Drivers and function of soil diversity in savannas and tropical forests

Anthony Mills[2]

Dalitz, H.[1]; Fey, M.[2]; Gliniars, R.[1]; Graiff, A.[4]; Gröngröft, A.[3]; Grohmann, C.[4]; Herpel, N.[3]; Kaiser, D.[4]; Linsenmair, K.E.[4]; Musila, W.[1,5]; Oesker, M.[1]; Petersen, A.[3] ; Siegle, M.[4]; Todt, H.[1]

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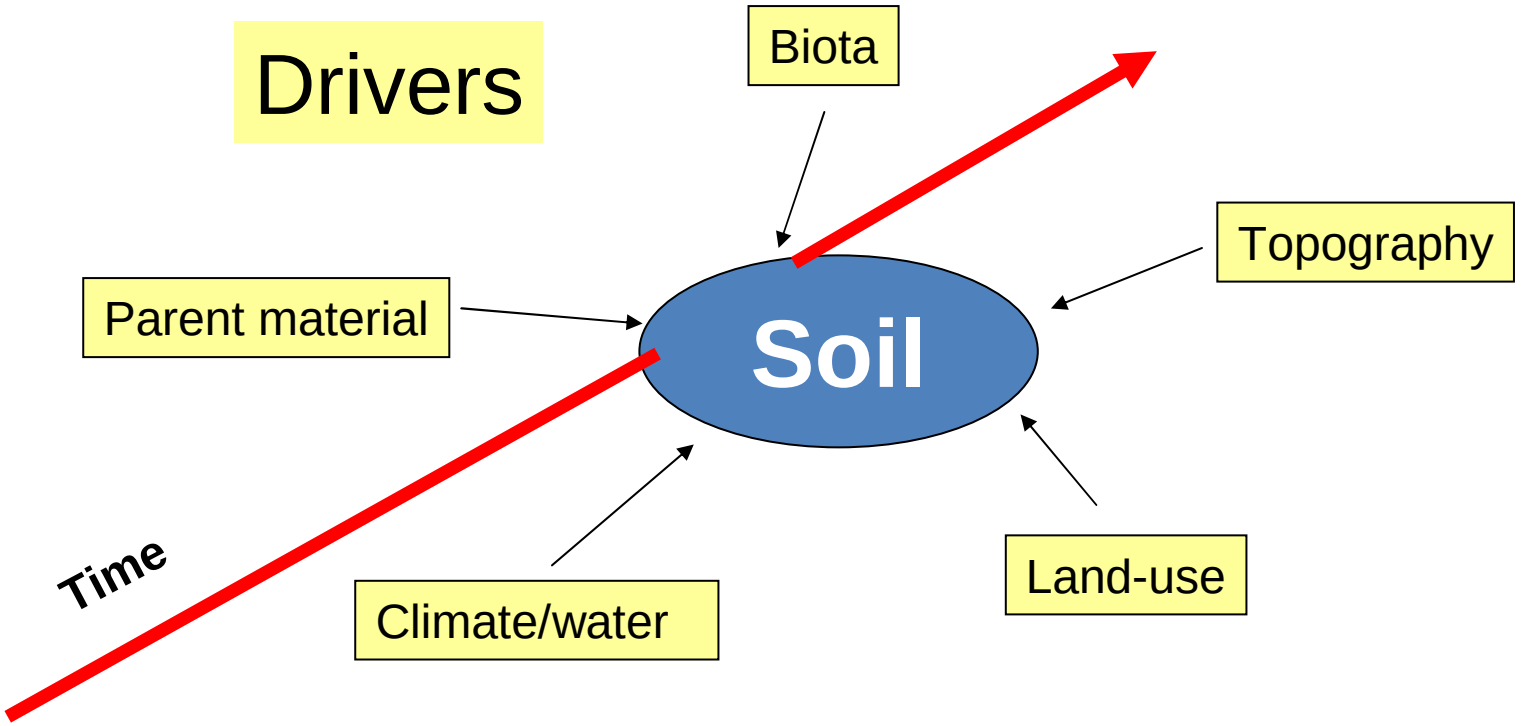
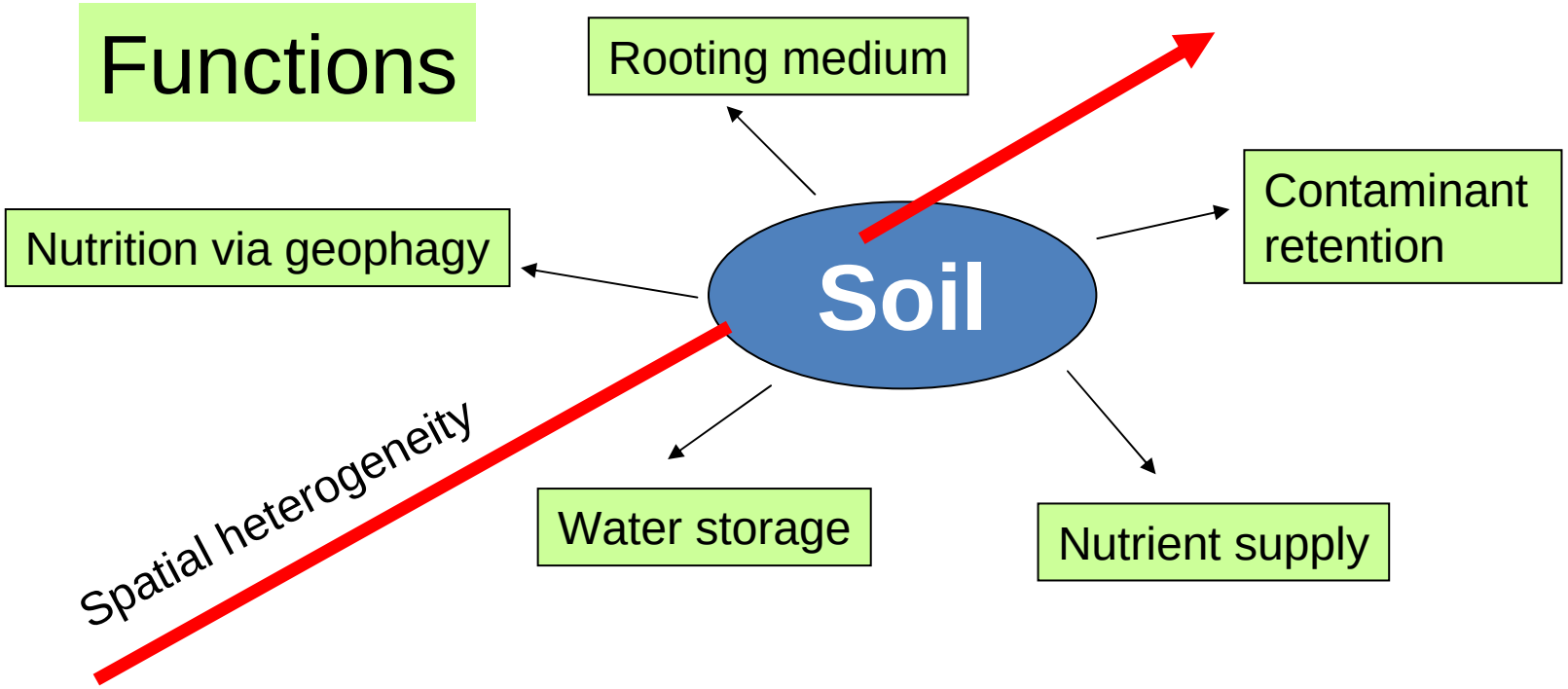
"Biodiversity of Africa - Observation and Sustainable Management for our Future!"
International Congress, 29 September – 3 October 2008, at Spier, RSA

