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PLANT CONSERVATION UNIT



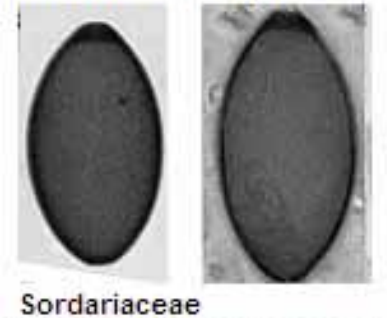
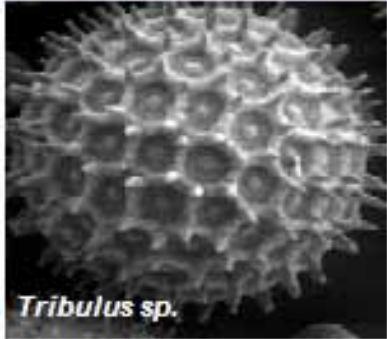
Hierarchy and scale: testing the role of Water, Herbivory and Nitrogen in the Savanna Landscape of Limpopo National Park (Mozambique)

Anneli Ekblom, (African and Comparative Archaeology, Uppsala University)

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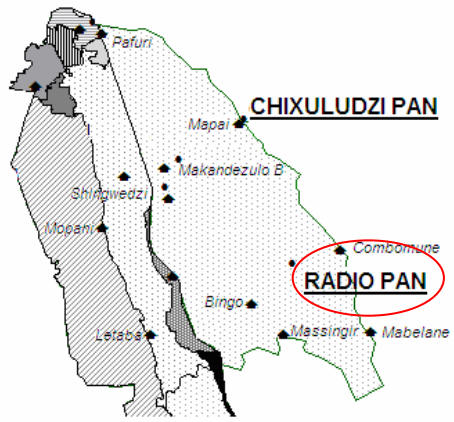
Lindsey Gillson (Plant Conservation Unit, University of Cape Town)





Aims

- To test to long term role of water, herbivory, fire and nitrogen in the savanna landscape
- By contrasting 2 localities with same rainfall regime but different hydrology
- Using fossil pollen, charcoal, dung fungal spores and nitrogen isotopes from sedimentary sequences.



Radio Pan

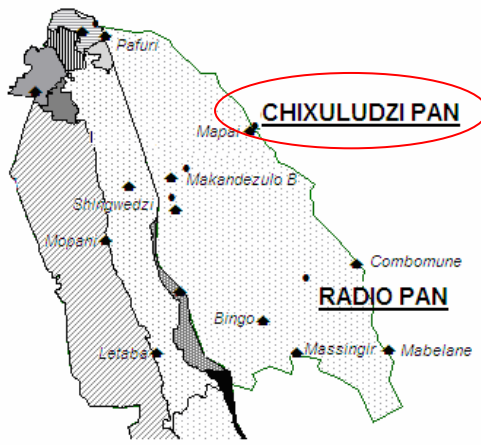


Deep alluvial sands

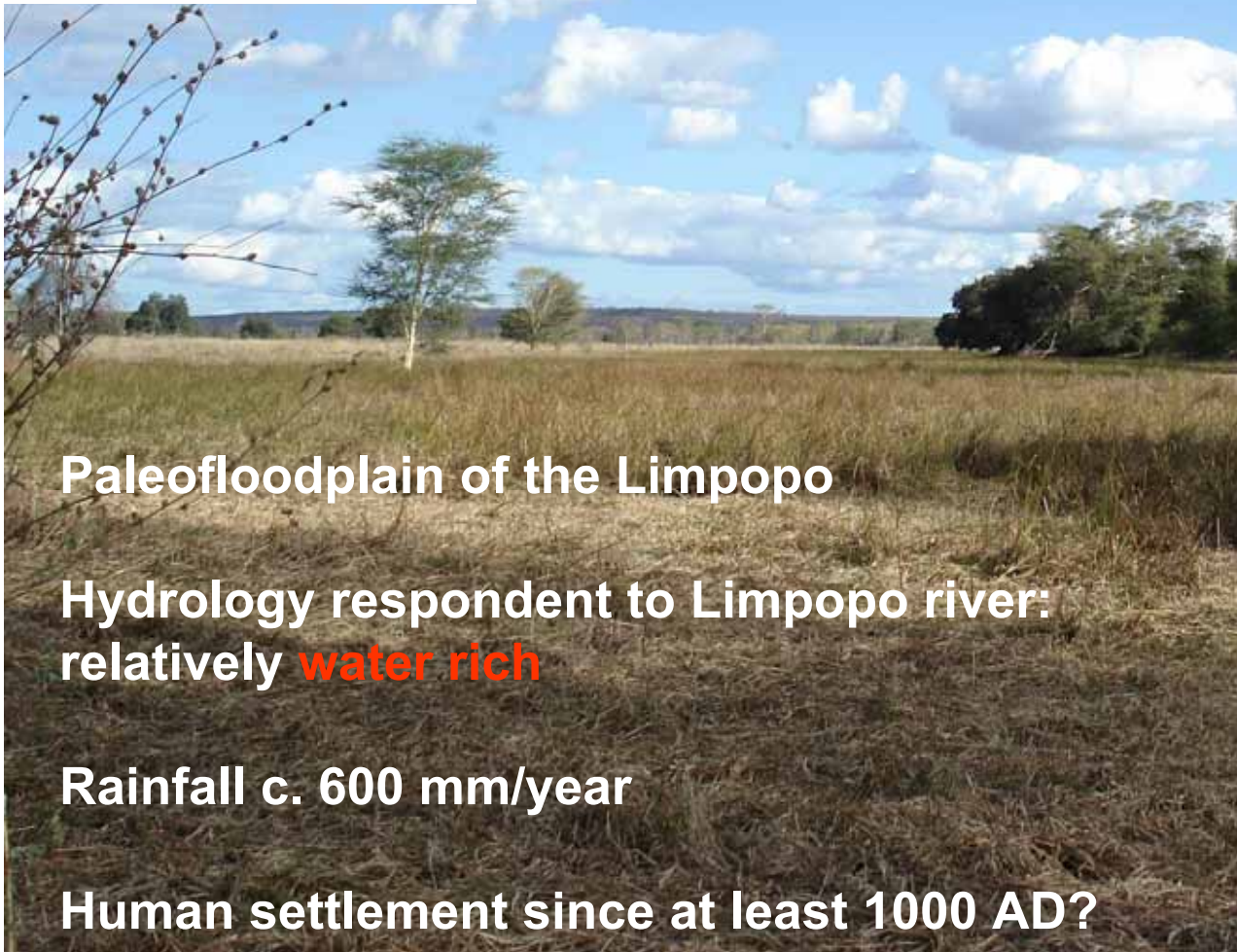
Seasonal availability of surface water: **water scarce**

Rainfall c. 600 mm/year

Complex hydrology (decoupled from rainfall?)



