Using phytostabilisation as a way to conserve threatened endemic species from the Southeastern D.R. Congo

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Natural metallicolous grasslands

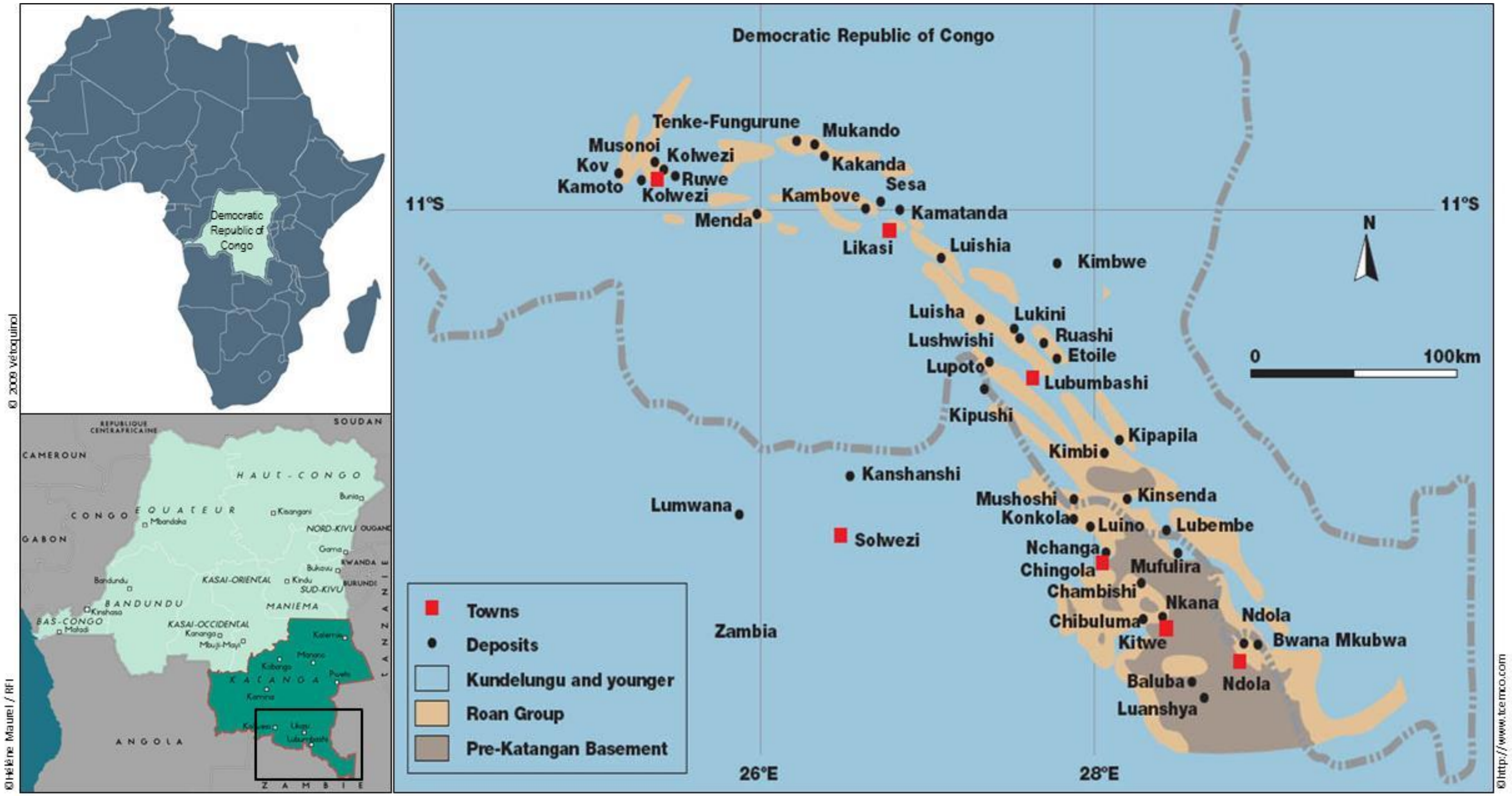
- Small areas
- Extreme conditions (metal concentrations)
- Ecological isolation

Biodiversity

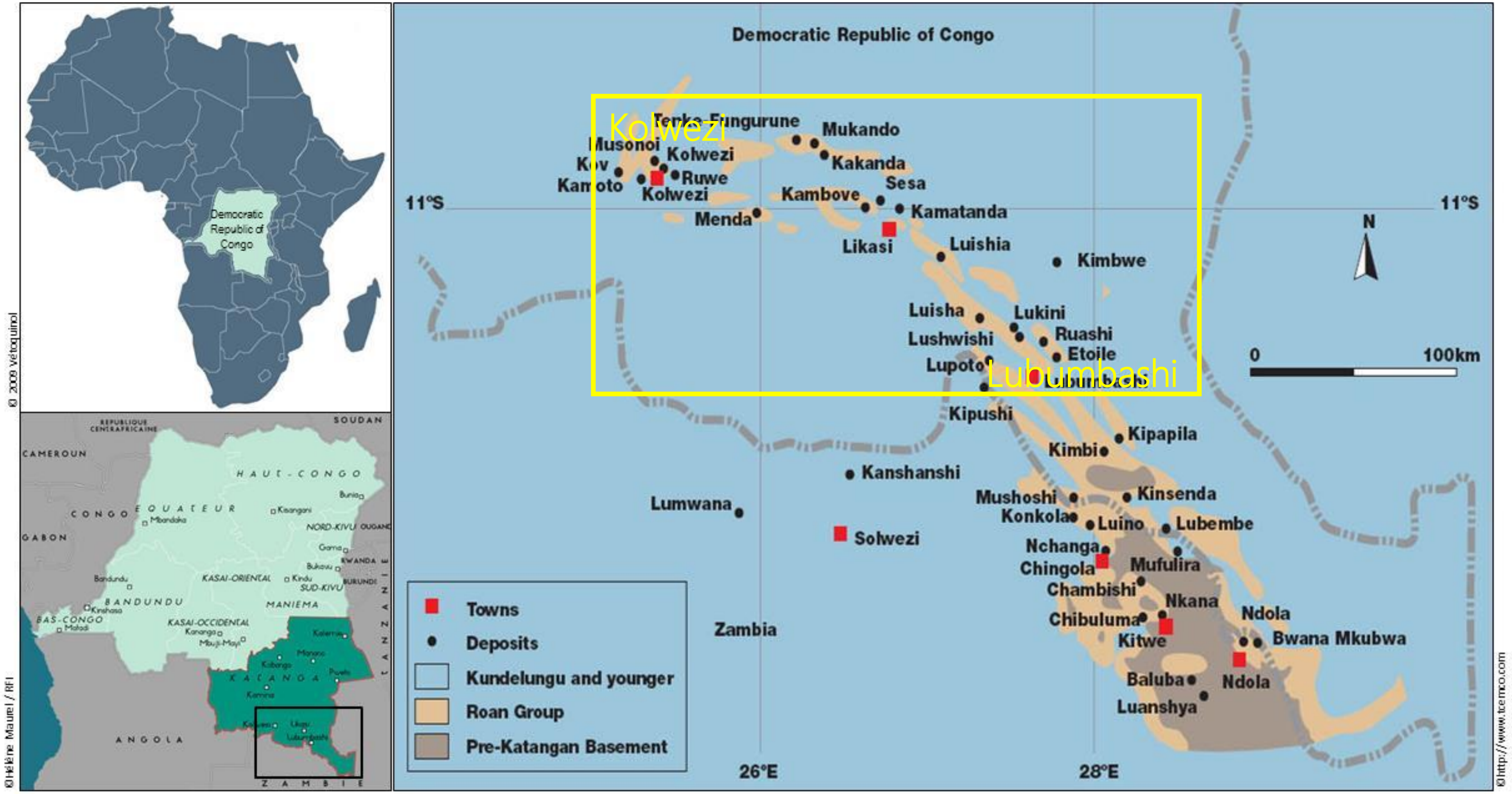
- ➢ Endemic species
- ➢ Specialist species
- ➢ Rare species
- ➢ Diversity of life forms