Structure

1. Definitions
2. Examples of drivers and functions
3. Conclusions
4. Road ahead

1. Definitions





BIOTA research: examining small-scale details to provide large-scale picture

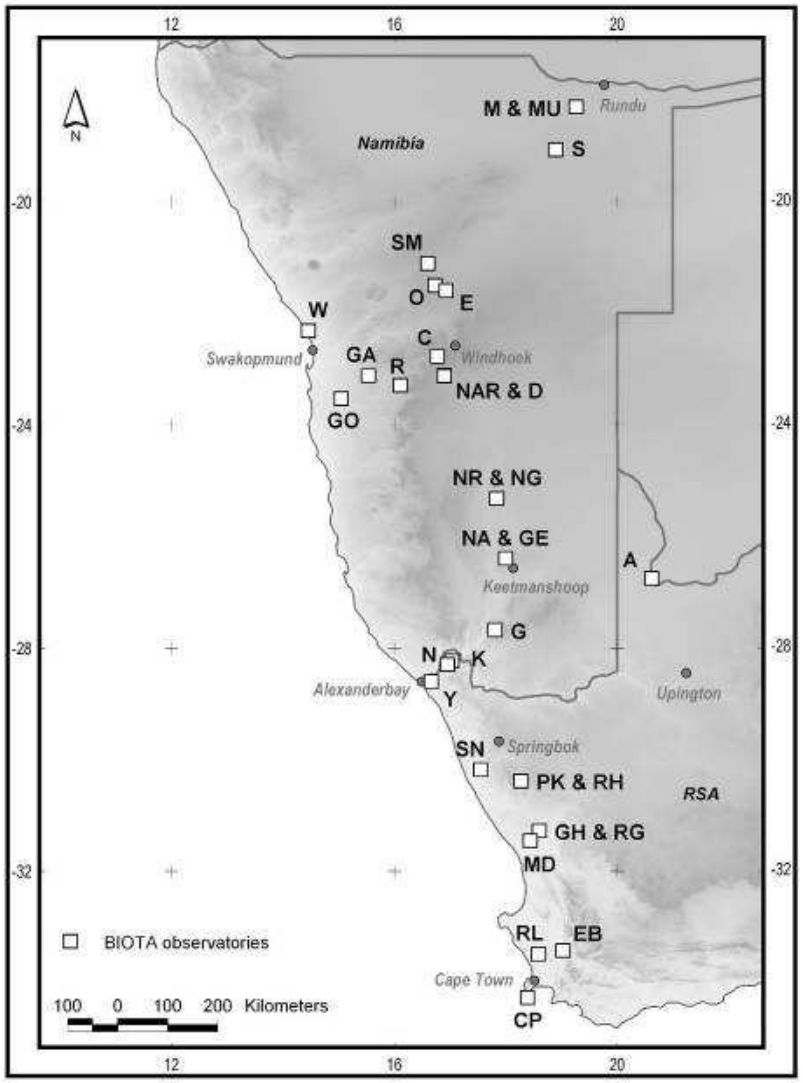
2.1 The water storage function

What soil properties control soil infiltrability?

31 sites (observatories)
581 topsoil samples

BIOTA South

Mills et al. (2006) Australian Journal of Soil Research.



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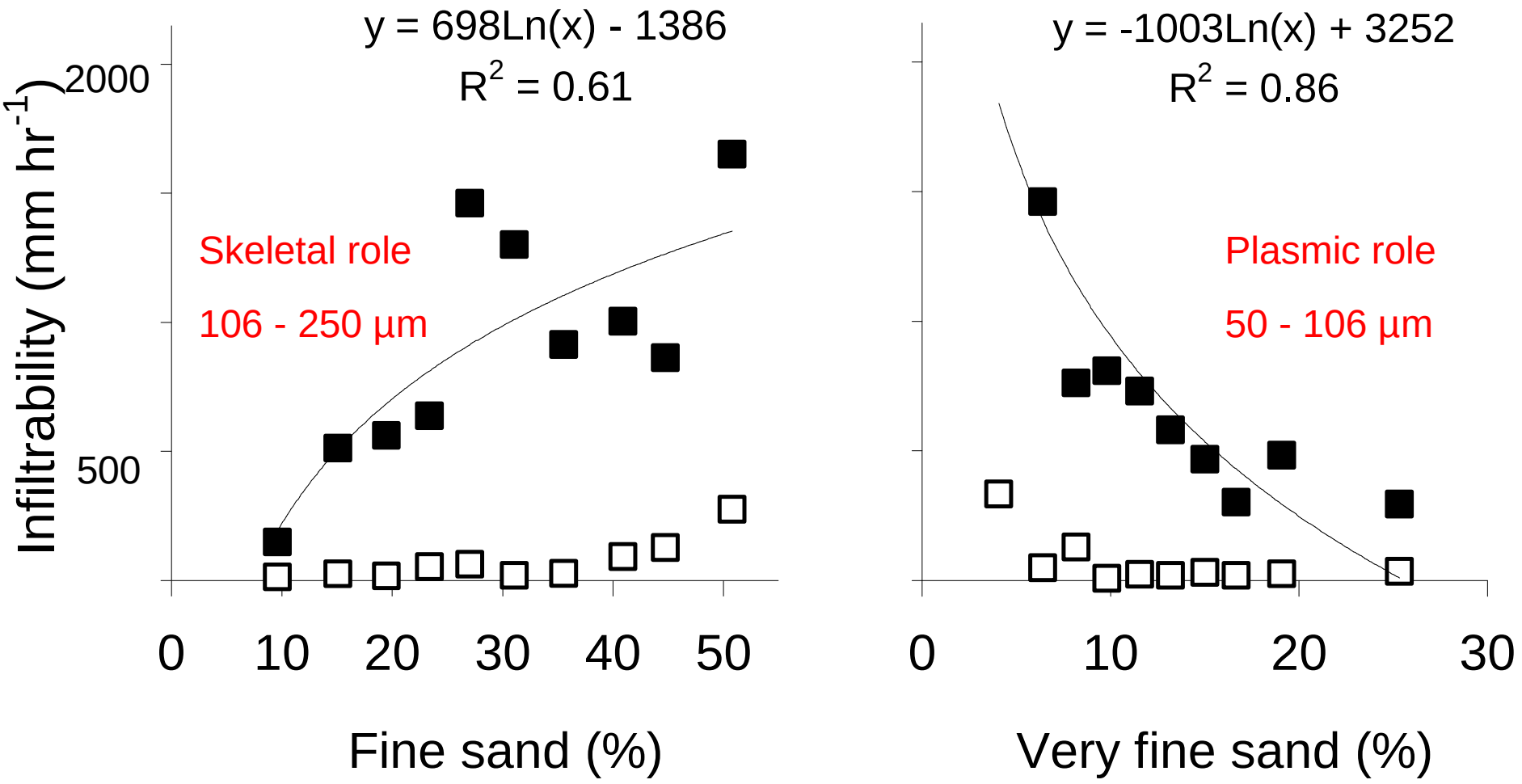

Clay & silt: Water-dispersible fraction most strongly related to infiltration

(Mills, Gröngröft, Petersen, Fey)

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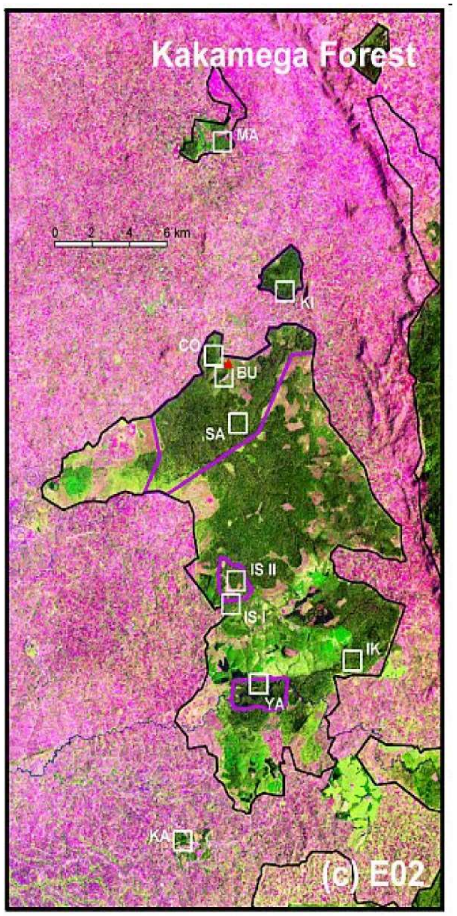
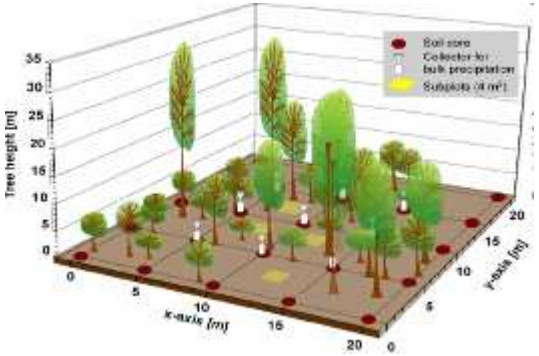
2.2 Vegetation as a driver