Chixuludzi Pan



Paleofloodplain of the Limpopo

Hydrology respondent to Limpopo river:
relatively **water rich**

Rainfall c. 600 mm/year

Human settlement since at least 1000 AD?



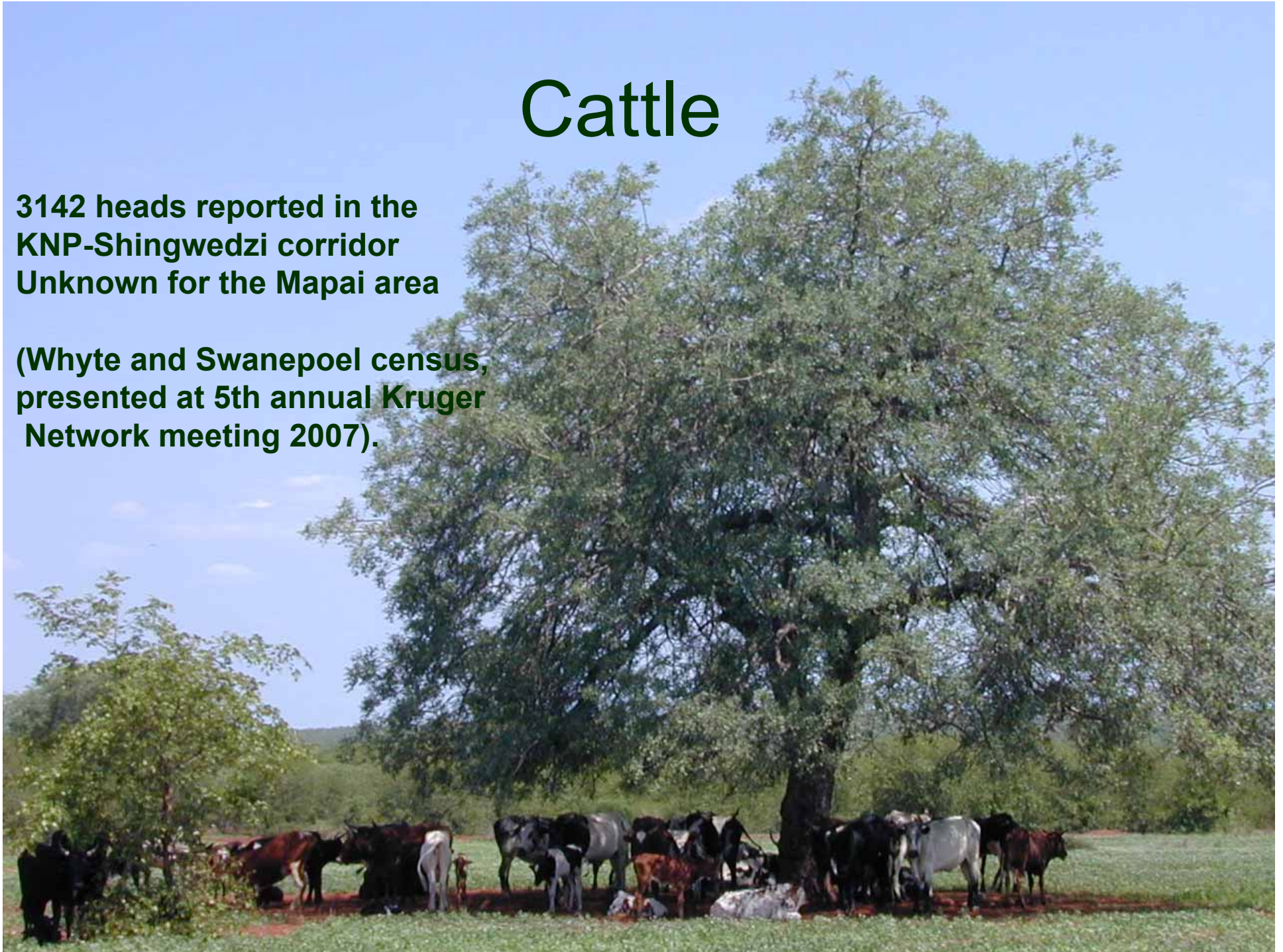
c) Mopane forest -Mapai

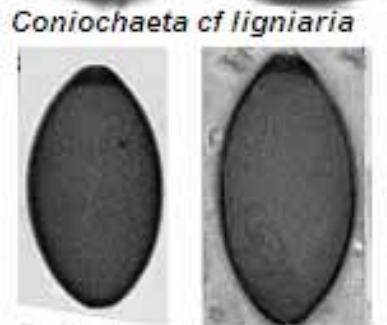
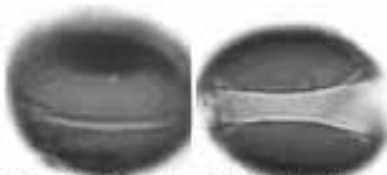
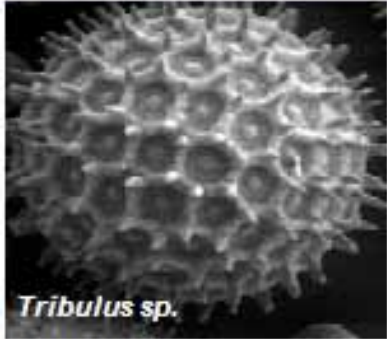


Cattle

**3142 heads reported in the
KNP-Shingwedzi corridor
Unknown for the Mapai area**

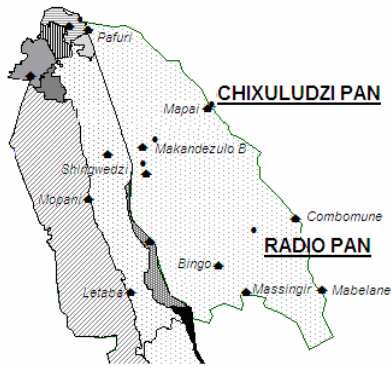
**(Whyte and Swanepoel census,
presented at 5th annual Kruger
Network meeting 2007).**