Kruckeberg et al., 1985; Meerts et al., 1997; Vekemans et al., 1997; Wolf et al., 2000; Mengoni et al., 2000; Assunção et al., 2003; Van Rossum et al., 2004; Safford et al., 2005; Bizoux et al., 2008; Faucon et al., 2010; Kay et al., 2010

Southeastern D.R.Congo

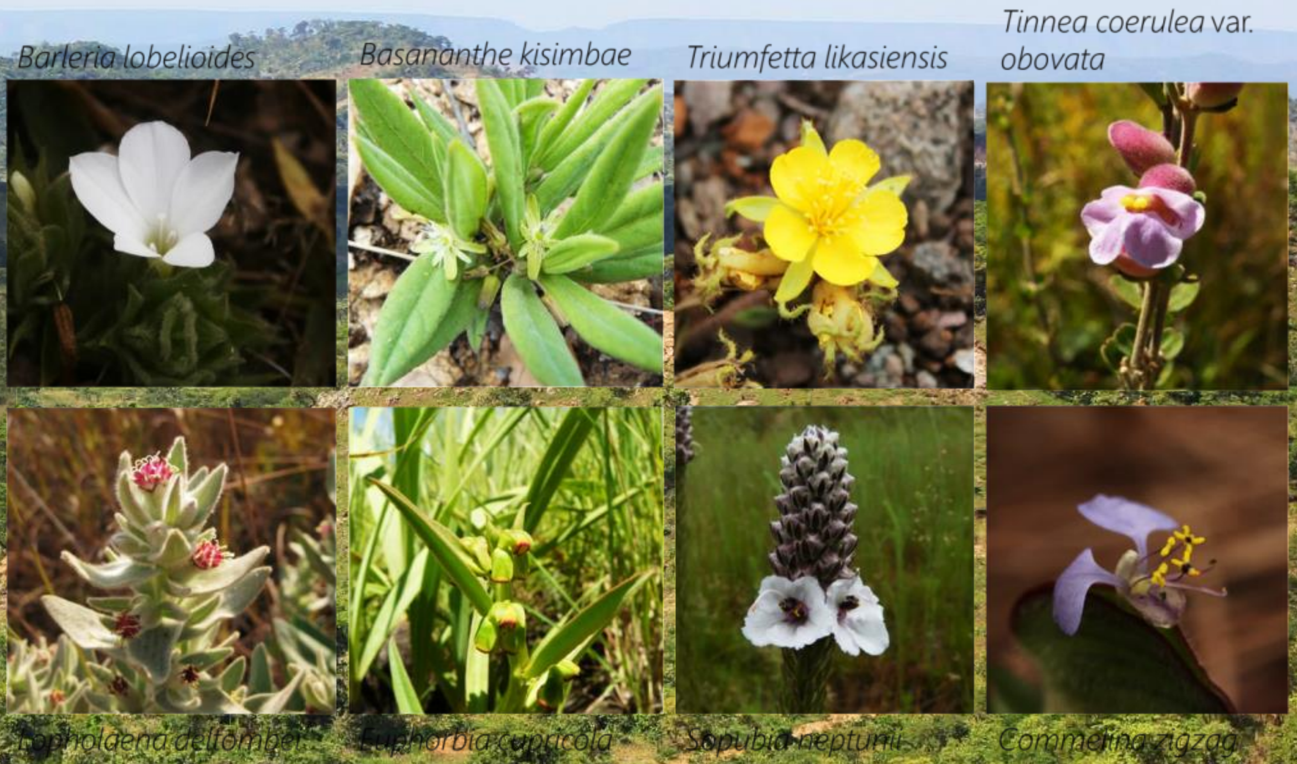


The Katangan Copperbelt



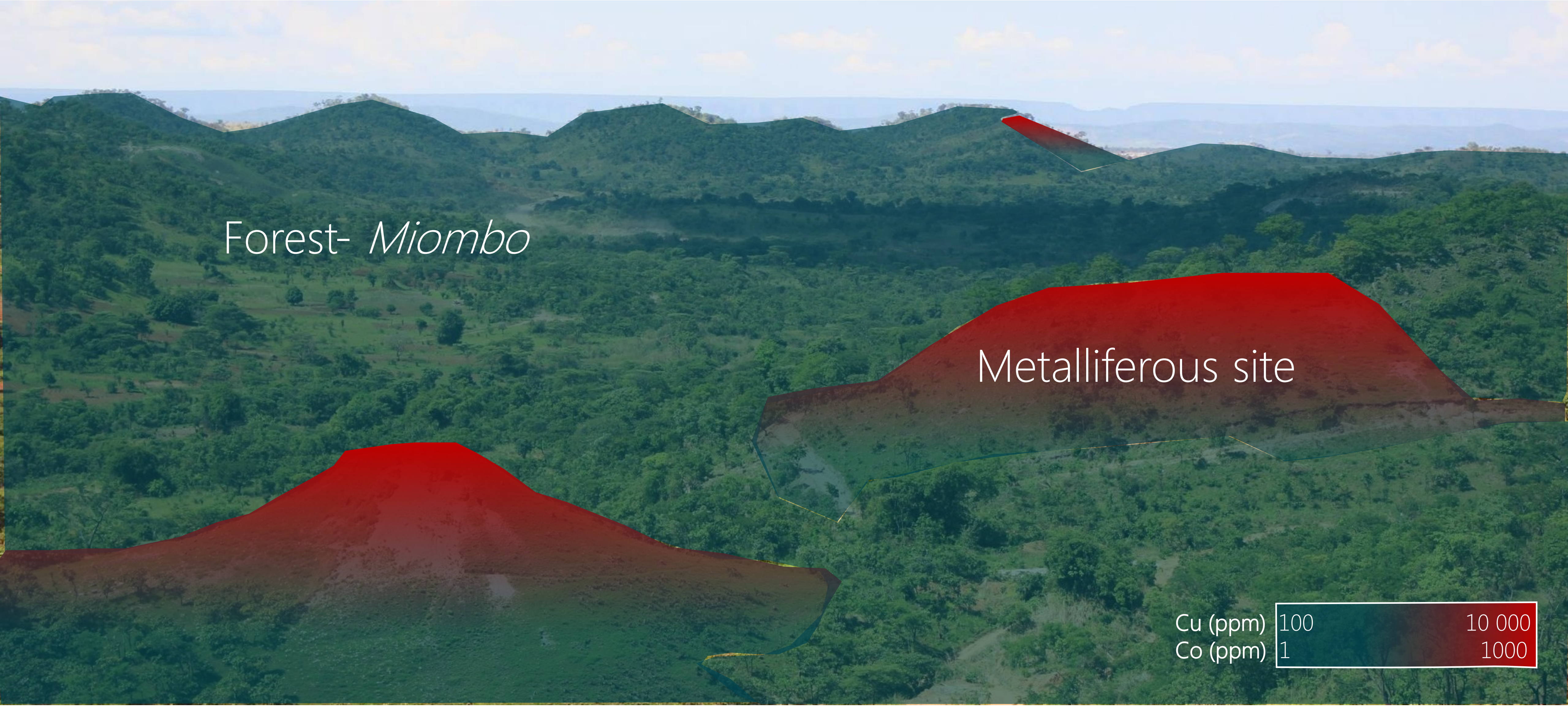
Katangan Copperbelt

- More than 150 copper-cobalt outcrops
- More than 550 plant species (= metallophyte)
- 10 % endemics of the Katangan Copperbelt