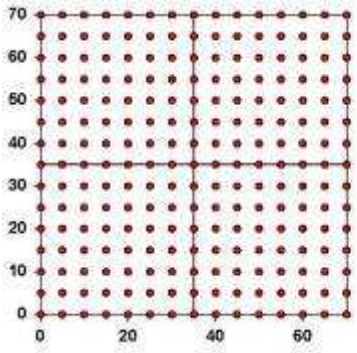
Large scale

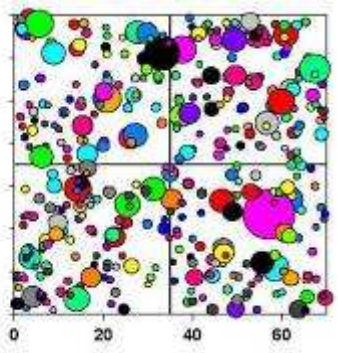


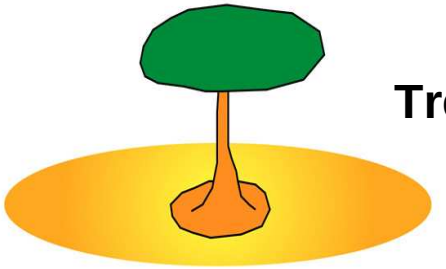
Medium scale

Plot scale (70m by 70 m)









Tree scale

BIOTA East 03

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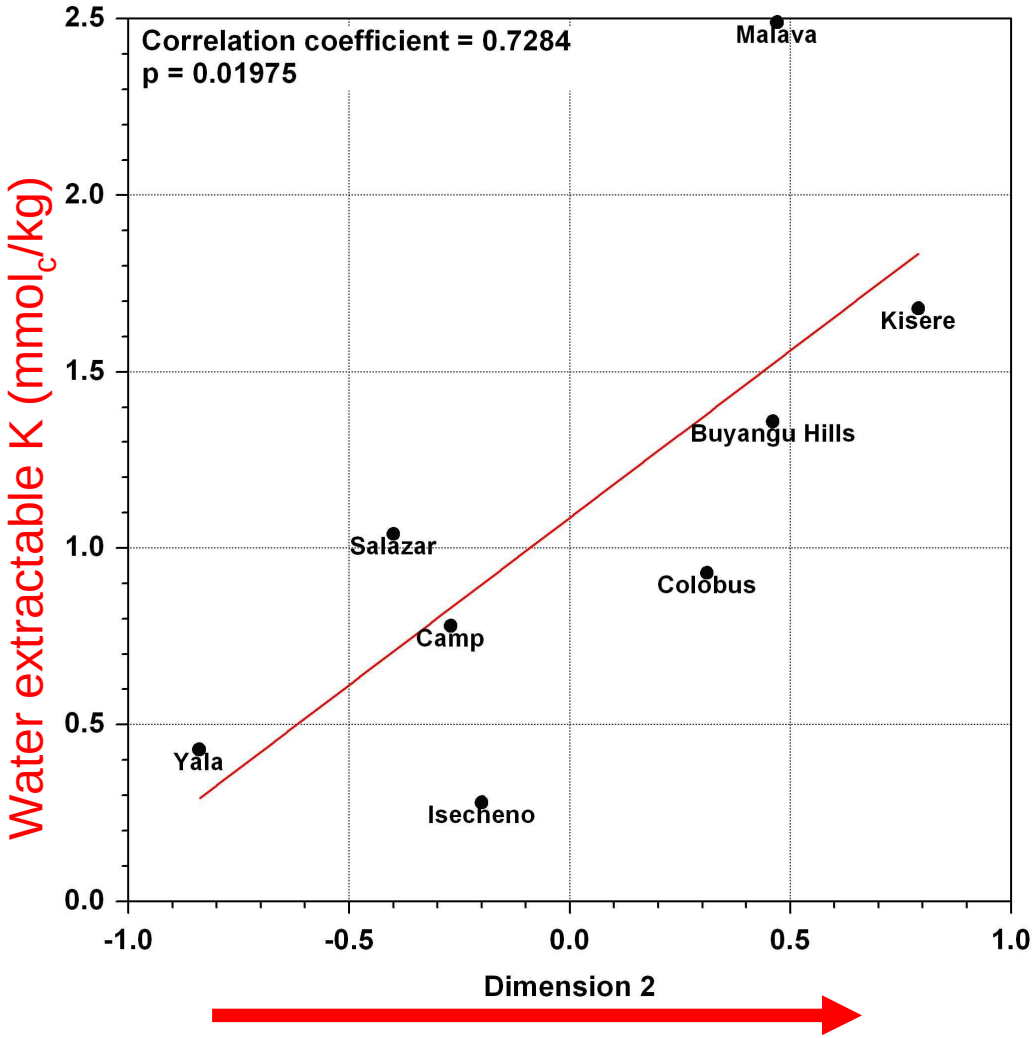
Large scale: Tree species composition



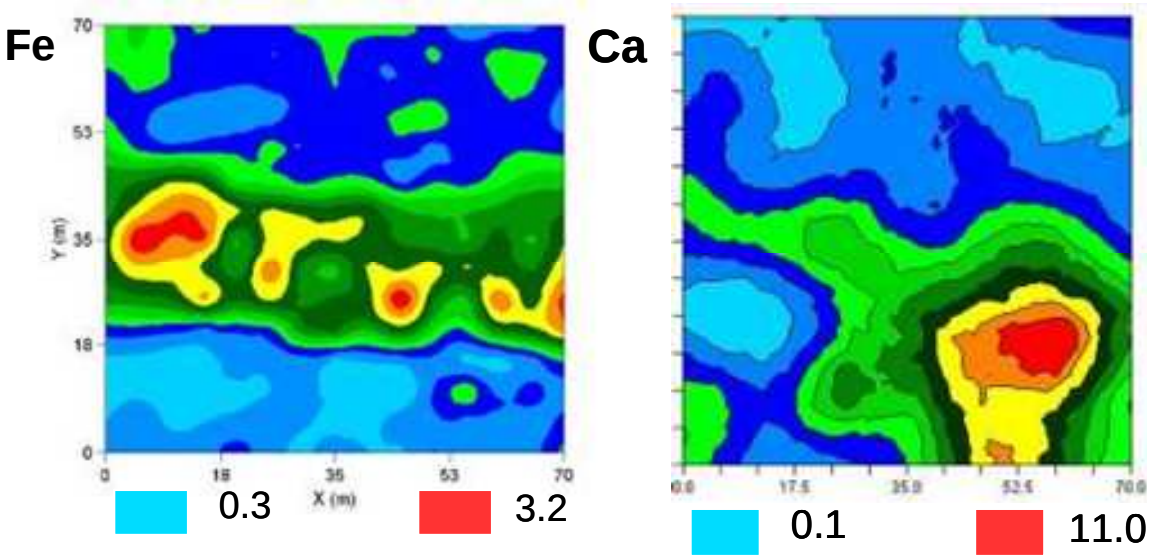
Plot scale: Spatial patterns of abiotic parameters and tree distribution

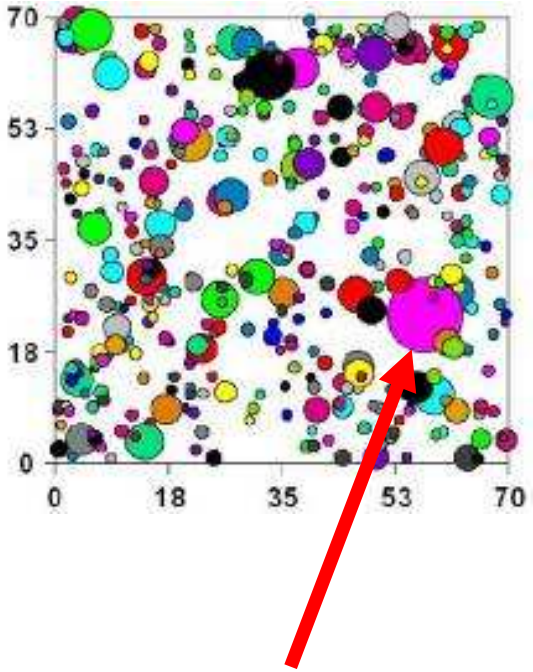
Trees (DBH > 5cm)