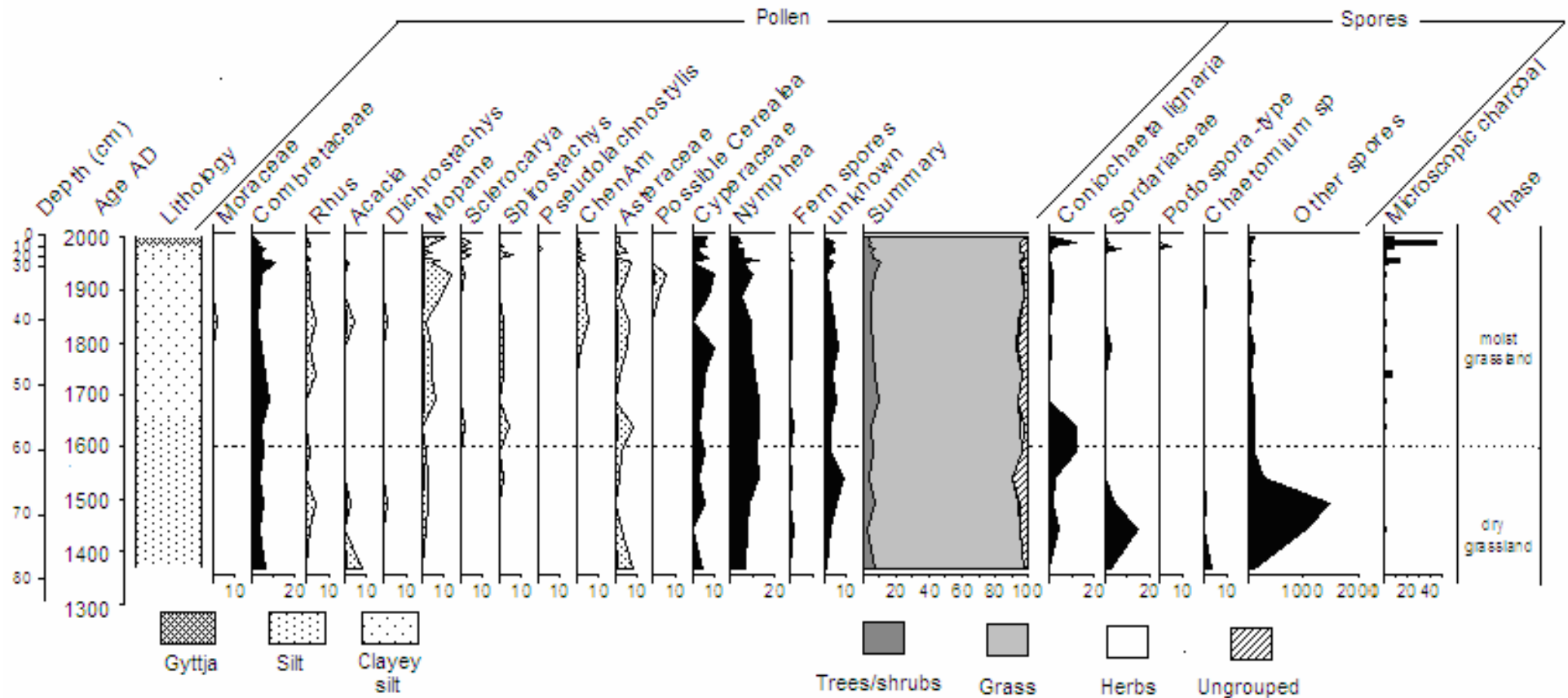
The use of dung fungal spores

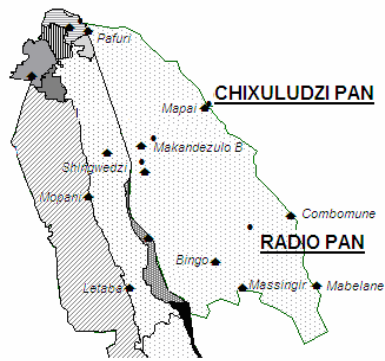
- Reconstruction of herbivore abundance in many parts of the world (wild and domestic)
- Megaherbivore extinction in Madagascar (Burney et al 2003)
- Modern dung fungi analysed by in KNP (Ebersohn and Eicker 1992, 1997)
- Most common types in our cores: *Coniochaeta cf ligniaria* and *Sordariaceae*