Duvigneaud and Denayer-De Smet 1963, Leteinturier 2002, Cailteux et al. 2005, Faucon et al. 2010

Natural metalliferous soils



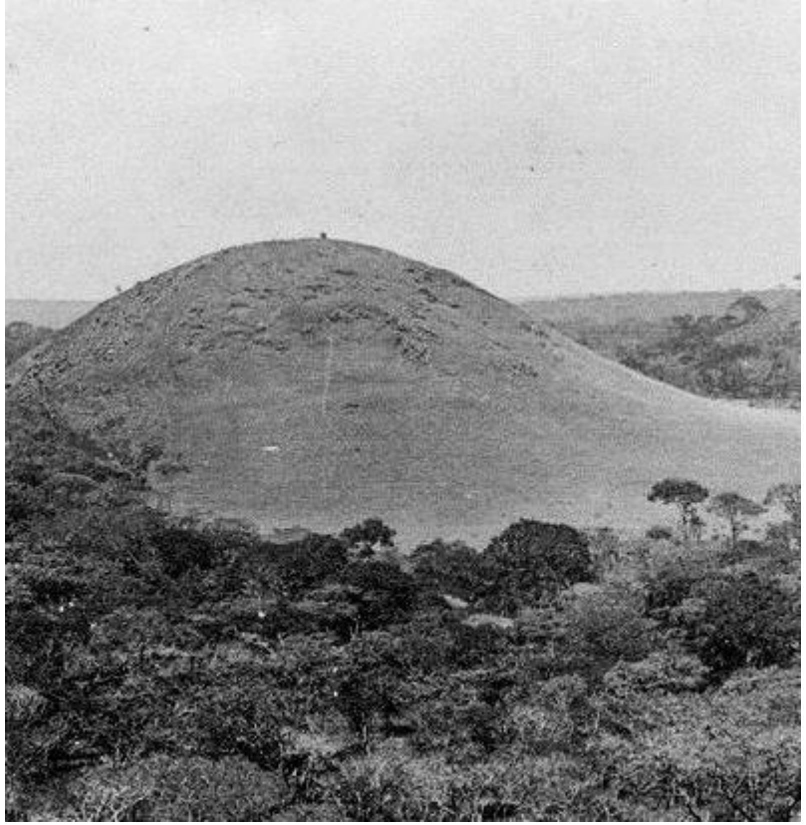
Natural metalliferous soils

Impact on natural ecosystems and on plant diversity

IUCN RED LIST

CR 67 % EN 3 % VU 9 % EX 9 %

Proposed by Faucon et al (2010)



