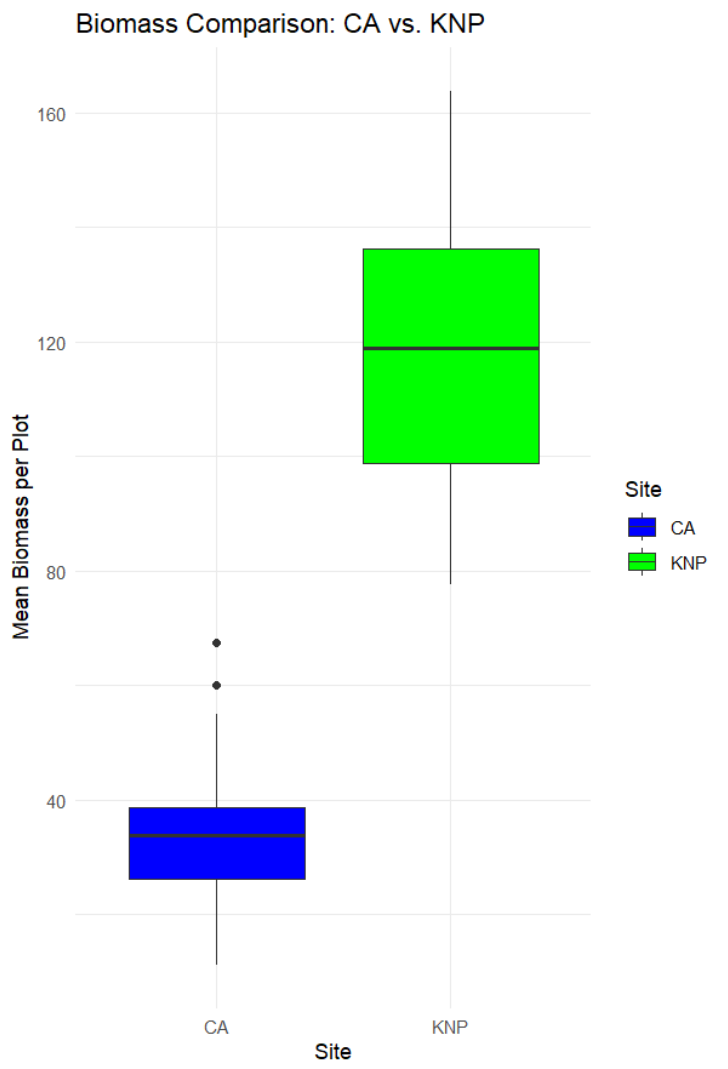
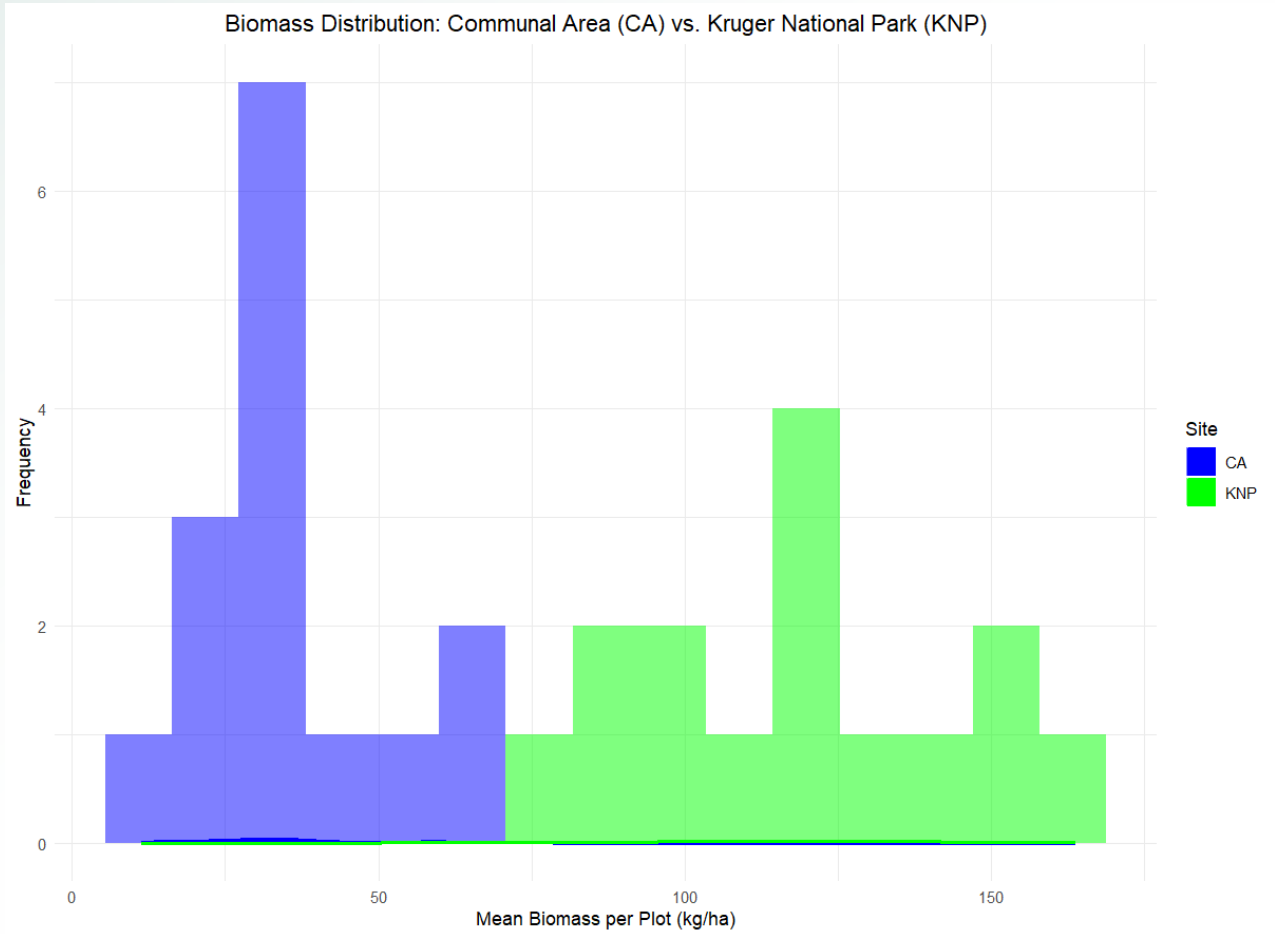