Radio Pan: stable open savanna grassland

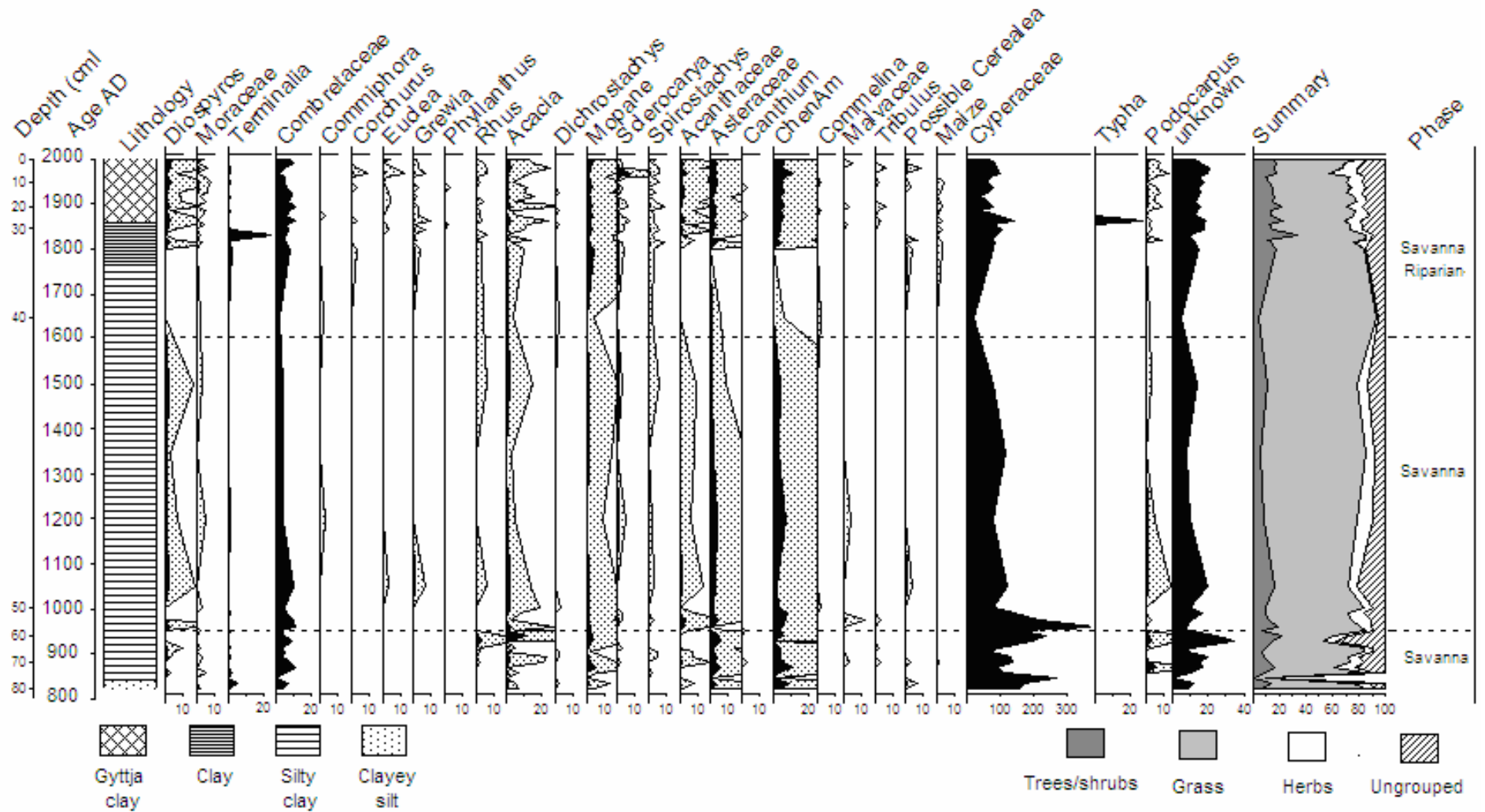
Radio pan -pollen and spore diagram





Chixuludzi Pan: savanna in flux

Diagram

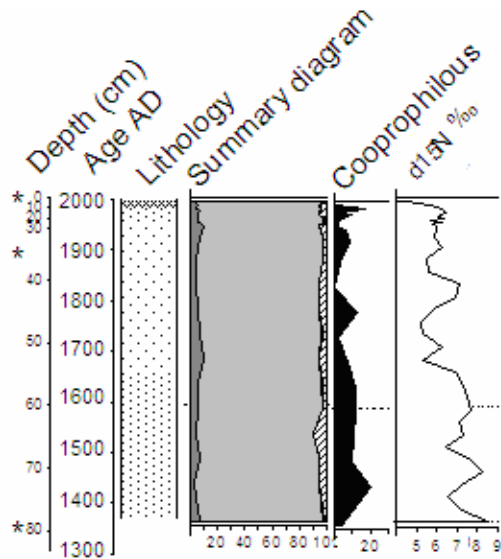




The role of herbivory, fire and grazing in savanna constrained/unconstrained by water availability

Assumptions

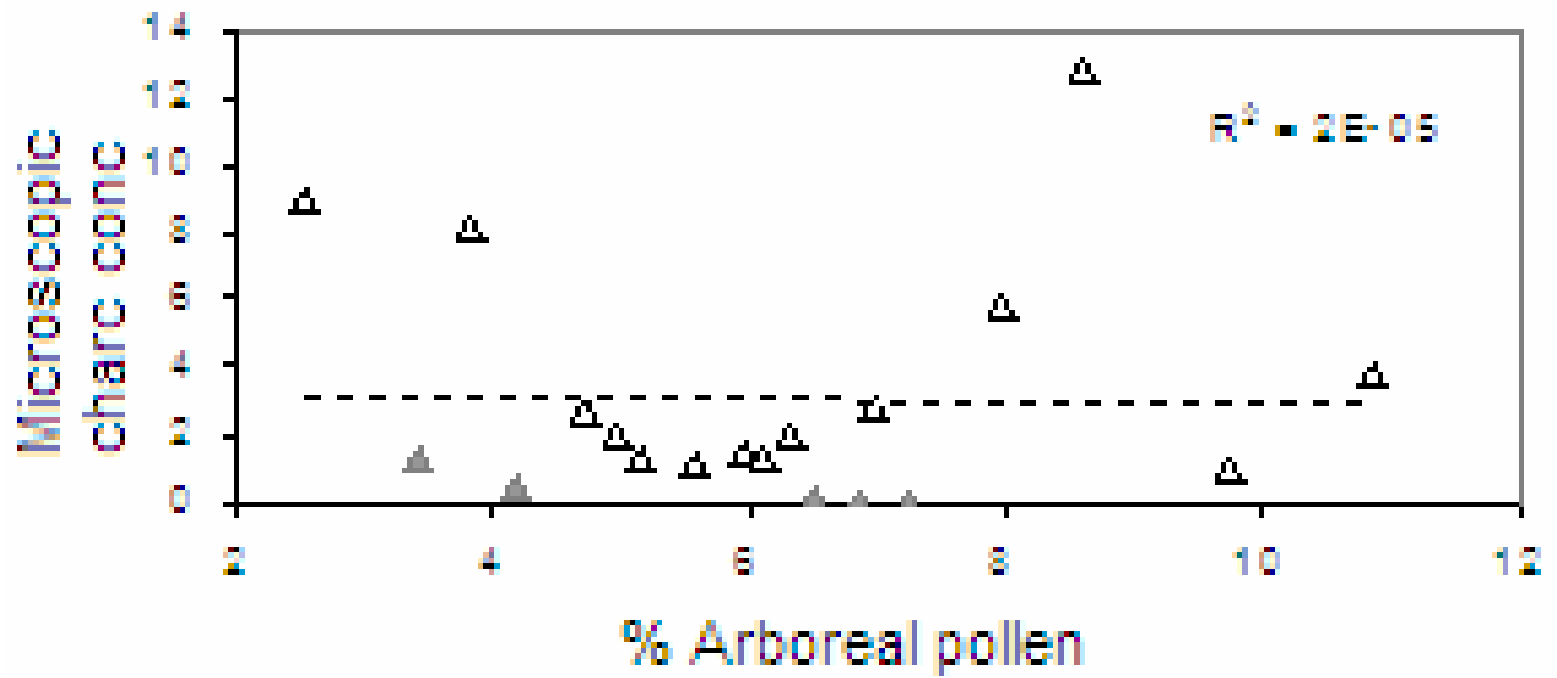
1. That historic rainfall variability has been synchronous between the two areas, a fact that will be further investigated in a coming climate paper
2. That there is a general correlation between arboreal pollen abundance and woody cover (Gillson and Duffin 2007)
3. That dung fungal spore abundance is representative of herbivore abundance

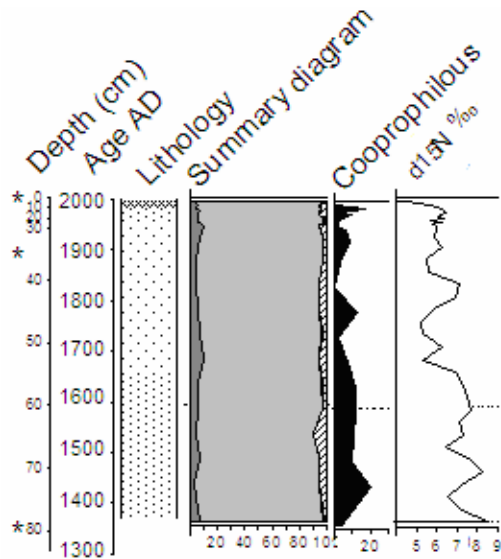


Radio Pan: constrained by water availability

No correlation between Tree cover (Arboreal Pollen) and Fire (charcoal)

