Species composition, tree canopies and biomass in southern African woodlands

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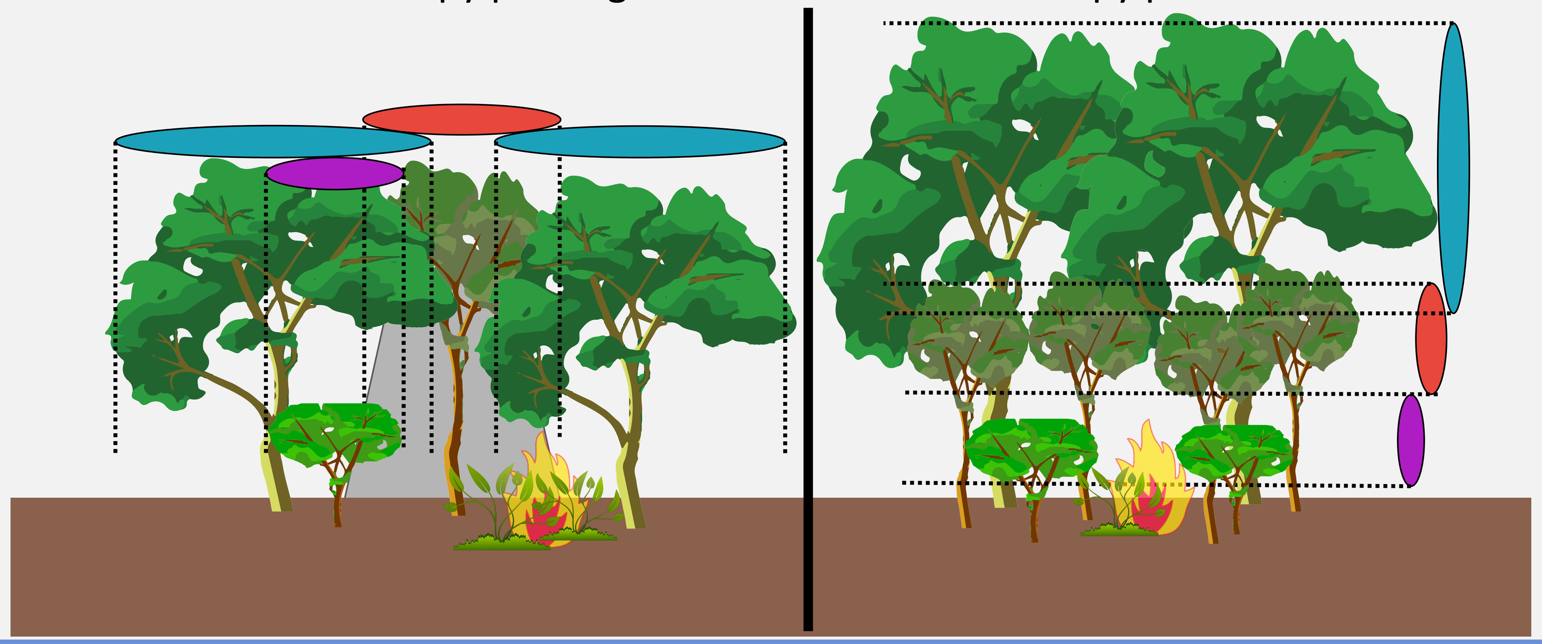
Background

Miombo woodlands are the dominant vegetation cover in southern Africa[1], forming woody savannahs with an often thick grassy understorey[2]. Miombo woodlands hold ~18-24 Pg C, comparable to that of the Congo basin rainforests[3], however the processes which govern woody carbon distribution are poorly understood.