398 individuals;
47 species

Geogenic

Biogenic





Ficus lutea

(Musila, Gliniars, Todt & Dalitz)

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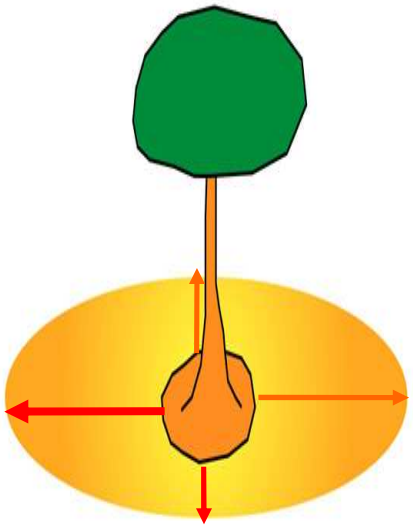
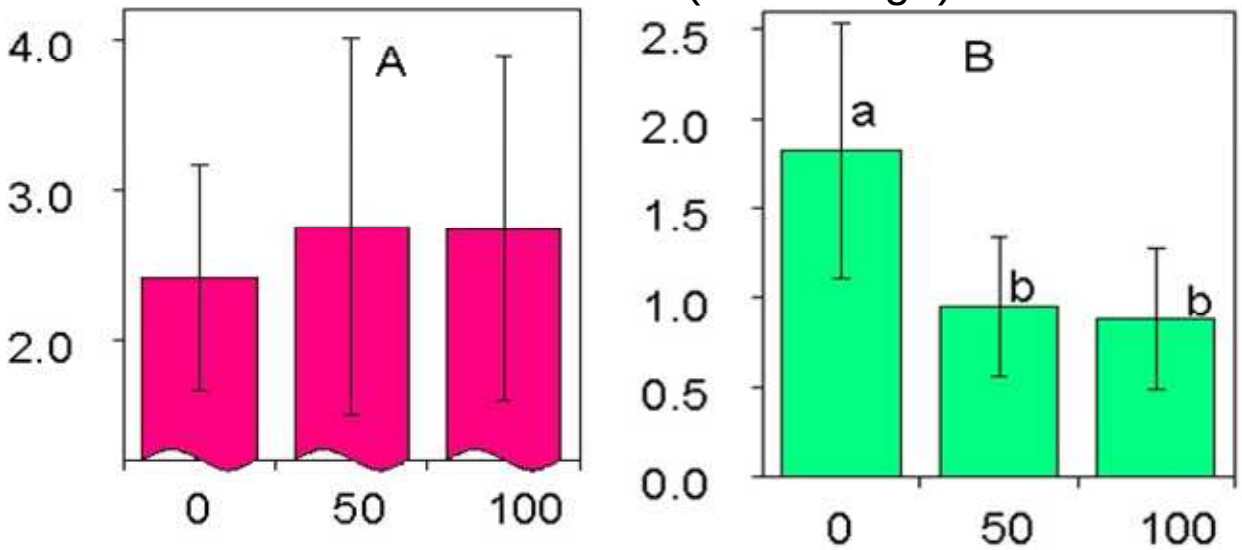
Tree scale: Effects of individual trees on soil properties



3 distances from tree trunk i.e. 0, 50 and 100 cm

Funtumia latifolia *Prunus africana*

Water extractable K (mmol * kg^{-1})

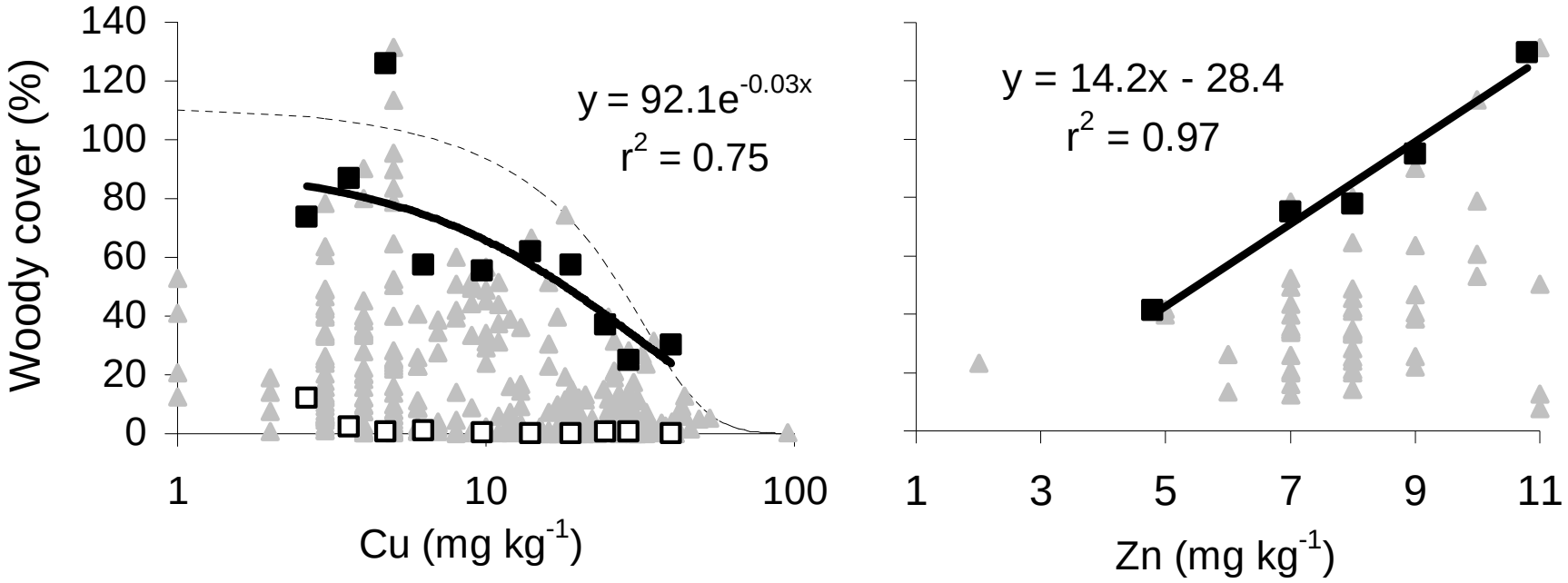


Distance from trunk (cm)

(Musila, Todt & Dalitz)

2.3 Nutrient supply function

Large scale (BIOTA South)



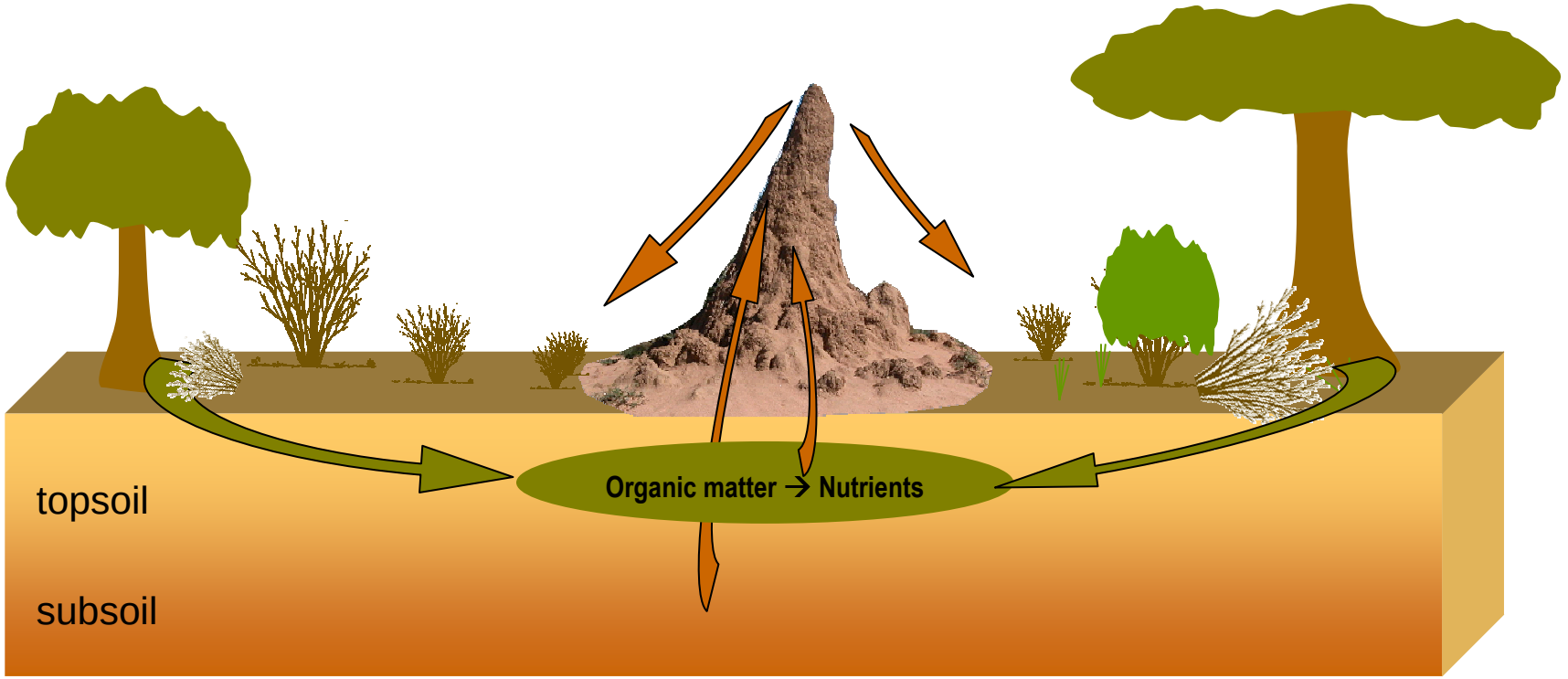
- Woody cover in south-western Africa is most constrained on soils with extremes of nutrient content.
- Are herbaceous plants most competitive in these extreme environments?