Fire vs woody cover



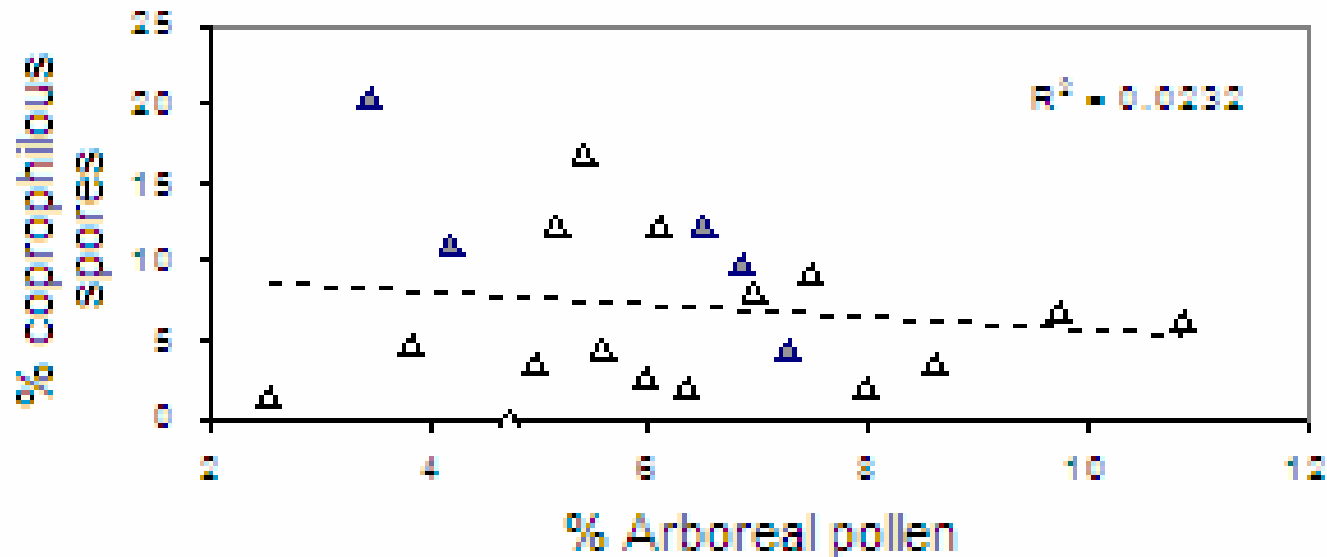


Radio Pan: constrained by water availability

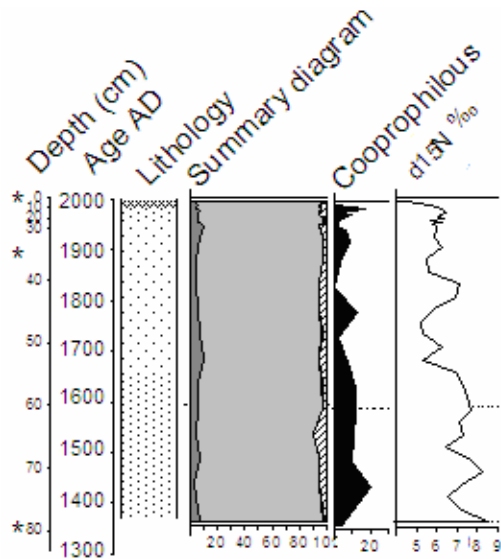
No correlation between Tree cover (Arboreal Pollen) and Fire (charcoal)

Herbivory (Coprophilous spores)