Figure 7: Histogram



Sample Means: Mean in CA = 35.33; Mean in KNP = 117.83
Biomass in communal areas is significantly lower than in KNP

Biomass Estimation Maps

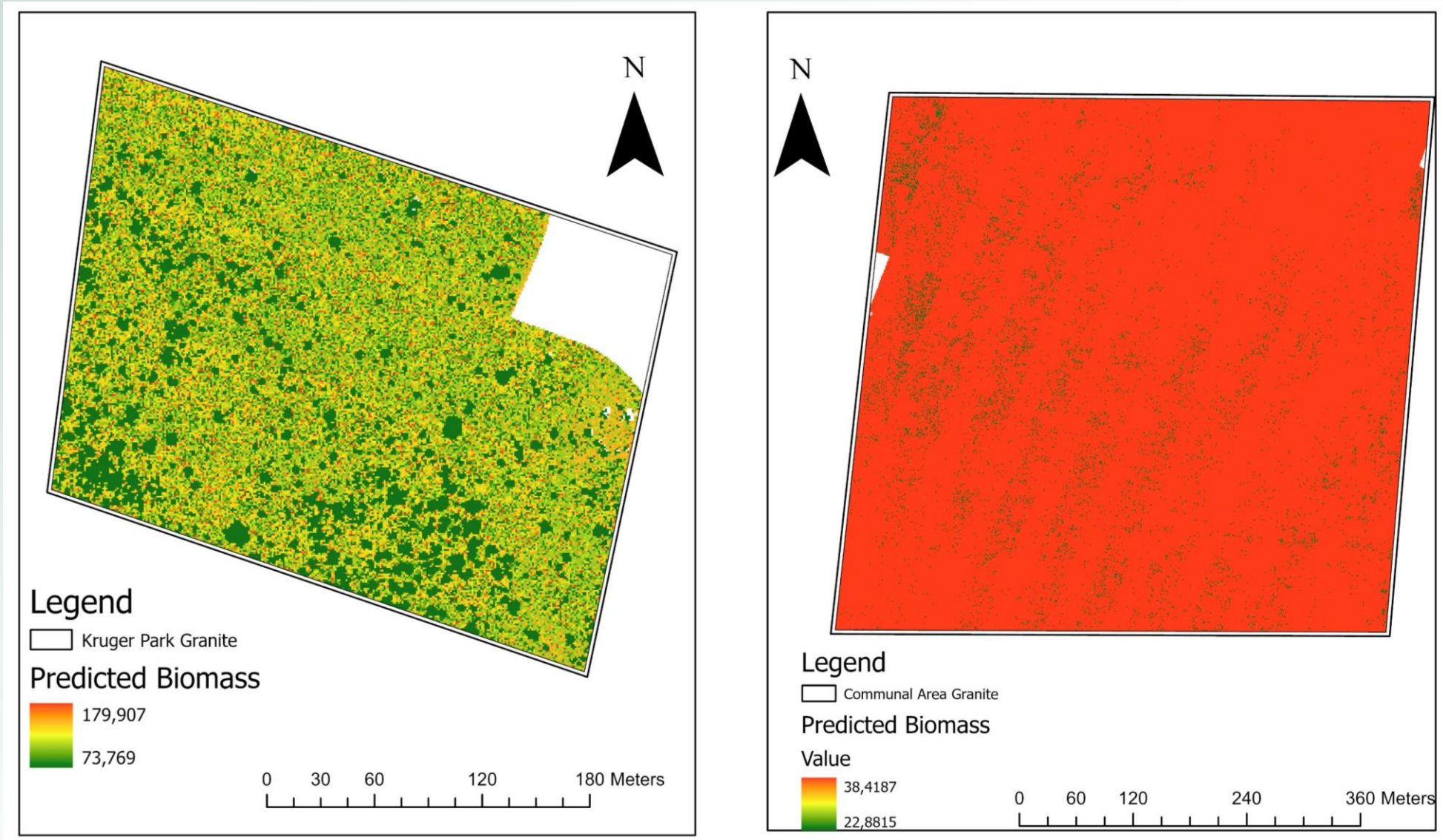
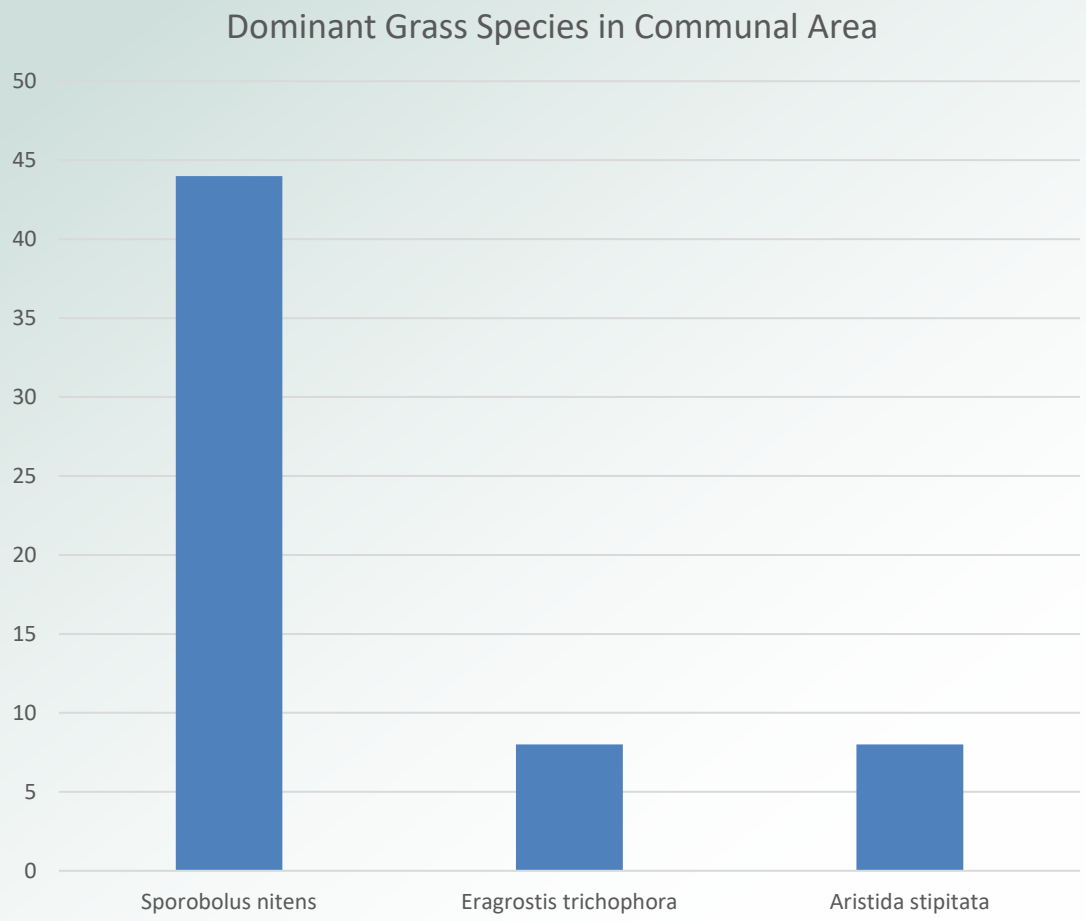
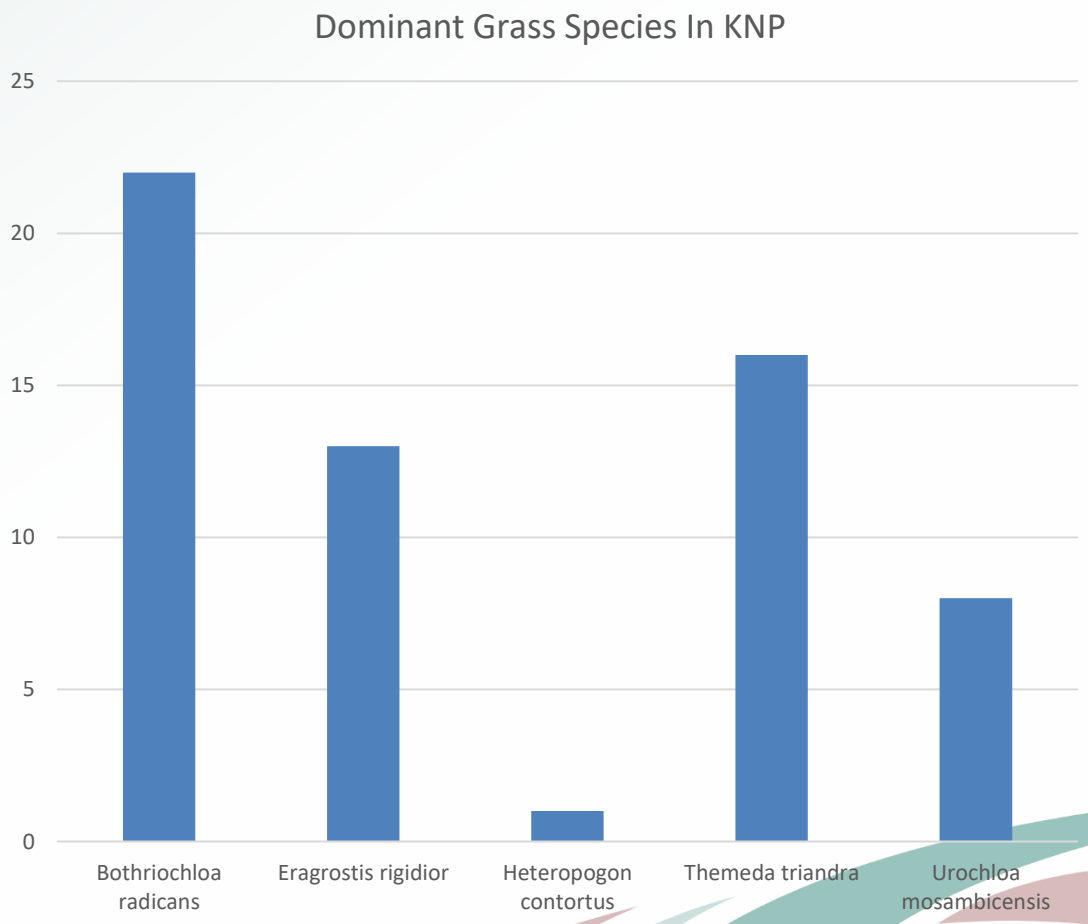