1913

2012

2016

Impact on anthropized areas



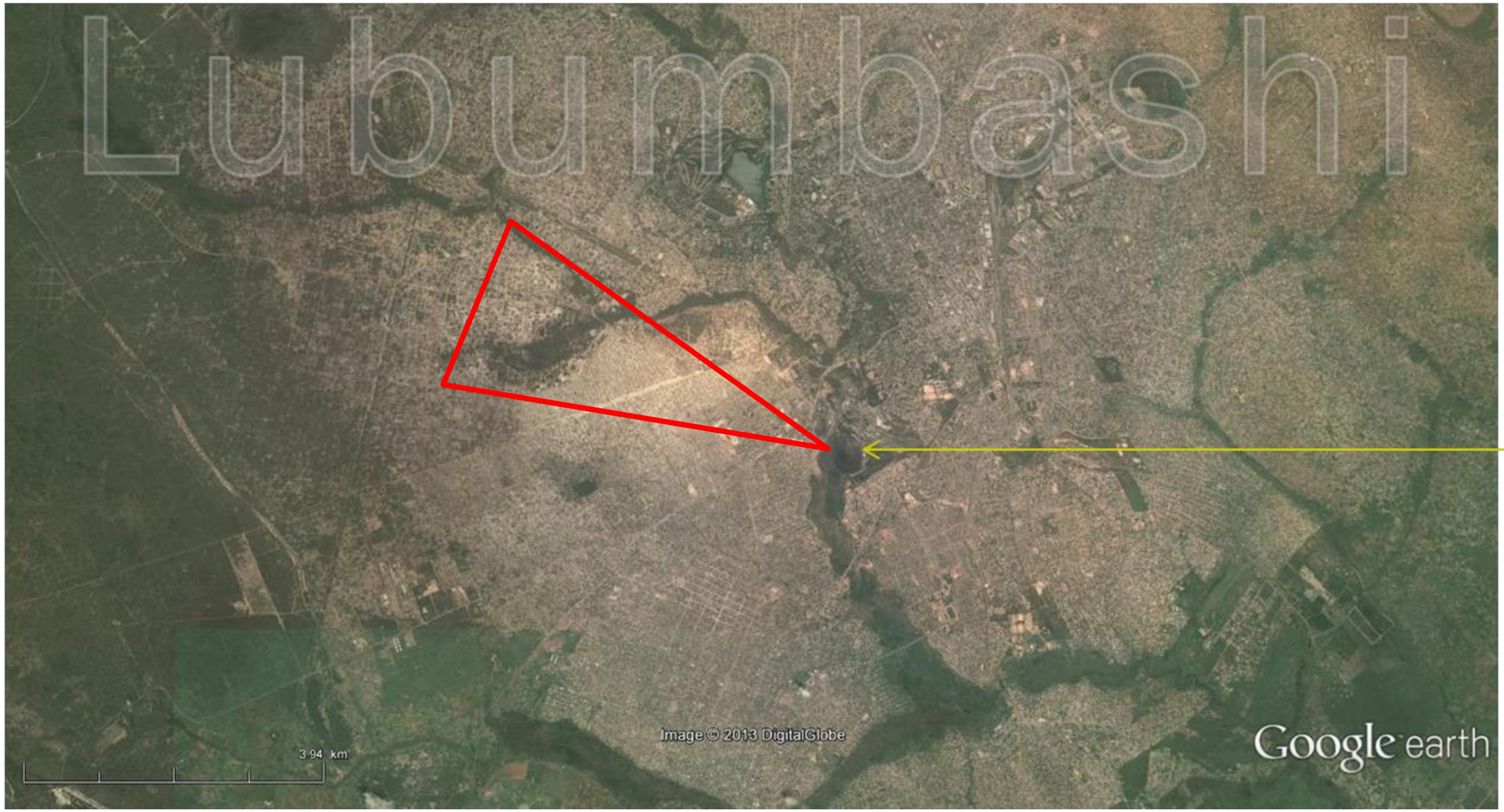

Soils

Drinking water

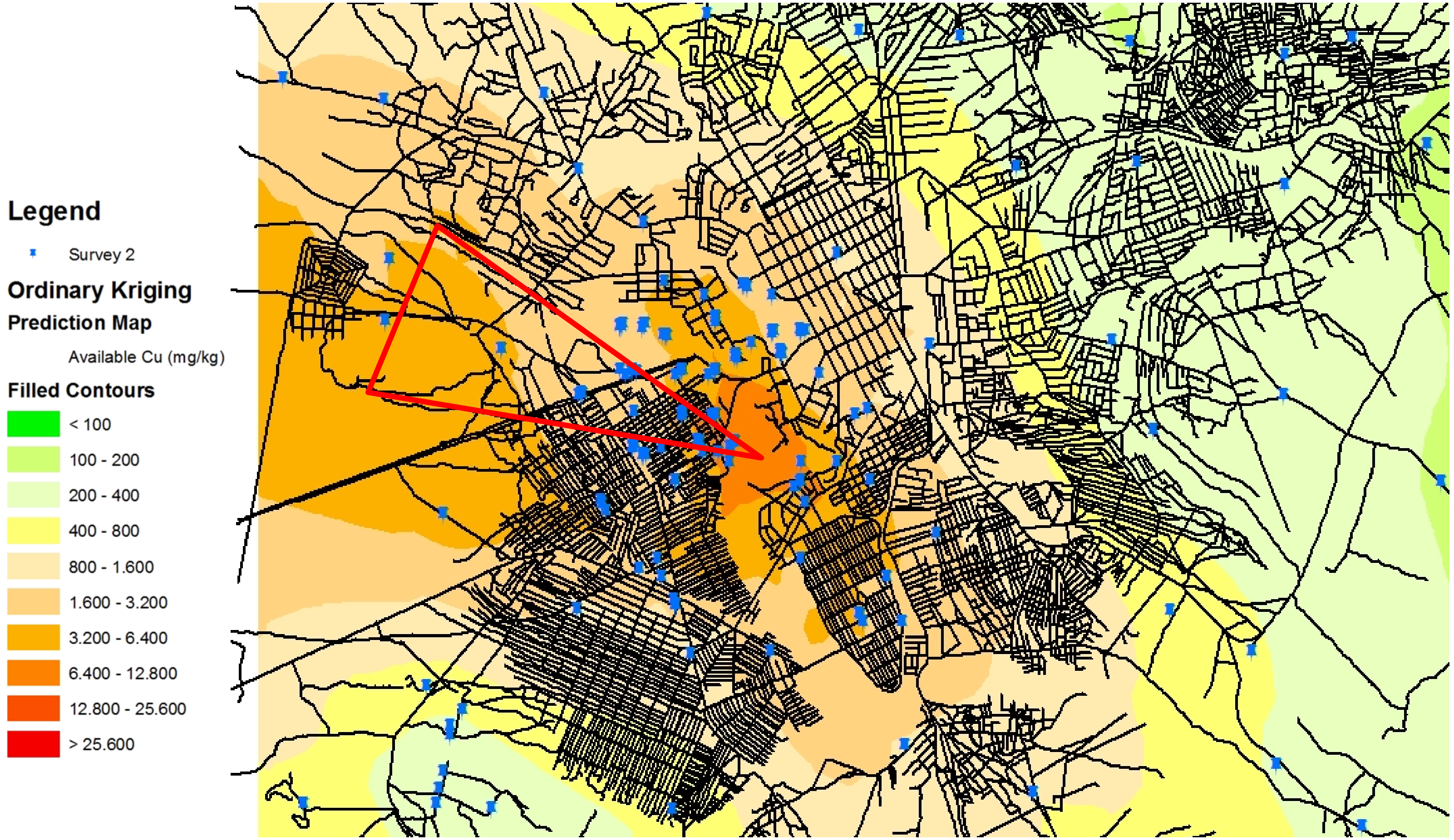
Human health exposure to metals

Banza et al. 2009, 2014
Mpundu et al. 2011, 2013, 2014
Manda et al. 2010

Soil pollution in Lubumbashi

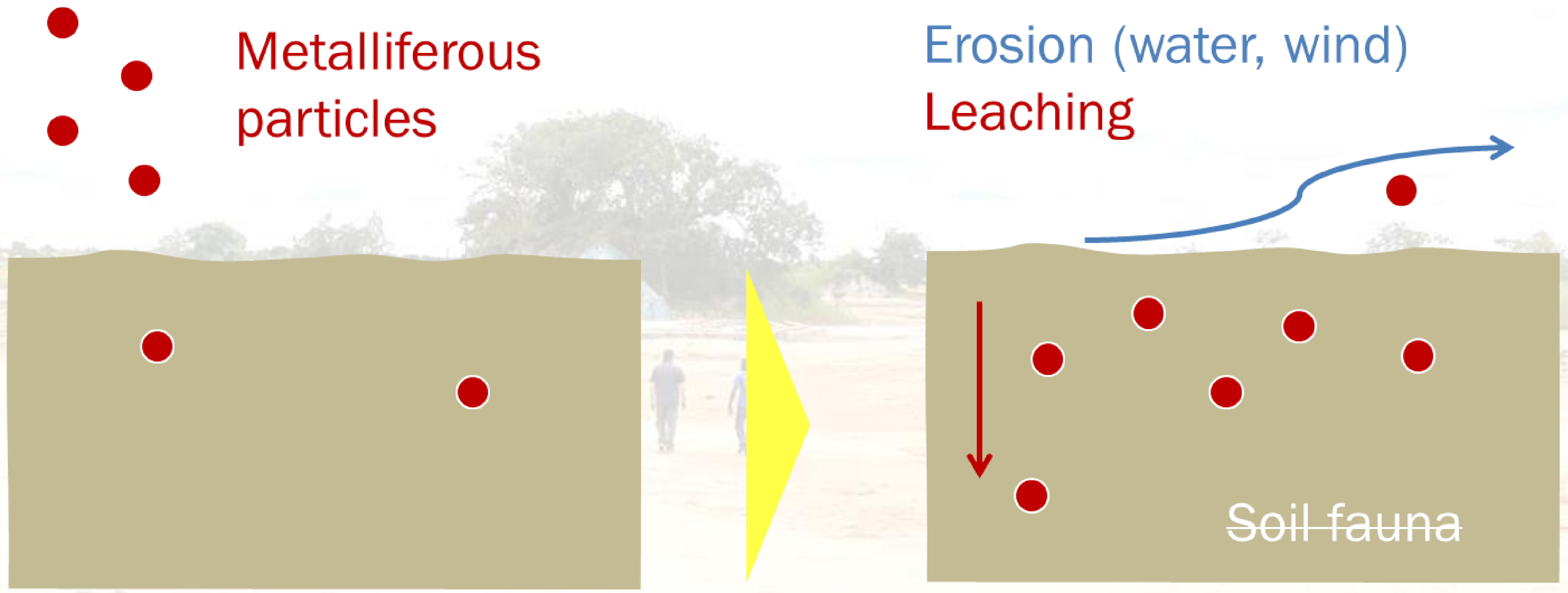


Soil pollution in Lubumbashi

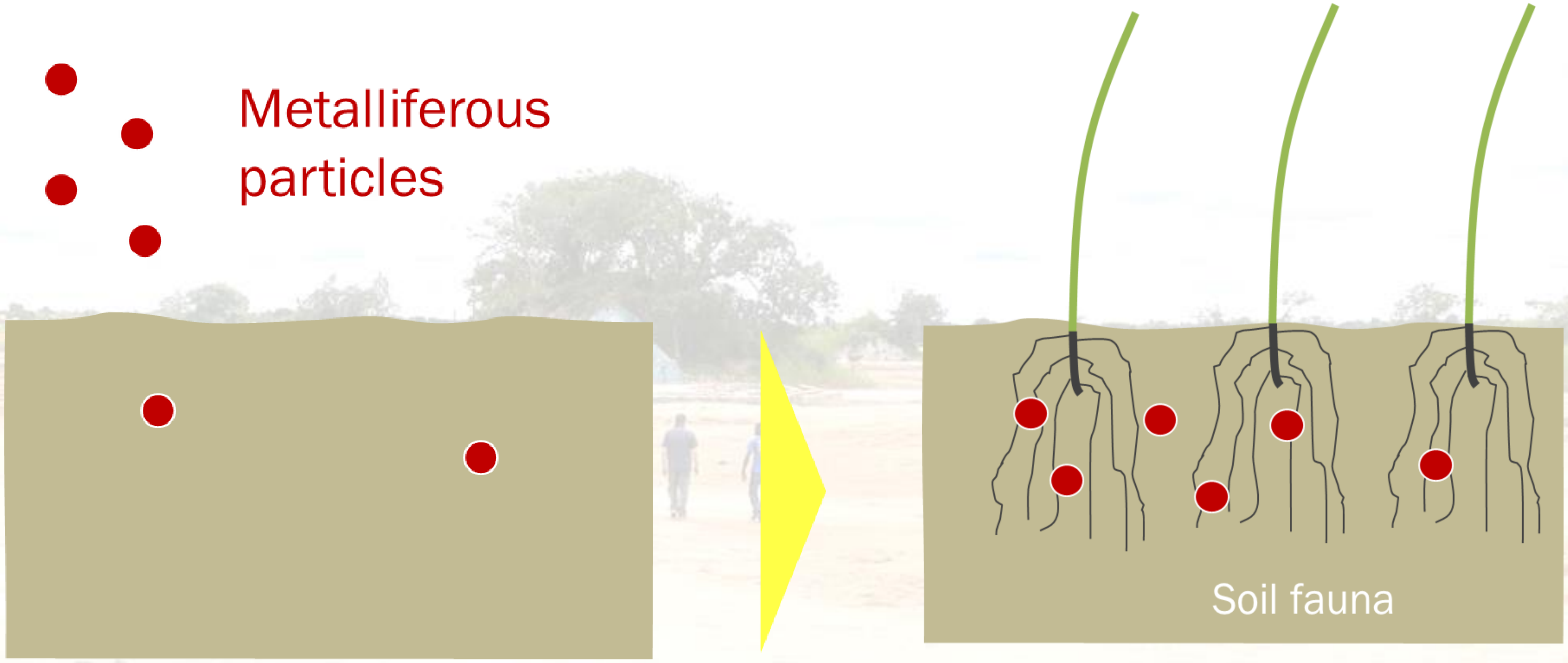


Soil pollution: consequences

Soil pollution by metals



Phytostabilisation



To immobilize metals in soil using copper tolerant species

Grass used in phytostabilisation strategies

Microchloa altera

Challenge

Biodiversity

Human health

Pollution

To test the success of establishment of **four threatened species** from the southeastern DRC on phytostabilised soils

and

to assess the potential role of the grass *M. altera* as **nurse plant** in phytostabilisation strategies