Grazing vs woody cover



▲ Radio moist grassland ▲ Radio dry grassland

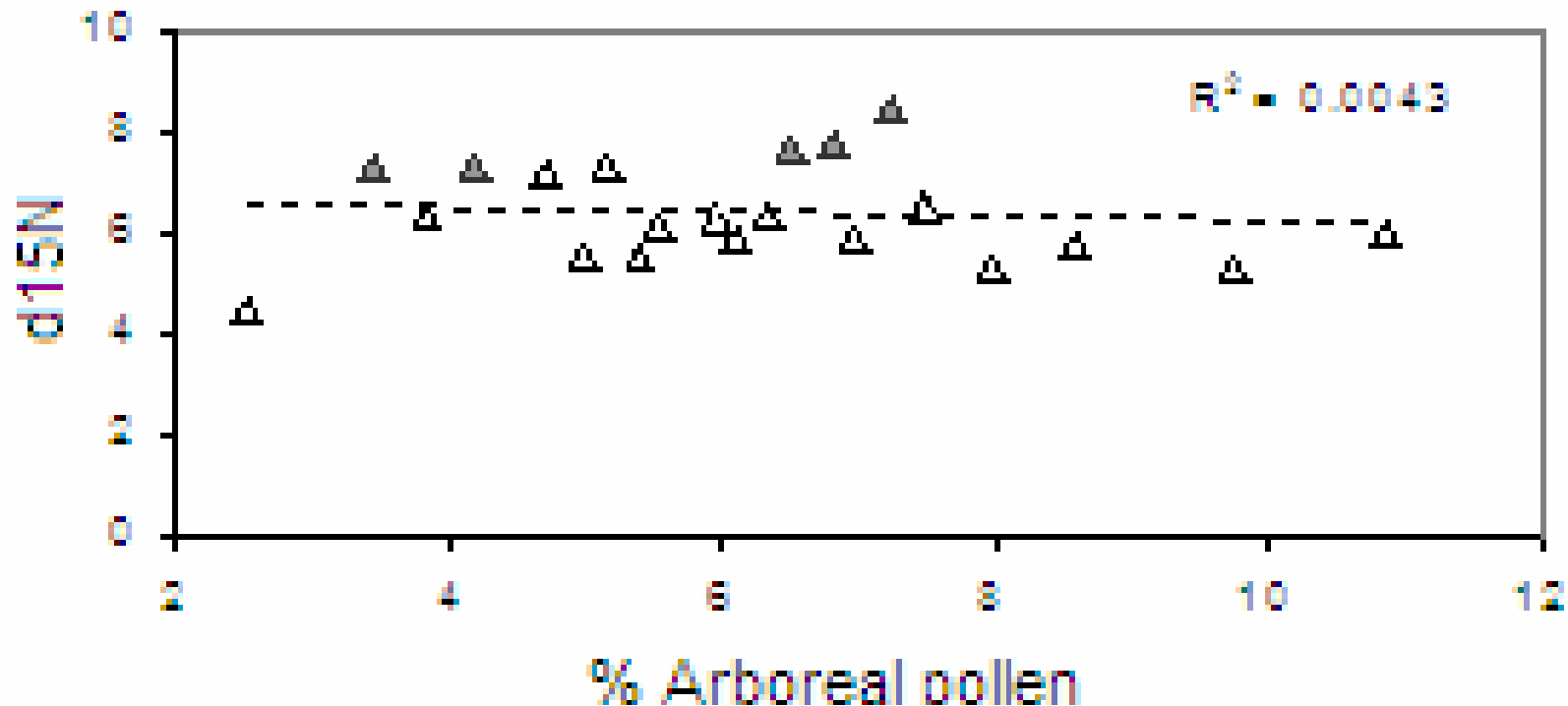


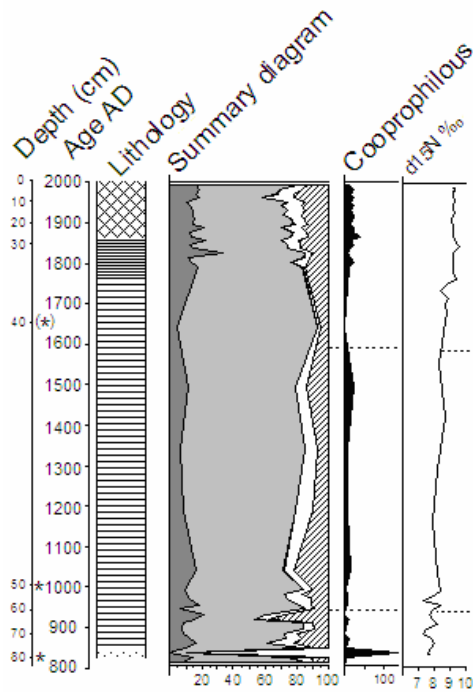
Radio Pan: constrained by water availability

No correlation between Tree cover (Arboreal Pollen) and Fire (charcoal)

Herbivory (Coprophilous spores) or nitrogen availability ($\delta^{15}\text{N}$)