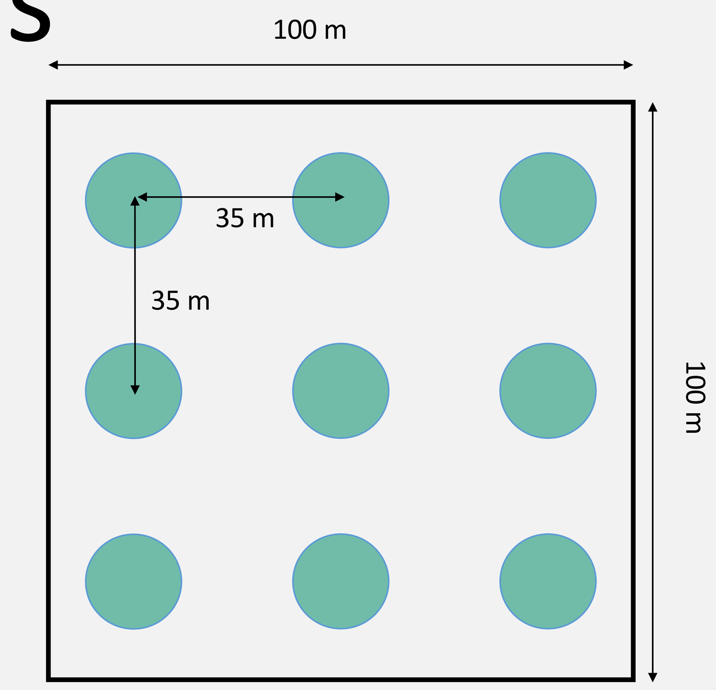
The Biodiversity – Ecosystem Function Relationship postulates that at a local scale, as the number of primary producer species increases, the values of various ecosystem processes such as gross primary productivity and standing biomass also increases due to wider niche space occupation[4].

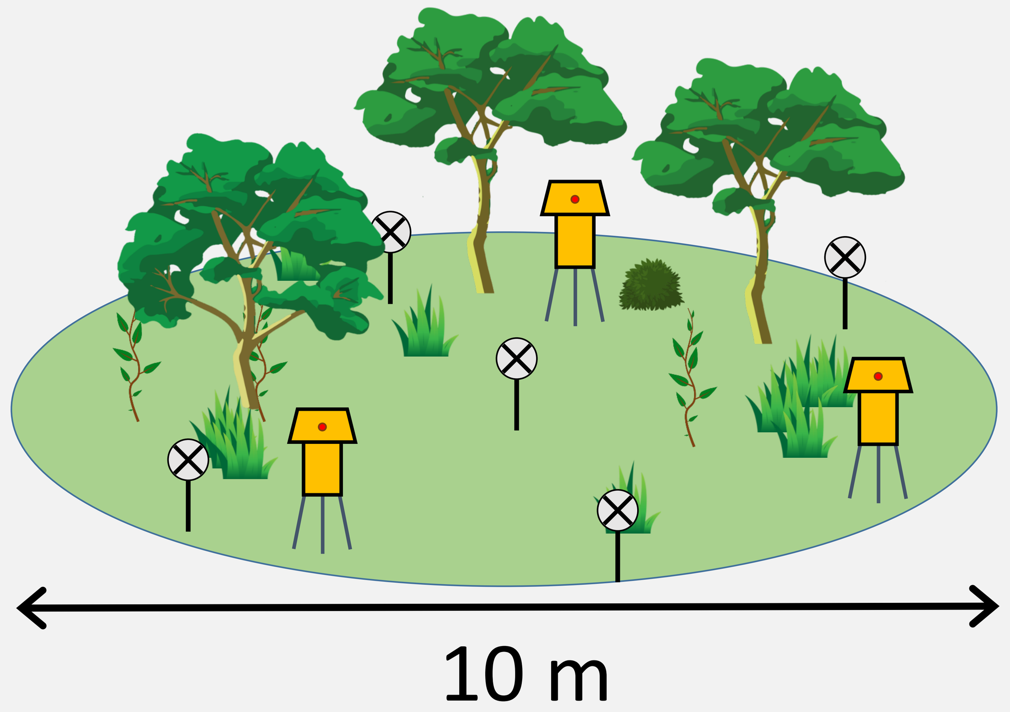
Tree species diversity may increase aboveground biomass in miombo woodlands through niche differentiation in canopy architecture and woodland canopy occupation. While some canopy tree species may be able to escape seasonal grass fires by growing rapidly to large canopy trees, others may be able to persist as small understorey trees in spite of fires, resprouting each year from a large root system. A larger species pool may therefore allow more stems per unit area



Methods

In Bicuar National Park, southwest Angola, we constructed 15 1 Ha square survey plots in intact miombo woodland, across a gradient of stem density which were further subdivided into nine 10 m diameter subplots, which form the sample unit for this study.