(Mills, Gröngröft, Petersen, Fey)

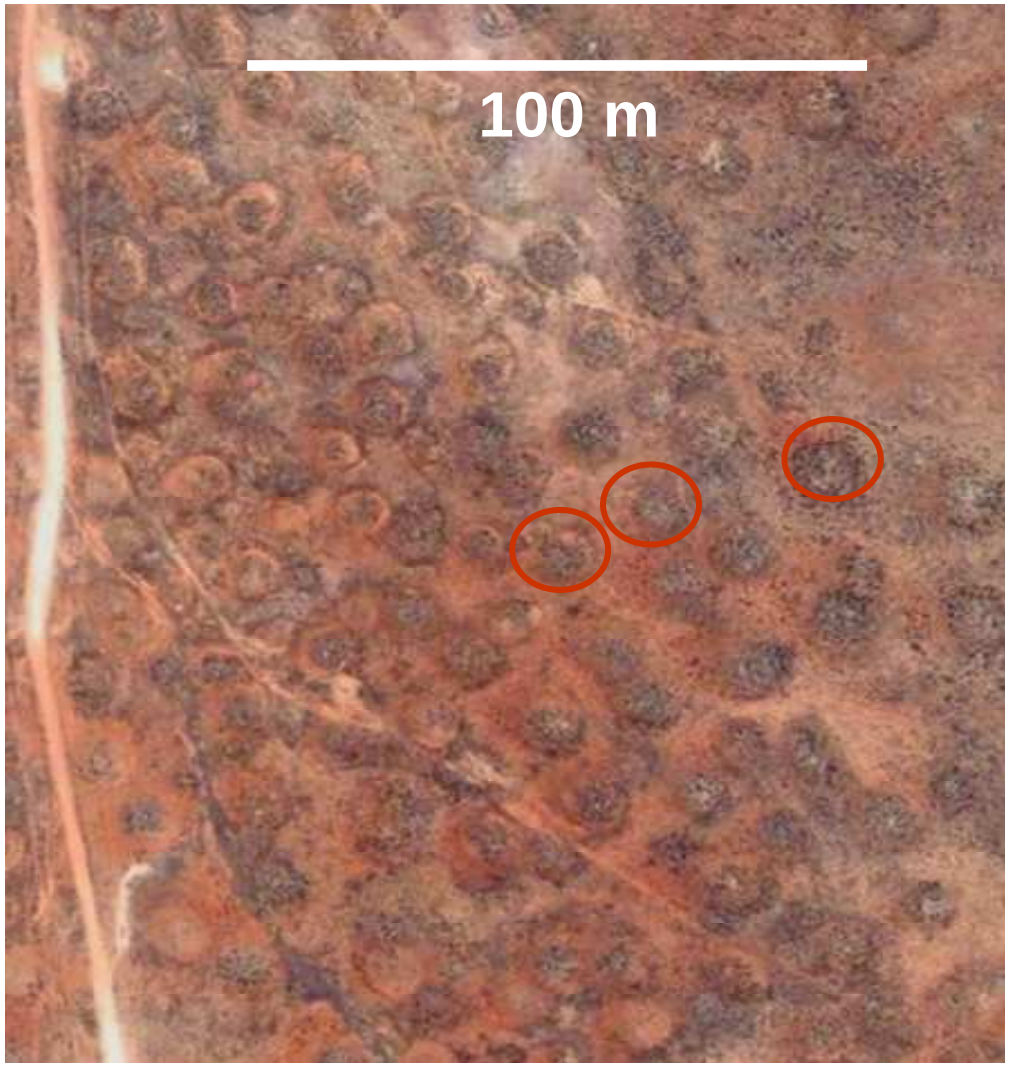
2.4 Termites as drivers

- Soil turnover
- Nutrient cycling
- Soil patchiness

BIOTA South and West



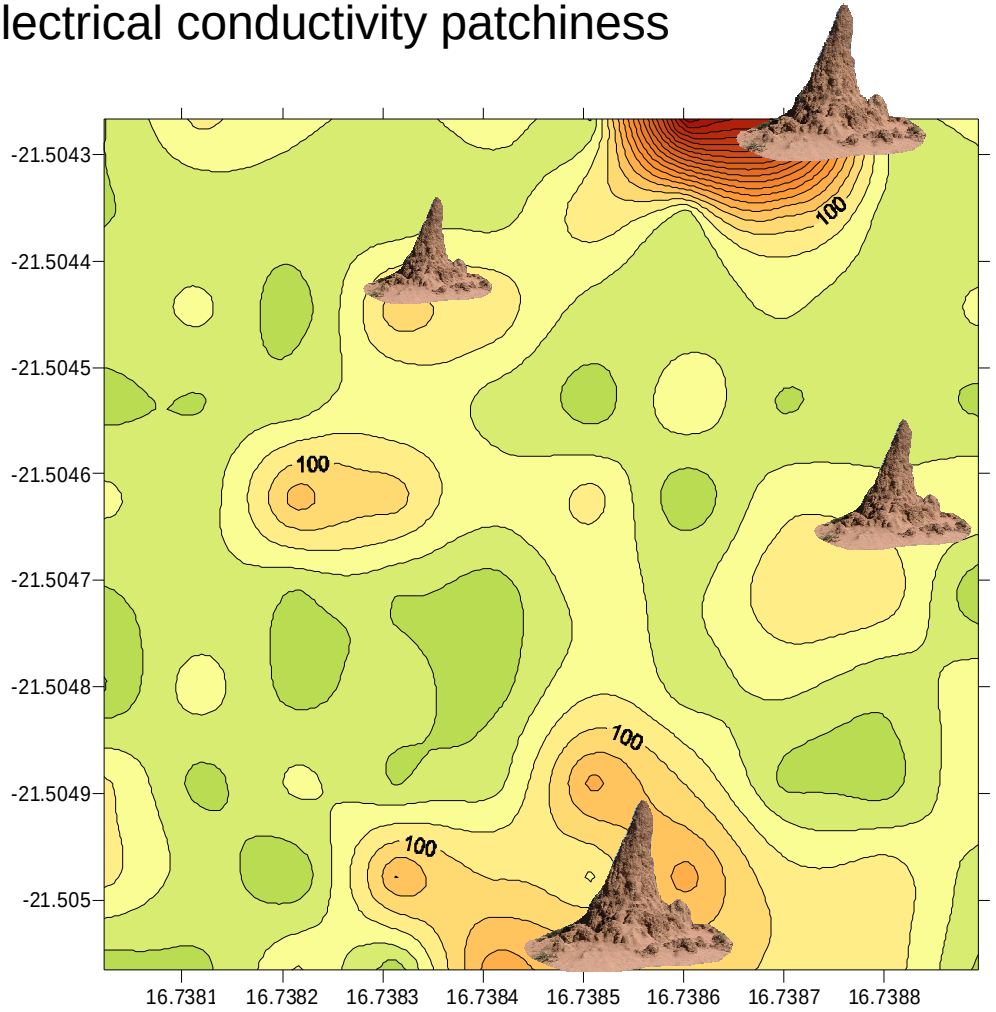
Heuweltjies – *Microhodotermes* or *Macrotermes*



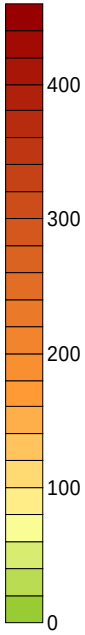
Macrotermes bellicosus

Macrotermes michaelseni

Electrical conductivity patchiness



EC (µS/cm)



100 meters

(Gröngröft, Petersen)

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Solute patchiness within mound.
Flow of solutes to mound periphery.