Studied species

2013

Crotalaria cobalticola

Annual

Anisopappus davyi

Annual

2014

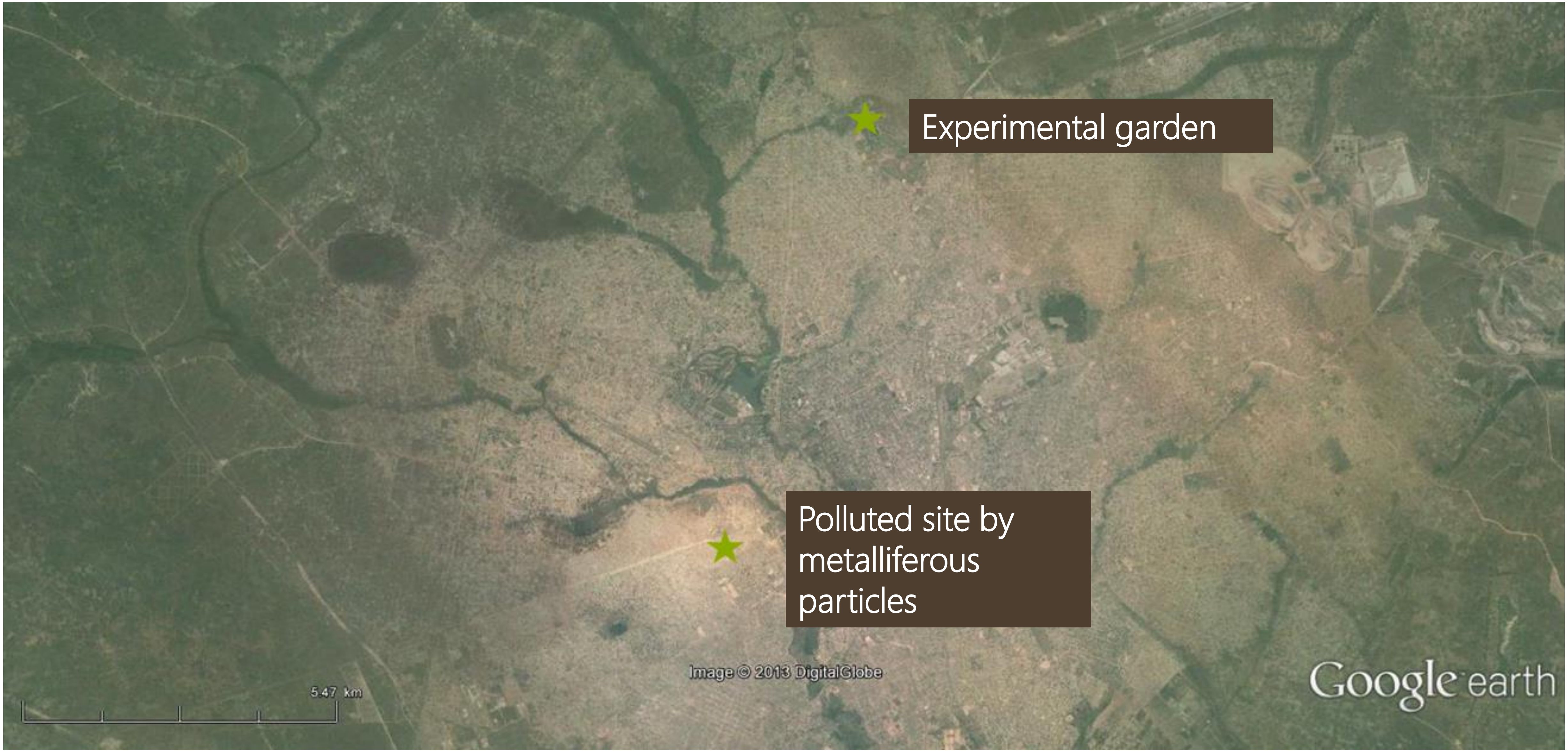
Crotalaria peschiana

Perennial

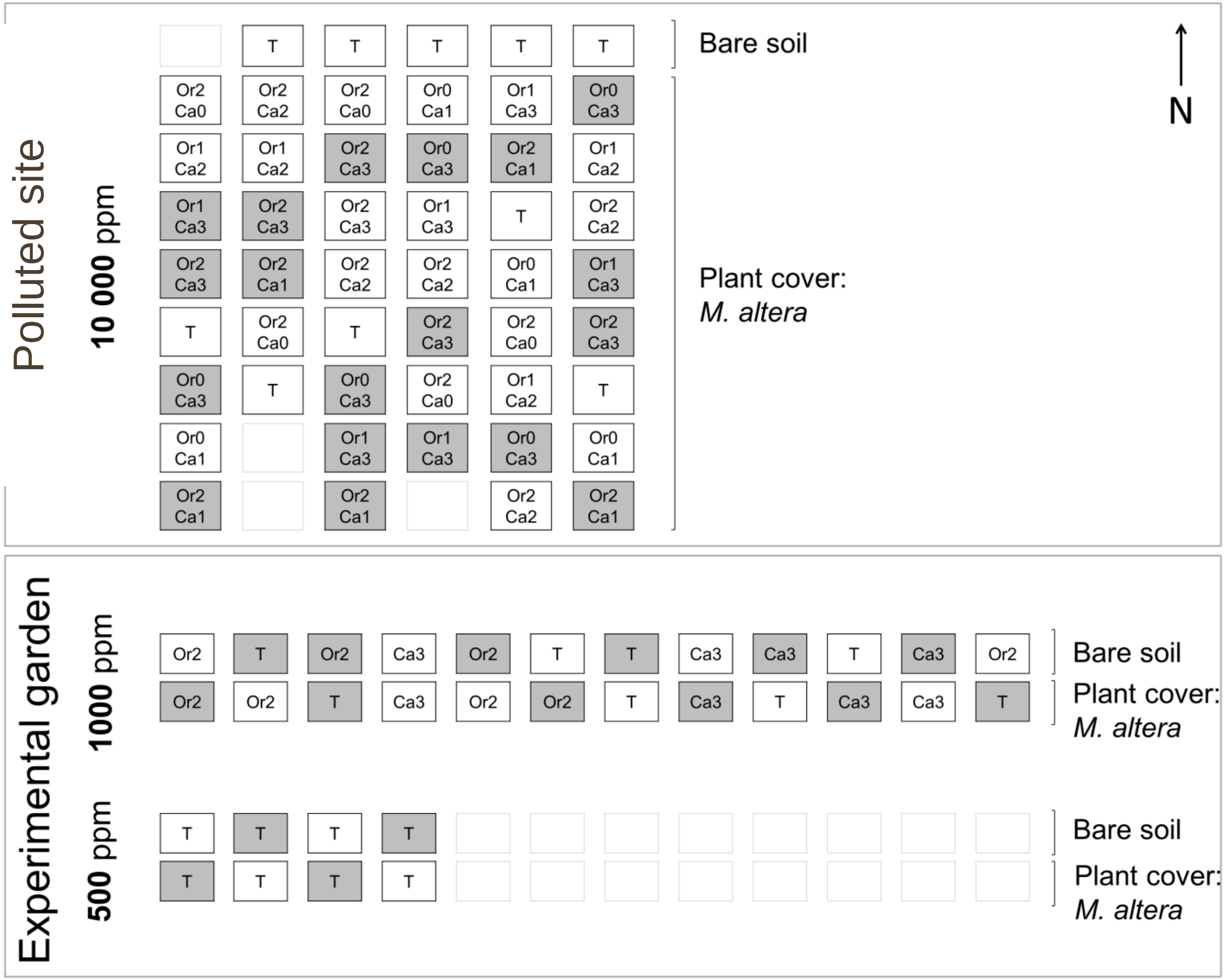
Triumfetta welwitshii

Perennial

Two sites: Experimental garden and polluted site



Experimental design



Legend:

Or0 No organic matter
Or1 4,5 kg.m^{-2}
Or2 22,5 kg.m^{-2}

Ca0 No Lime
Ca1 0,25 kg.m^{-2}
Ca2 0,5 kg.m^{-2}
Ca3 1 kg.m^{-2}

T no amendement/Control

Study site

Experimental garden (500 ppm and 1000 ppm)

Polluted site (> 10 000 ppm)

Study site

Experimental garden (500 ppm and 1000 ppm)

Polluted site (> 10 000 ppm)