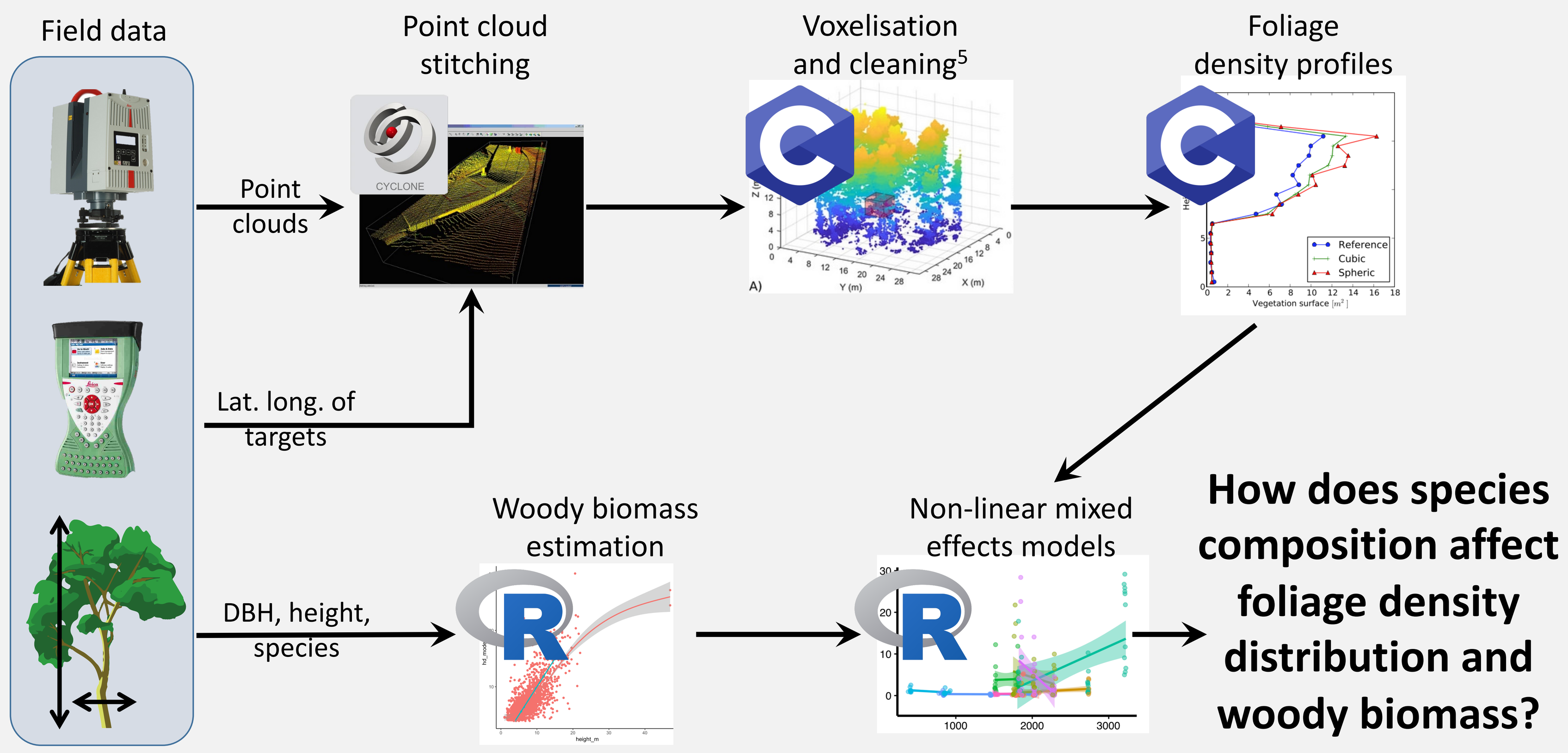




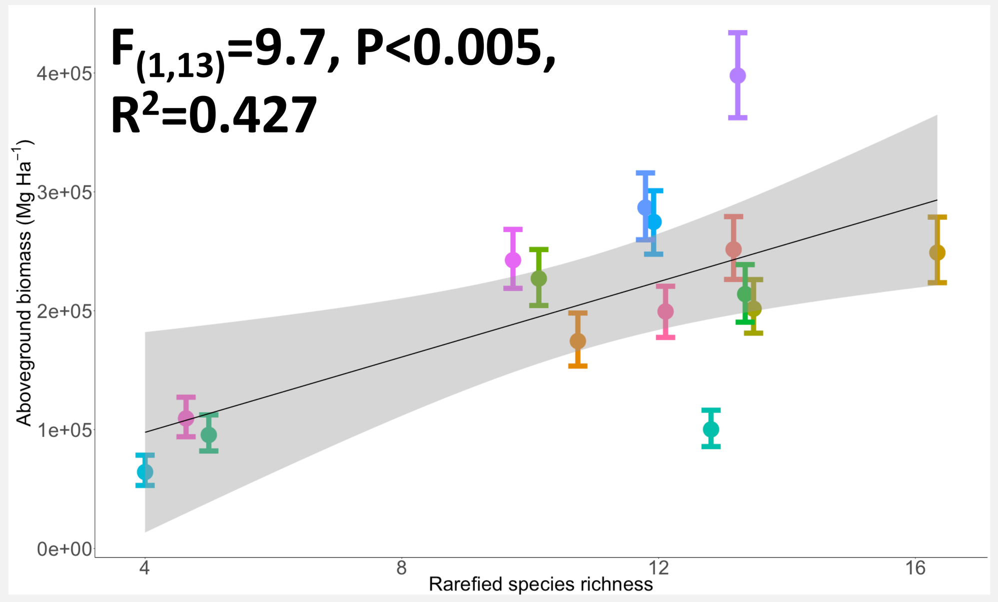
A Leica HDS6100 Phase Shift Terrestrial Laser Scanner (TLS) was used to construct 3D shadowless images of the foliage inside each subplot. Reflective targets were to allow the data to be compared with satellite LiDAR products in the future, greatly extending the value of the data.