(Gröngröft, Petersen, Grohmann, Linsenmair)

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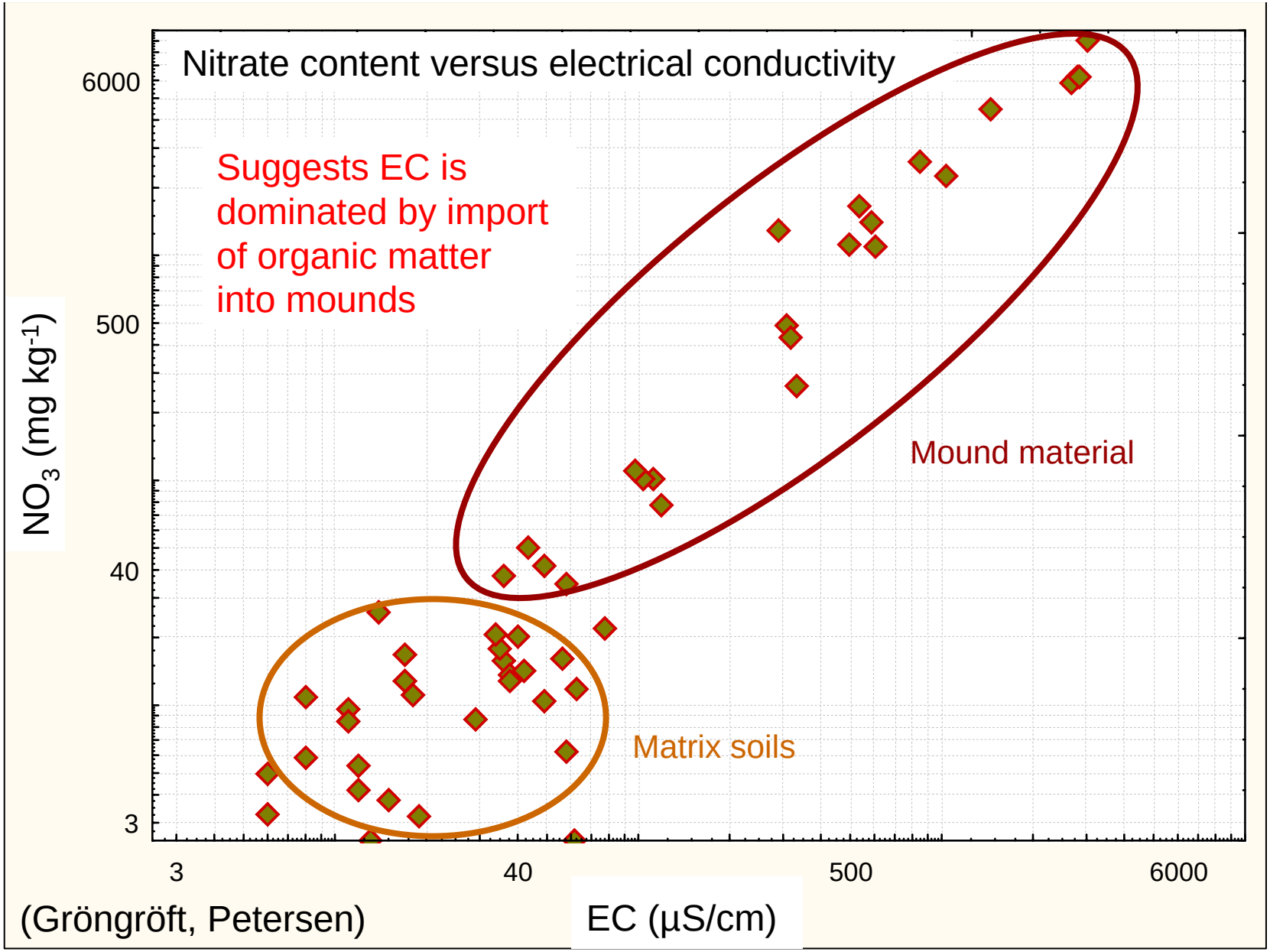

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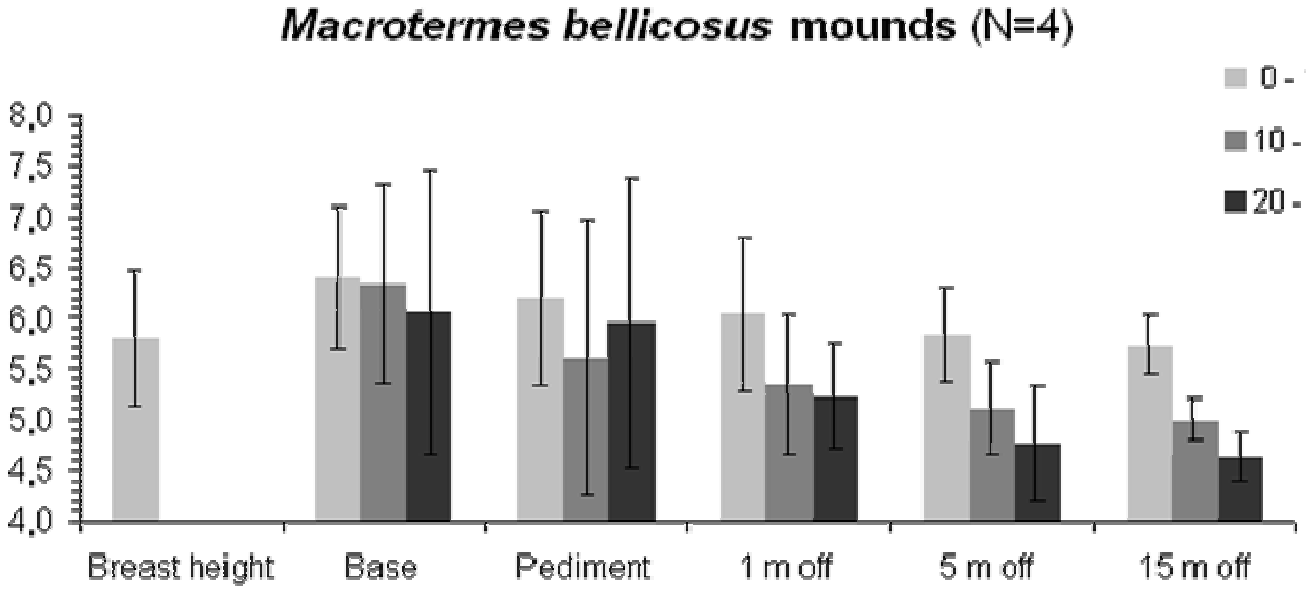
Northern Benin