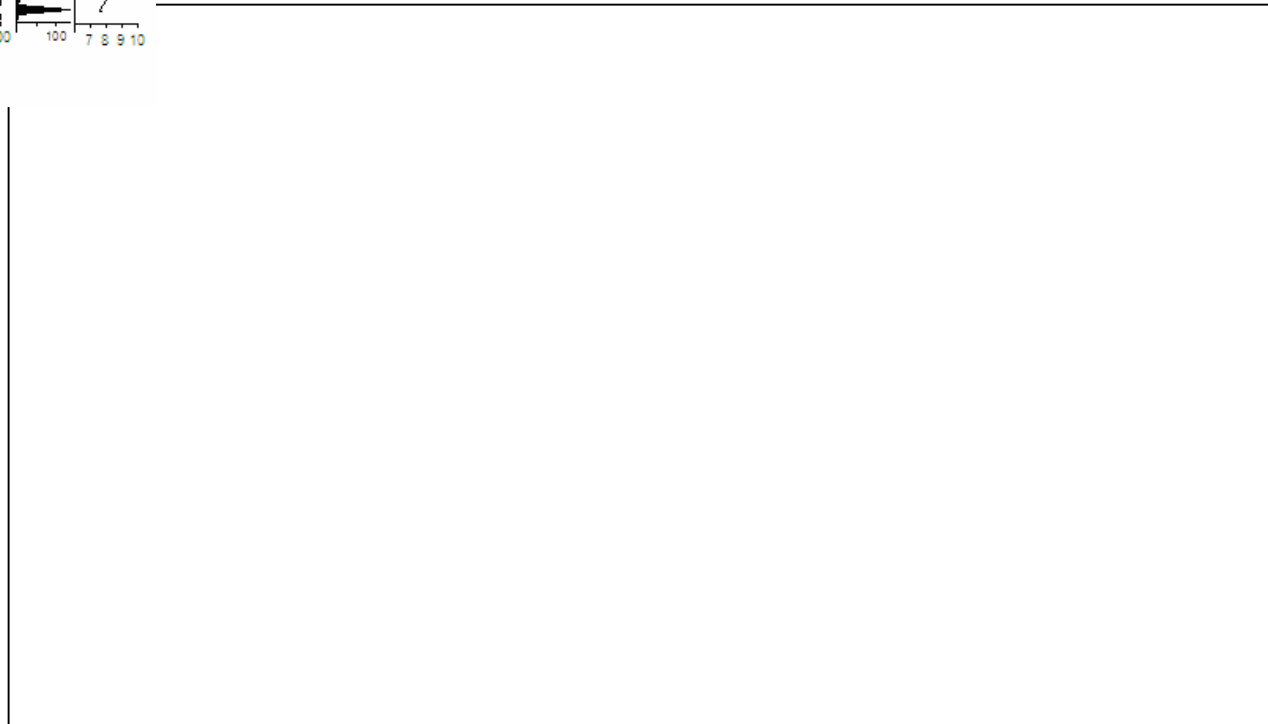
Nitrogen vs woody cover



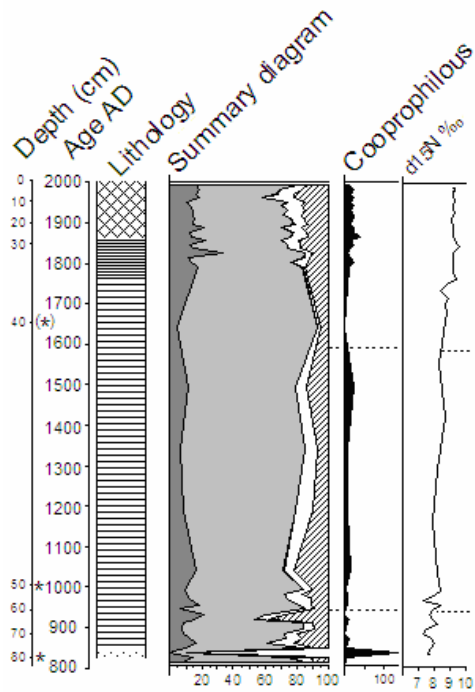


Chixuludzi Pan: Unconstrained by water availability

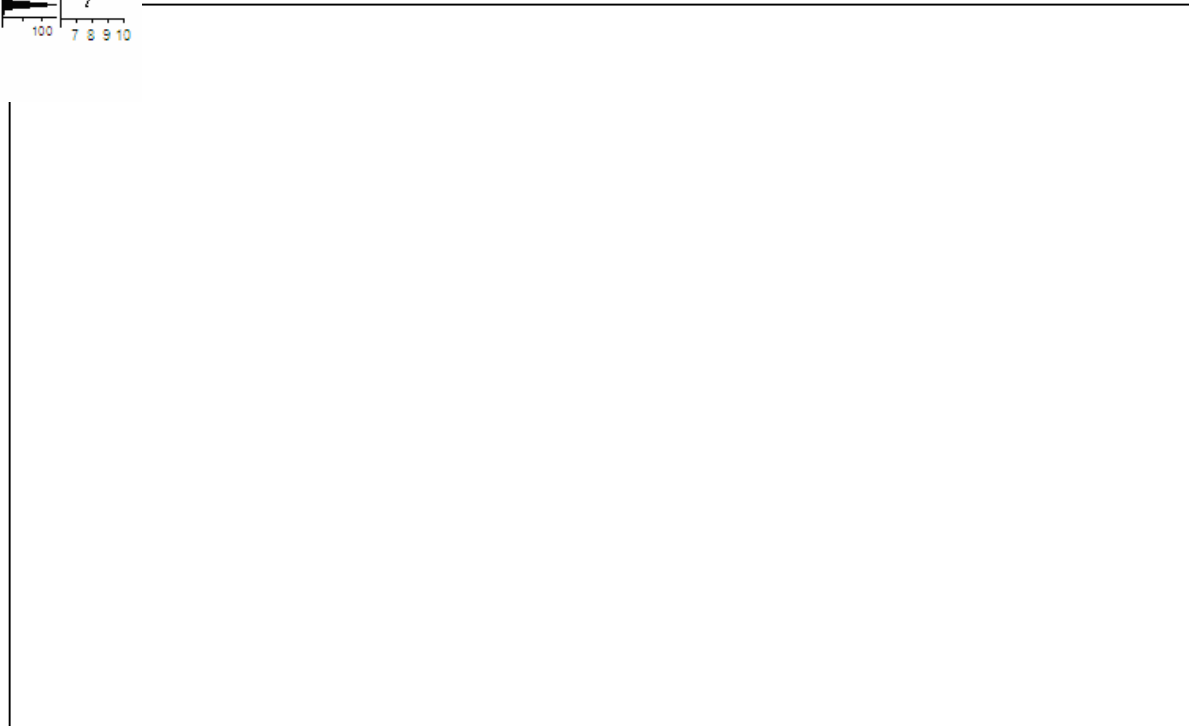
Significant correlation between trees (arboreal pollen) and dung spore abundance (herbivory)

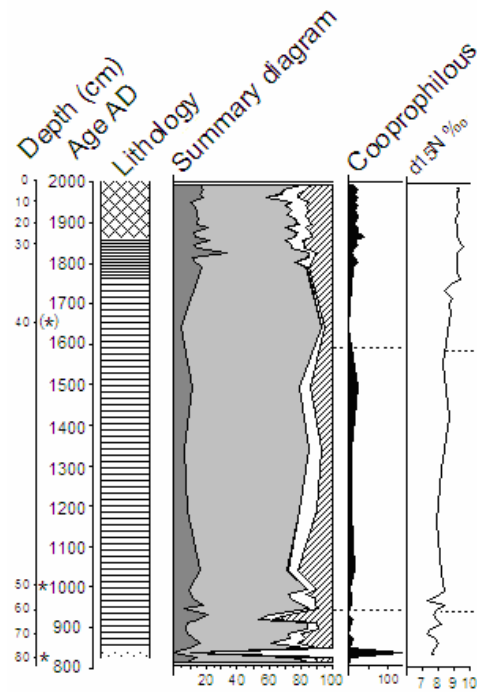


Chixuludzi Pan: Unconstrained by water availability



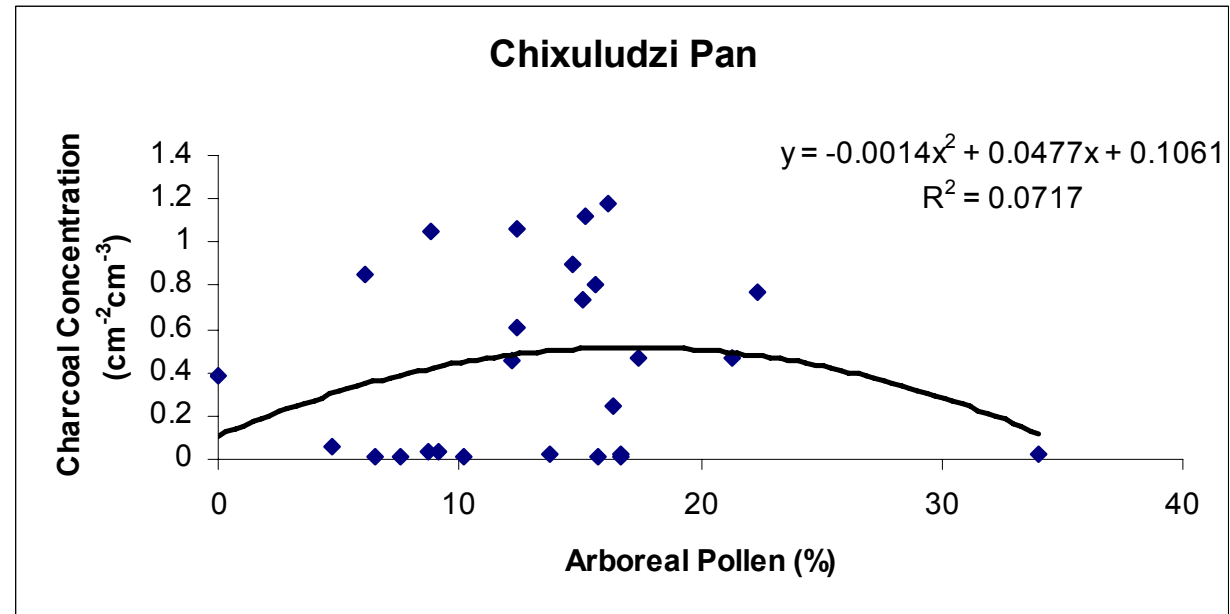
**Significant correlation between trees
(arboreal pollen) Nitrogen availability**

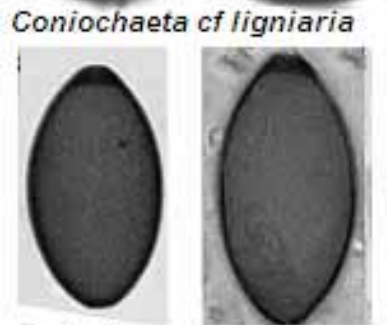
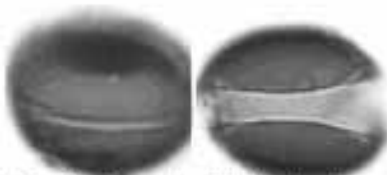
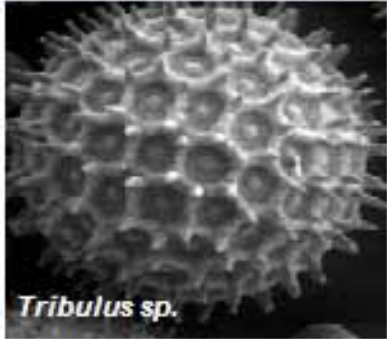




Chixuludzi Pan: Unconstrained by water availability

Quadratic relationship between trees and fire in the grassland savanna phase?