Sowing and measures

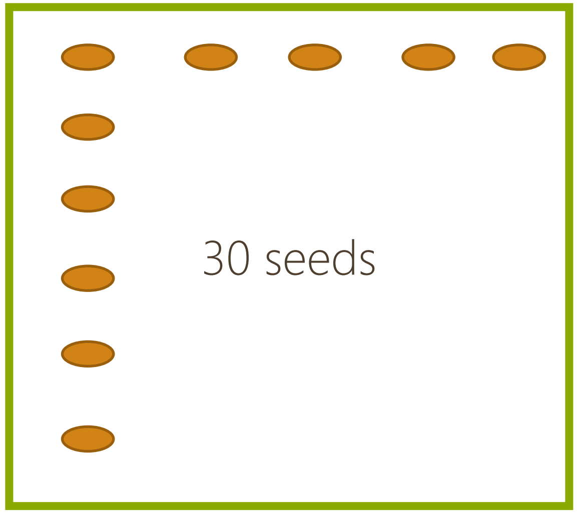
Measures

- Emergence
- Survival

- Height
- Number of leaves

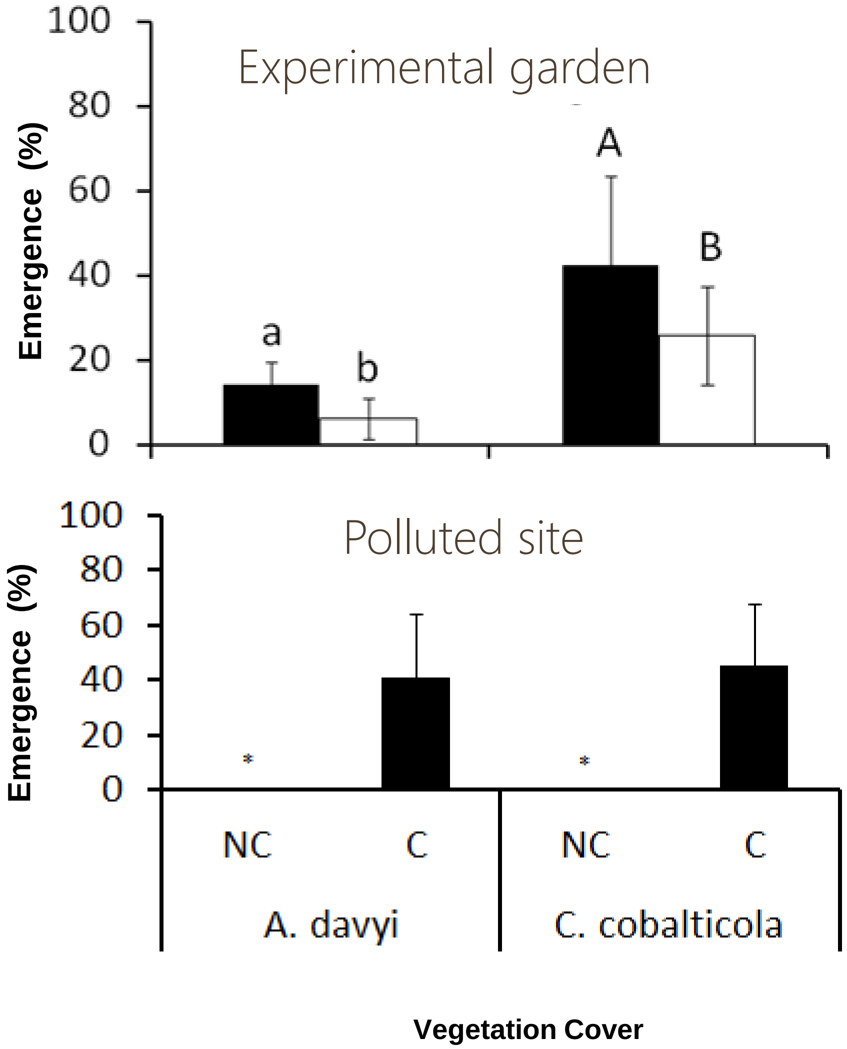
- → During the rain season

- Resprouting after dry season (for perennial species)



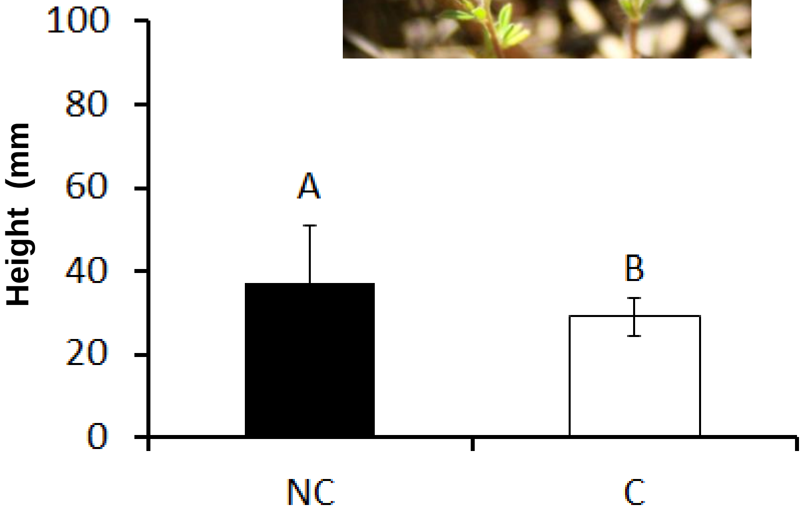
Linear mixed effect model **by site**
Grouping factor: plot (n=2)
Factor 1 : Vegetation cover (or not)
Factor 2: Amendments

Annual species - Emergence



Annual species - Growth

Experimental garden



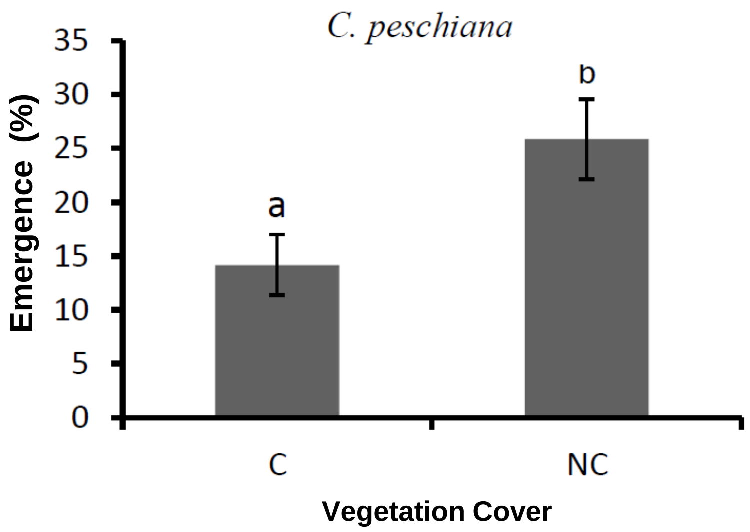
No difference of growth between amendments

Perennial species - Emergence

- Polluted site
  - No emergence in the plots of polluted sites without vegetation cover
  - No difference of emergence between amendments

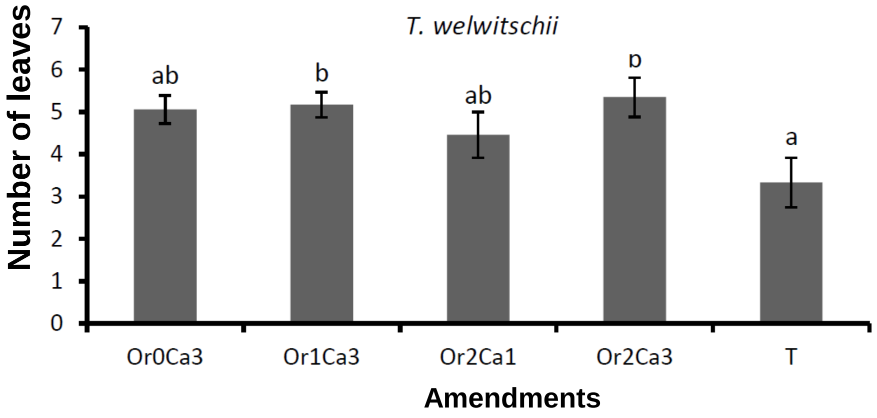
- Experimental garden
  - No difference of emergence between amendments
  - No difference for *T. welwitschii* between plots with or without vegetation cover (7,5 ± 1,8%)

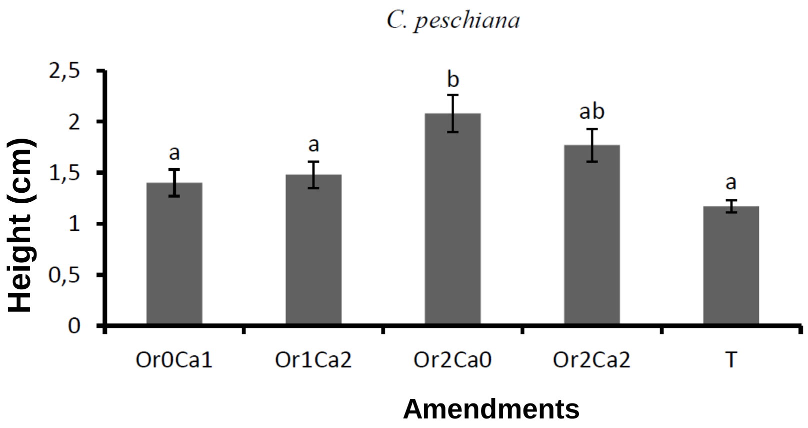
Experimental garden



Perennial species - Growth

- Experimental garden
  - No difference in height/number of leaves between plots with or without vegetation cover
- Polluted site