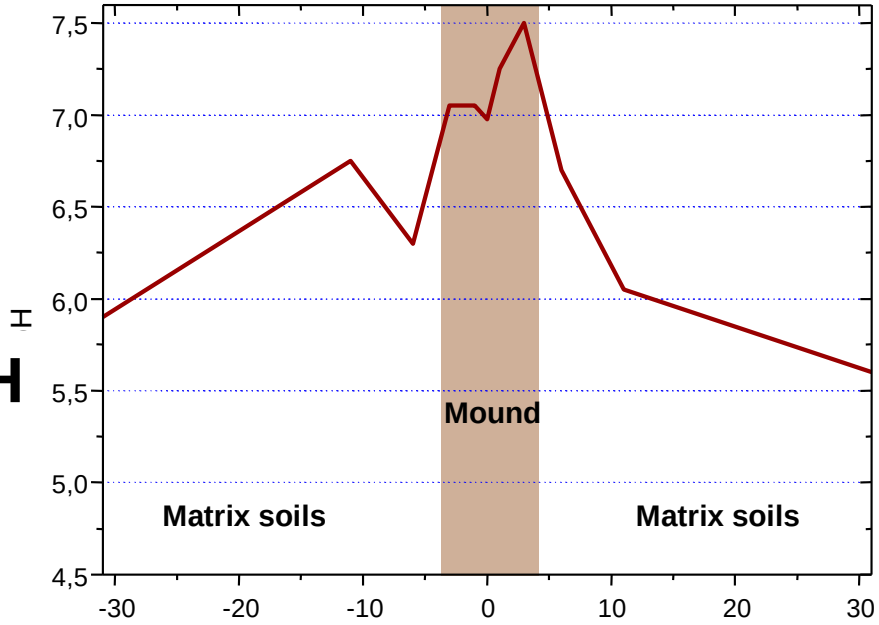
pH



(Kaiser, Linsenmair)

Northern Namibia

pH



(Grohmann, Gröngröft, Petersen, Linsenmair)

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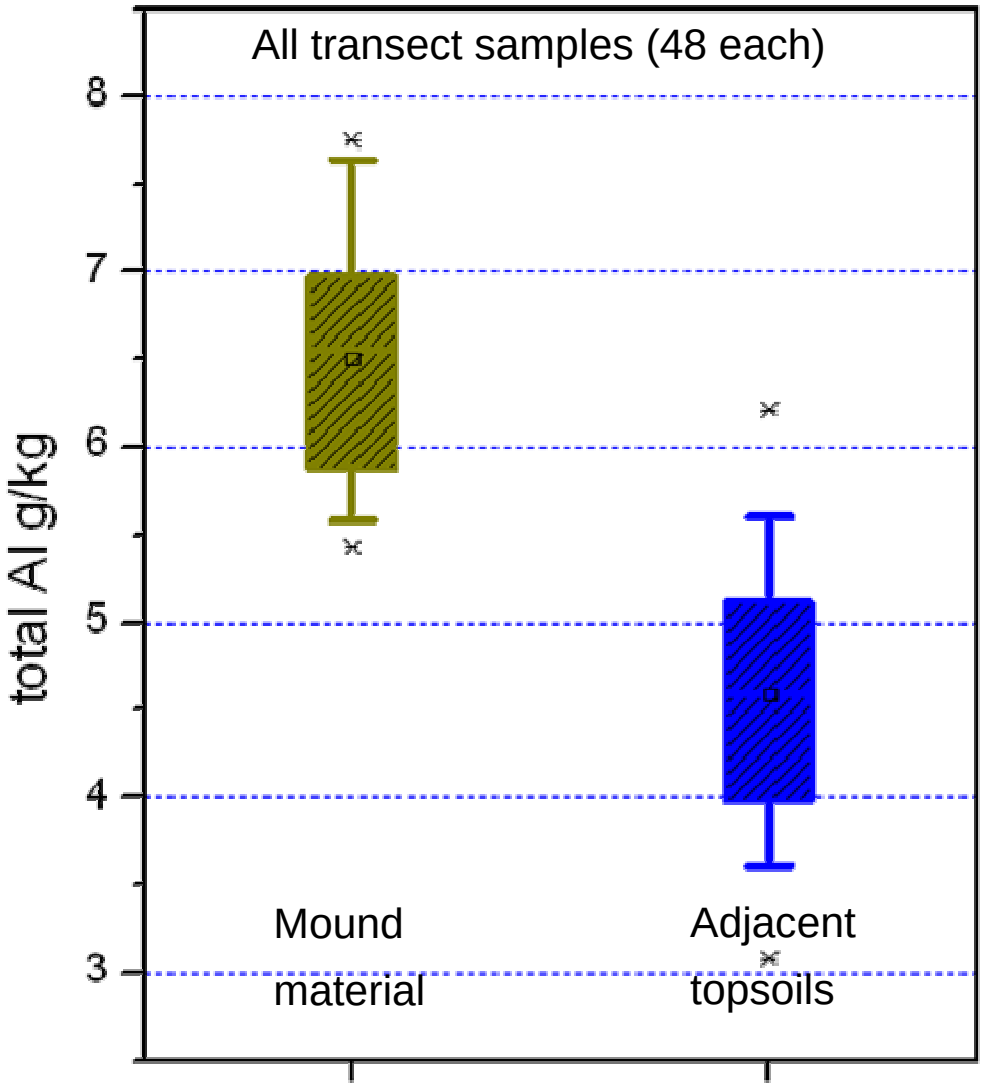
Origin of the mound material: geochemical clues from BIOTA South



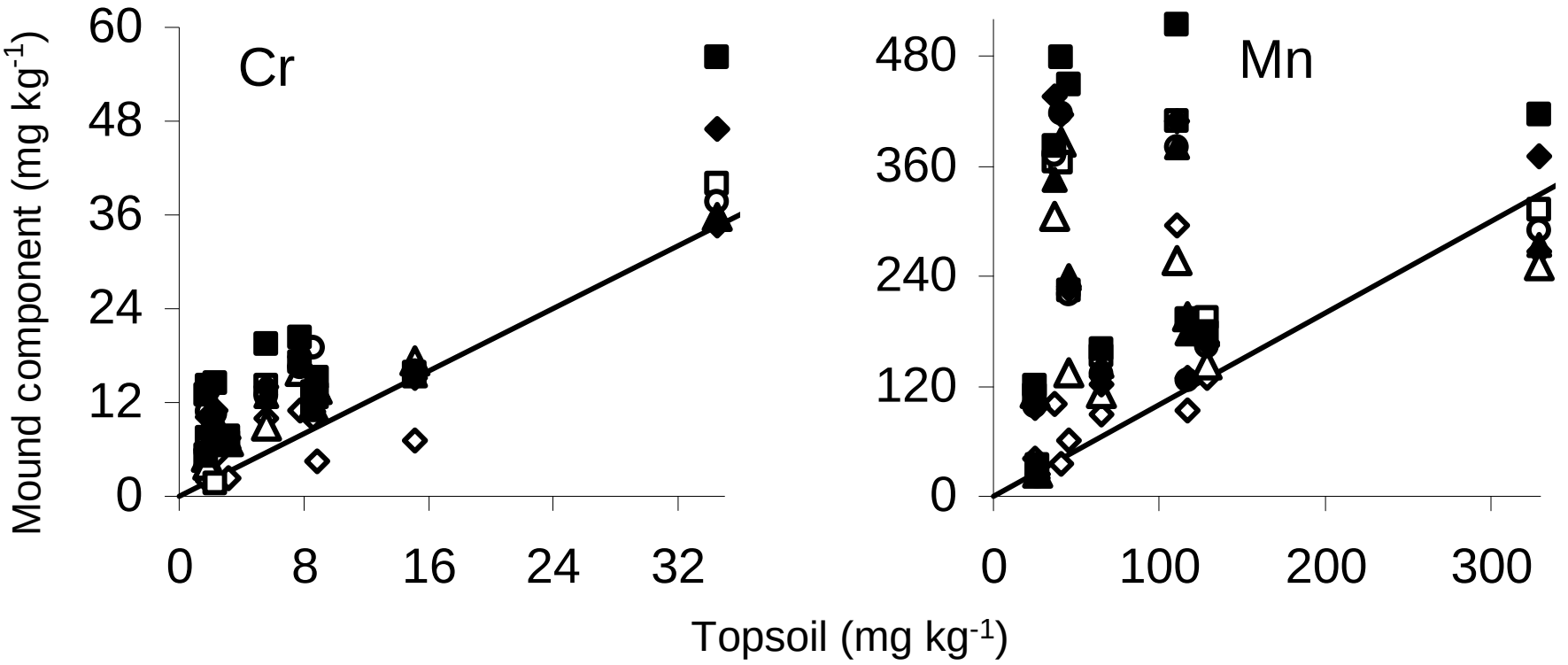
(Gröngröft, Petersen)