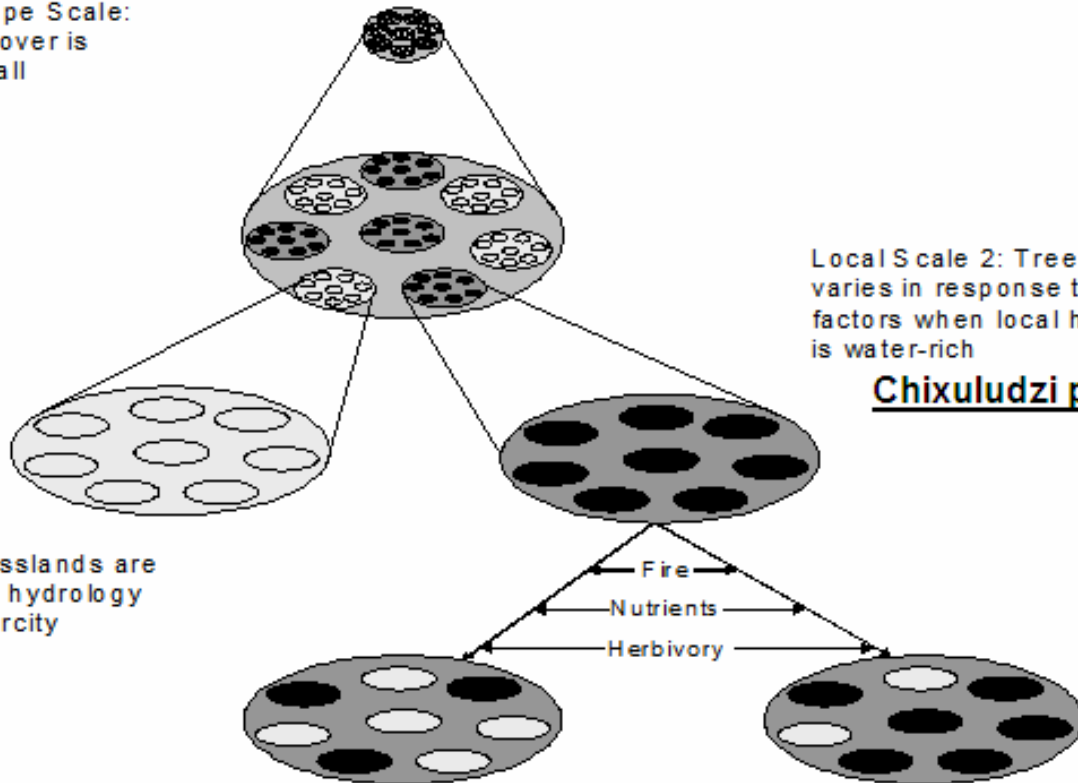
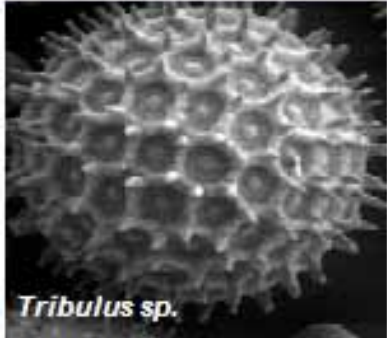
Conclusion

- 2 scenarios in savannas where rainfall is low (ie c. 600 mm/year)
 - a) Where local hydrology is constraining water availability determines max abundance of woody cover
 - Other factors fire, herbivory, nutrients of no/little importance
 - b) Where local hydrology is NOT constraining water,
 - c) availability, other factors become important
 - Other factors fire, herbivory, nutrients, human activities of controls maximum abundance of woody cover

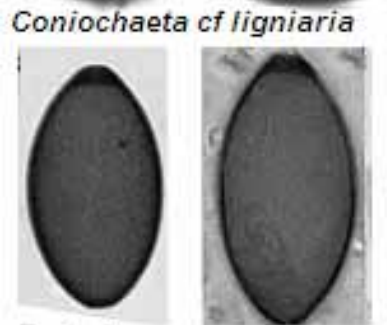
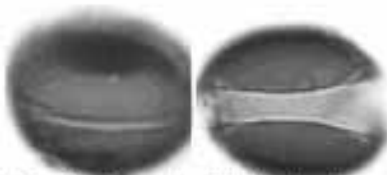
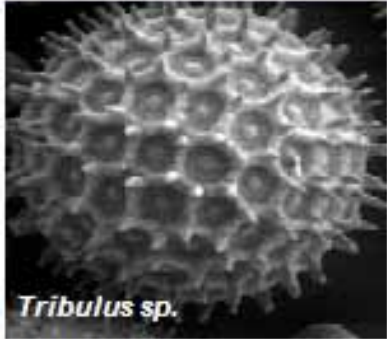
Hierarchy and scale (Gillson 2004)



Regional – Landscape Scale:
Upper limit to tree cover is
determined by rainfall

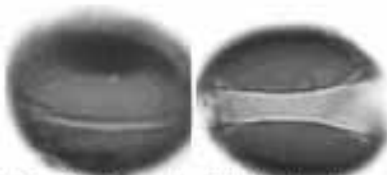
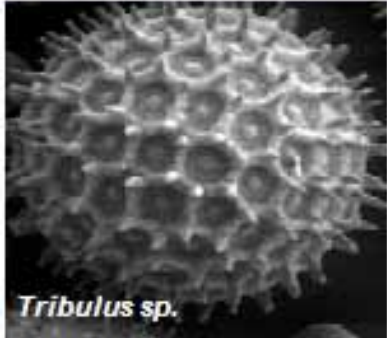


Rainfall is a higher order constraint spatially and temporally. At the local scale, local hydrology, determines ecosystem response to other local variables such as fire, nutrient availability, and herbivory: shows importance of local context (Levick 2008)

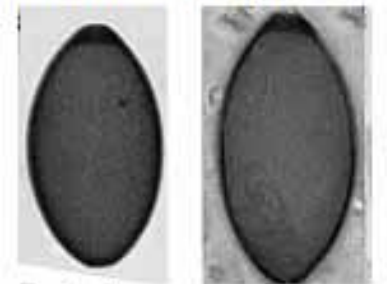


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- Dr Michel Notelid for fieldwork assistance.
- Prof. Kathy Willis and researchers and students at Long-Term Ecology Laboratory, University of Oxford



Coniochaeta cf ligniaria



Sordariaceae



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