Effects of factors according to the life stage

	Germination		Growth		Survival		Resprout	
	Amendments	Cover	Amendments	Cover	Amendments	Cover	Amendments	Cover
Annual species		+		-	X			
Perennial species		0/-	x	-		+	x (Lime)	

\+ Vegetation cover positively enhance the germination or survival
\- Vegetation cover negatively affect the germination or the growth
X heterogenous effect

Conclusion

M. altera had a **positive effect** on the **germination** of annual species

→ Creation of favorable microclimatic conditions for germination (R.H., shade, T°C, …) - **Facilitation**

Growth of annual and perennial species was lower in plots with vegetation cover

→ **Negative interaction** at the growth stage: **Competition** for light (<> steppe)

Amendments had **no/few effects** on the growth and the survival

BUT the growth was higher in plot with lime

Polluted and bare soils are generally nutrient-poor

→ To select other grasses to promote long term association (plant soil feedback)

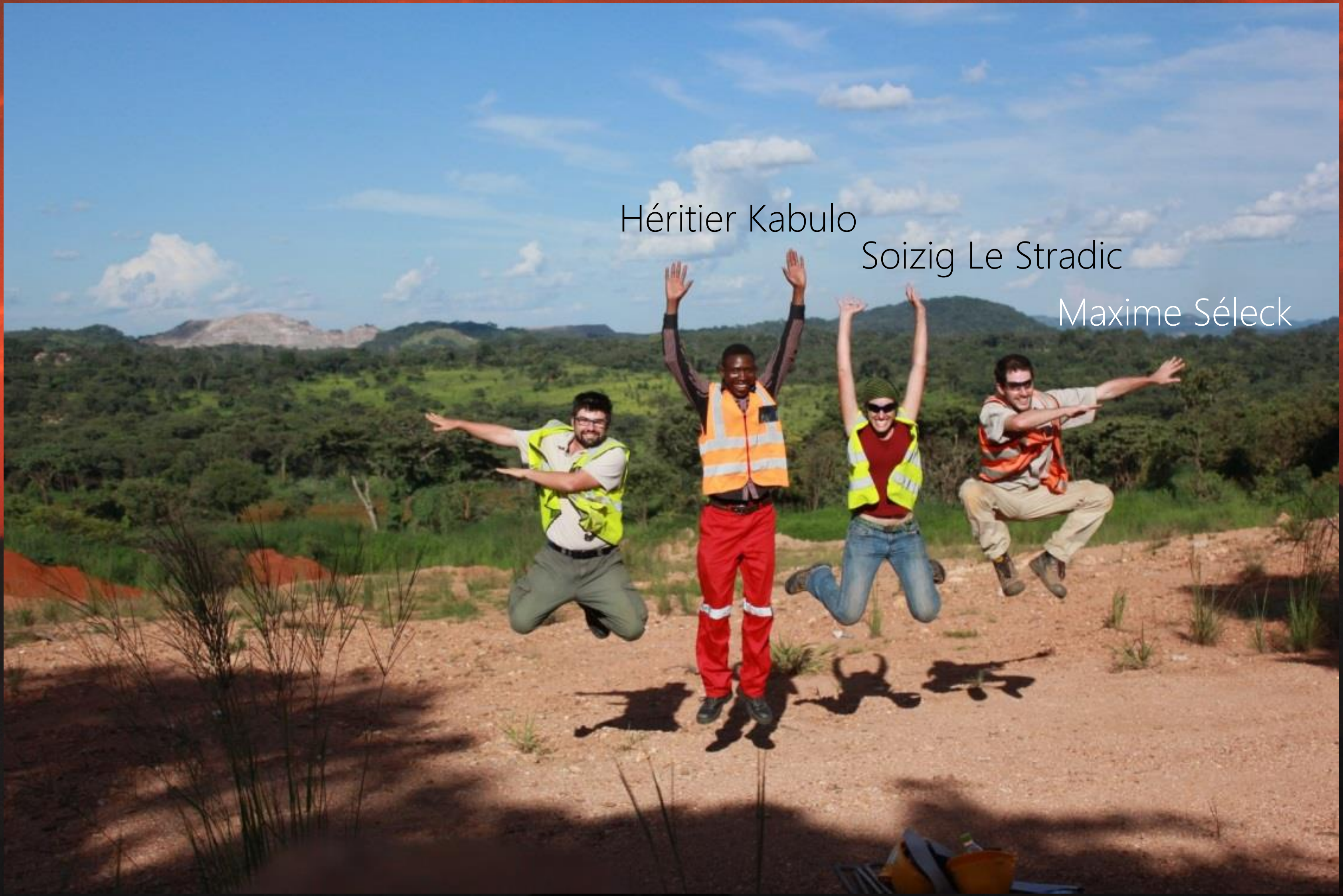
→ To associate grasses and plant able to increase soil nutrient content

For example Fabaceae *Crotalaria cobalticola*

Thank you!

Happy Birthday

Elise!



Pictures
Boisson S. & copperflora.org

	Or0Ca1	Or0Ca3	Or1Ca2	Or1Ca3	Or2Ca0	Or2Ca1	Or2Ca2	Or2Ca3	T	*F*	*P*
pH KCl	6,3 ± 0,5[a]	6,7 ± 0,9[ab]	6,4 ± 0,3[ab]	7,6 ± 0,8[b]	5,6 ± 0,3[a]	6,1 ± 0,5[a]	6,5 ± 0,3[ab]	6,8 ± 0,7[ab]	5,7 ± 0,5[a]	5,04	< 0,001***
Ca ($mg.100g^{-1}$)	85,8 ± 18,1[a]	104,5 ± 57,5[a]	84,4 ± 22,4[a]	200,4 ± 131,6[a]	118,7 ± 62,2[a]	123,8 ± 50,3[a]	97,4 ± 21,8[a]	141,8 ± 35,3[a]	105,8 ± 82,4[a]	1,22	> 0,05
C_{org} (‰)	10,4 ± 1,8[a]	14,9 ± 12,5[a]	14,8 ± 5,7[a]	9,3 ± 1,7[a]	17,8 ± 7,7[a]	15 ± 5,1[a]	16,0 ± 10,7[a]	11,9 ± 2,6[a]	13,3 ± 6,8[a]	0,74	> 0,05
Cu ($mg.kg^{-1}$)	1770,3 ± 1109,1[a]	2864,1 ± 2856,5[a]	3810,3 ± 1993,8[a]	2135,5 ± 1186,2[a]	4536,3 ± 3913,1[a]	2300,1 ± 1882,0[a]	3022,0 ± 3841,8[a]	2312,0 ± 1291,4[a]	2674,0 ± 1818,7[a]	0,49	> 0,05
Co ($mg.kg^{-1}$)	46,5 ± 26,9[a]	27,7 ± 22,5[a]	57,0 ± 16,4[a]	33,5 ± 17,7[a]	44,1 ± 17,7[a]	43,5 ± 12,9[a]	53,9 ± 42,5[a]	38,7 ± 21,0[a]	40,5 ± 22,1[a]	1,10	> 0,05
Mn ($mg.kg^{-1}$)	32,4 ± 11,6[b]	14,1 ± 9,0[a]	33,4 ± 18,5[b]	22,6 ± 7,8[ab]	18,5 ± 7,7[ab]	34,2 ± 4,7[b]	31,7 ± 8,4[b]	28,0 ± 4,3[ab]	25,6 ± 13,2[ab]	3,16	< 0,01**