Terrestrial LiDAR Analysis

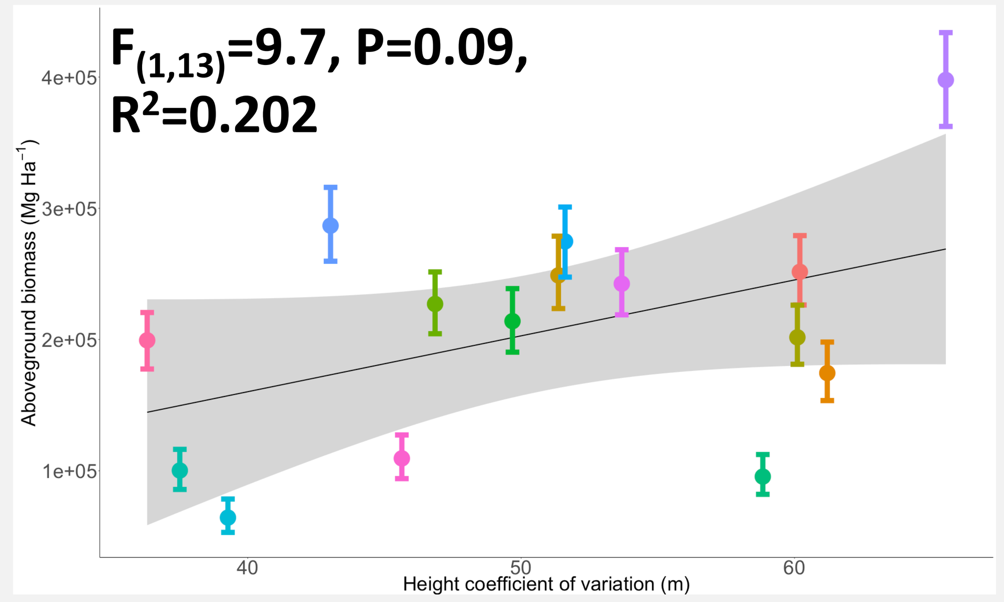
TLS data will be aggregated and voxelised for each subplot to produce estimates of the woodland canopy foliage density at different heights through the canopy. **It is expected that plots with higher species richness will have a greater overall foliage area and a wider foliage distribution over the canopy profile.**