Figure 8: Maps showing Biomass Distribution in KNP and Thorndale Communal Area

Species Composition





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Key Findings

•**Forage Biomass:**
•Higher in KNP than communal grazing lands suggestive of overgrazing.
•Management practices in communal grazing areas need to be reconsidered, due to the significant biomass loss compared to KNP.

- Findings highlight the impact of different land management practices.

•**Grass Species Composition:**
•**Communal Area**: The dominance of *Sporobolus nitens* and presence of *Aristida congesta* suggest a system under high grazing pressure, leading to a shift in species composition towards less palatable, lower-quality grasses.
•**KNP**: More species found in KNP, but *Bothriochloa radicans* is dominant, despite being unpalatable. It persists in the dry season due to its resilience and often avoided by grazers due to its strong aromatic smell.

•**Different grazing systems impact biomass availability and species composition.**

Conclusion

- **Summary:**
  - Significant differences in forage biomass and species diversity between protected and communal areas.
  - UAV Lidar and machine learning offer transformative tools for rangeland assessment.
  - Dry-season monitoring provides critical insights into forage availability and species composition.
- **Future Work:**
  - Include wet-season data to capture seasonal dynamics.
- **Closing Statement:**
  - Findings contribute to balancing conservation efforts with sustainable grazing practices.

Acknowledgements

THANK YOU

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