Mean subsoil

Mean topsoil

Reference profiles (4) of transects

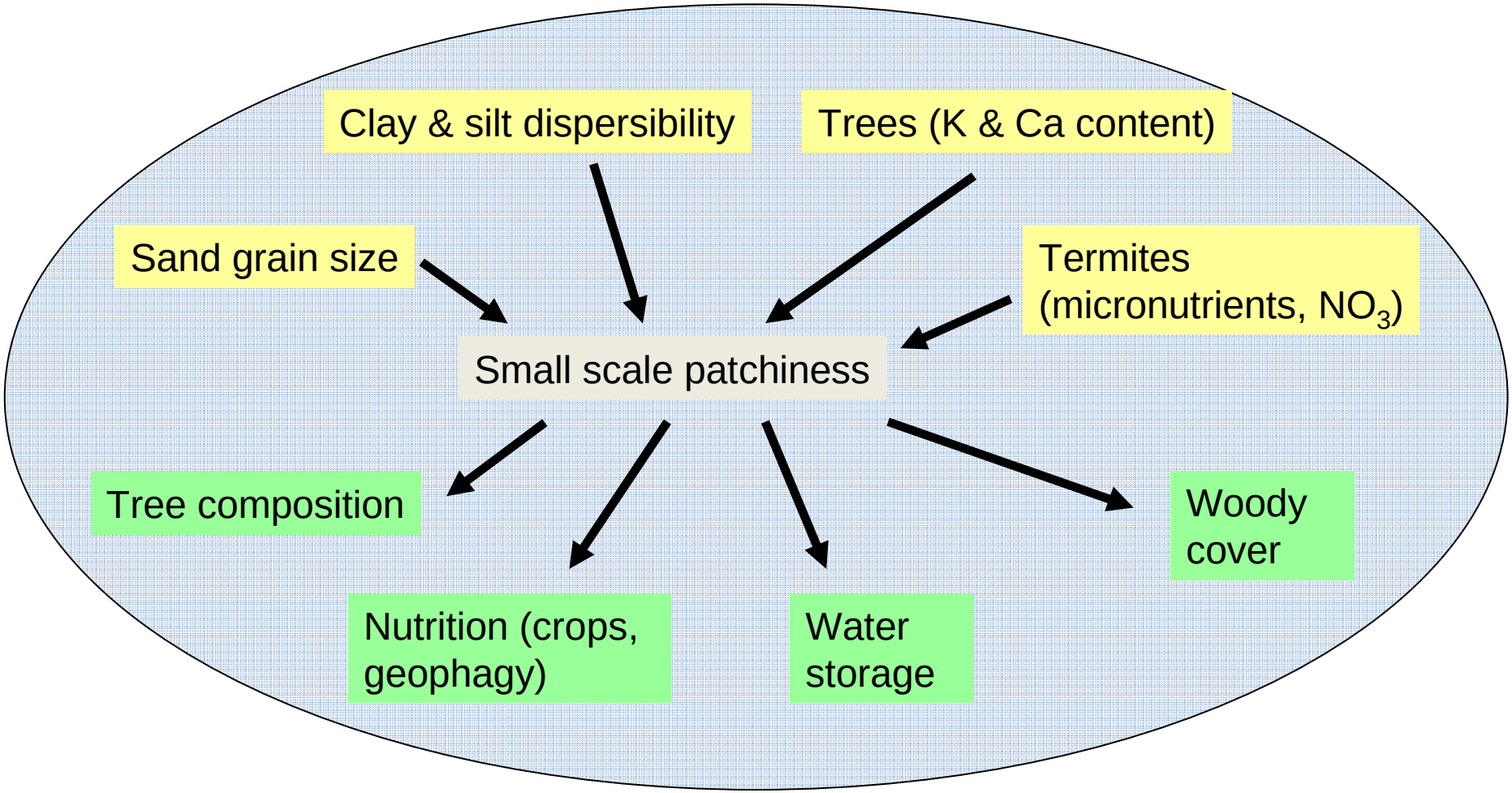
2.5 Termites and the nutrient supply function



- Preferential selection of Mn oxides?
- Mining of micronutrients for fungus gardens?
- Micronutrient contents (e.g. 3.6 ppm Se) significant for geophagy/agriculture.

Mills et al. (2008). Journal of Zoology. In review. (Mills, Gröngröft, Petersen, Fey)

3. Conclusions



Large-scale function = sum of small scale parts

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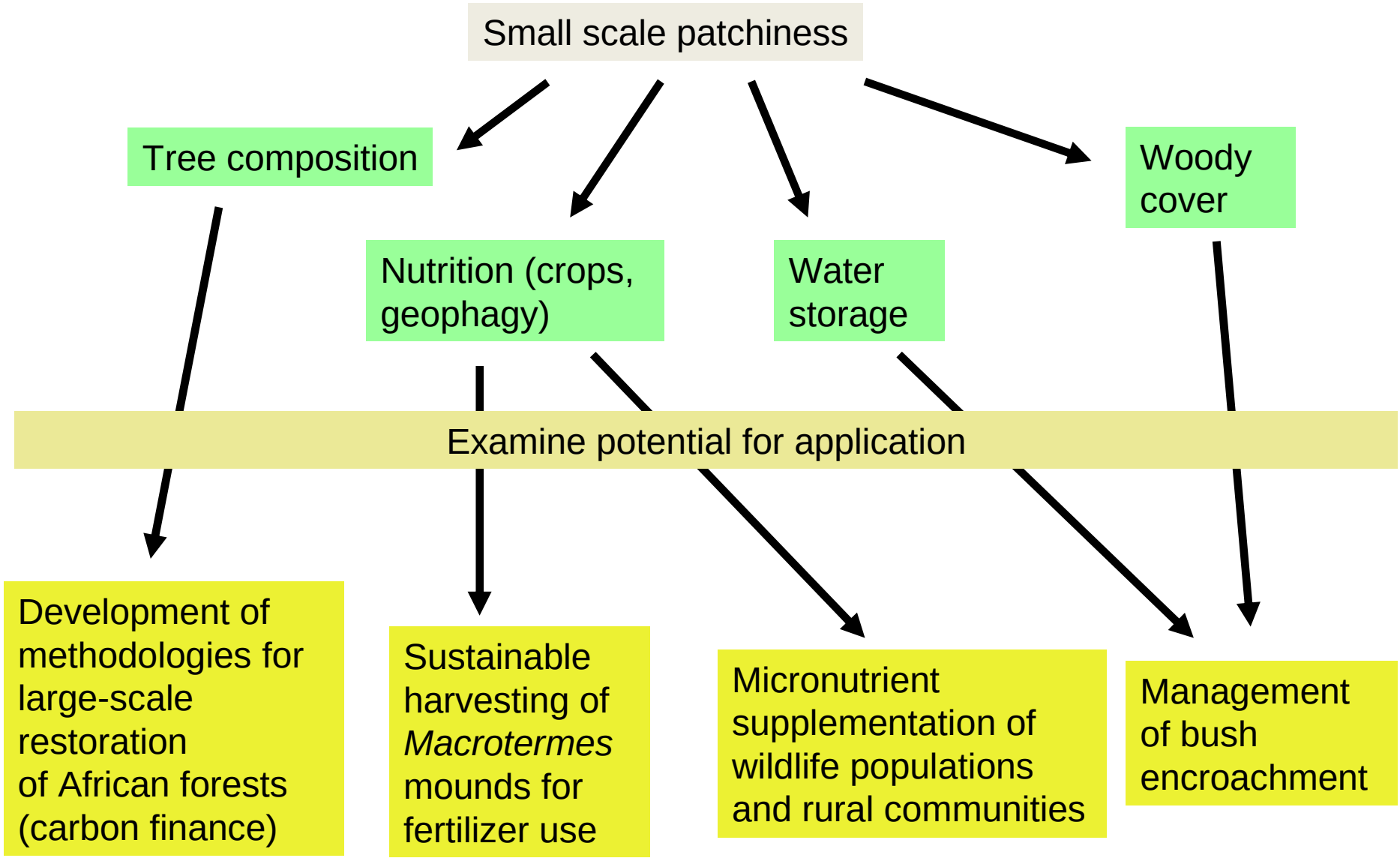
4. Road ahead


Small scale patchiness
Tree composition
Nutrition (crops, geophagy)
Water storage
Woody cover
Examine potential for application
Development of methodologies for large-scale restoration of African forests (carbon finance)
Sustainable harvesting of *Macrotermes* mounds for fertilizer use
Micronutrient supplementation of wildlife populations and rural communities
Management of bush encroachment

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