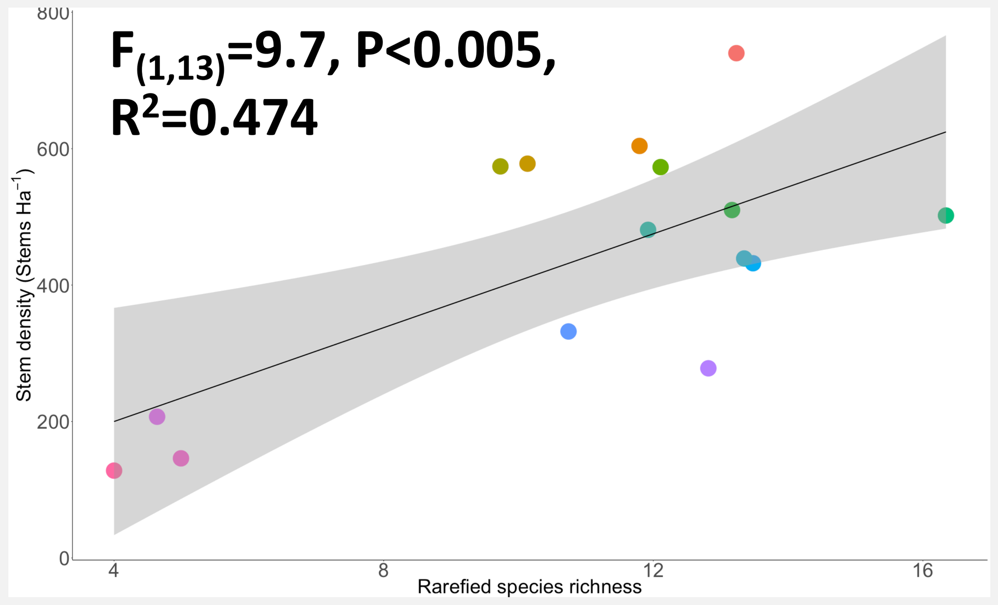
Preliminary results

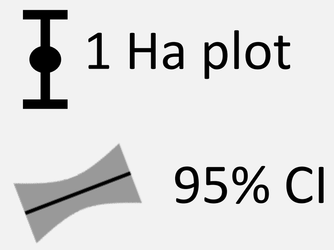


A positive relationship exists between species richness (rarefied to account for variation in stem density and aboveground biomass (AGB), explaining 43% of the variation in AGB.



Additionally, variance in tree height had a positive but weak effect on aboveground biomass, suggesting that a distribution of foliage material throughout the canopy profile may allow greater stem density and above ground biomass per unit area.





Next steps

- Process terrestrial LiDAR data to produce foliage density profiles for each subplot.
- Create metrics to assess foliage distribution through the canopy profile.
- Compare foliage density profiles from the TLS with satellite borne LiDAR data to scale up to the whole of Bicuar National park.
- Explore tree functional richness via canopy position as a potential driver of aboveground biomass.

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