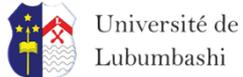
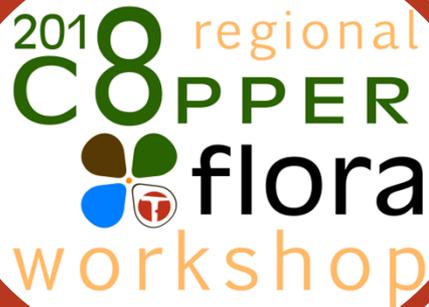


28 February – 1 March 2018



# Challenges for the copper flora

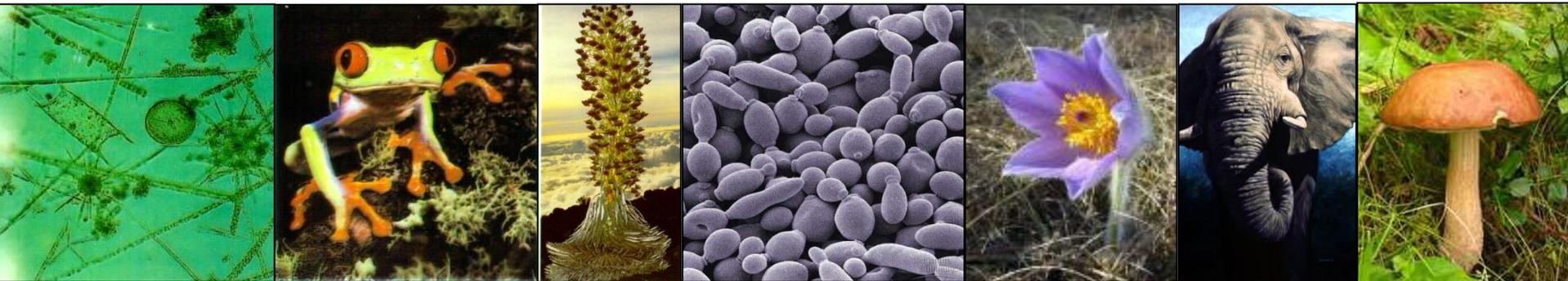
Pr. François Malaisse  
Pr. Grégory Mahy



Kolwezi-Fungurume - Democratic Republic of Congo

"Biological diversity" means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

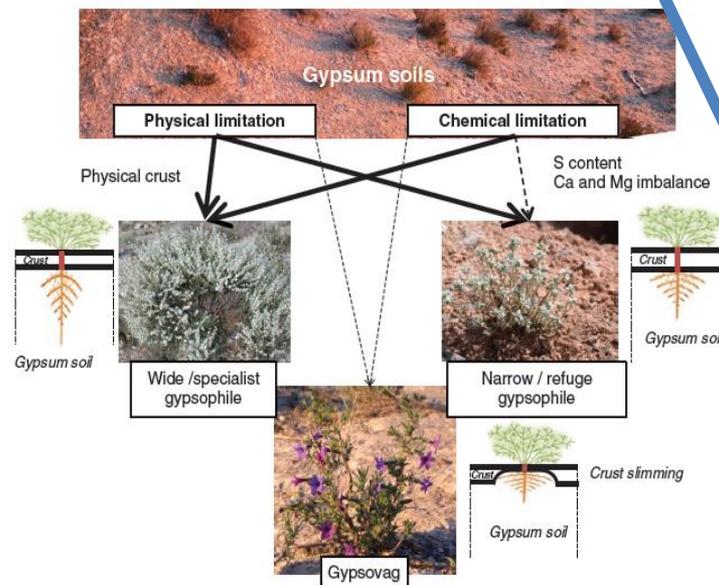
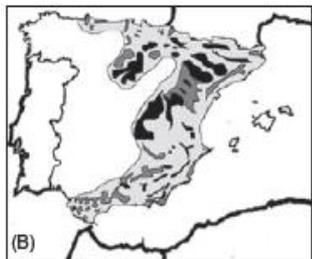
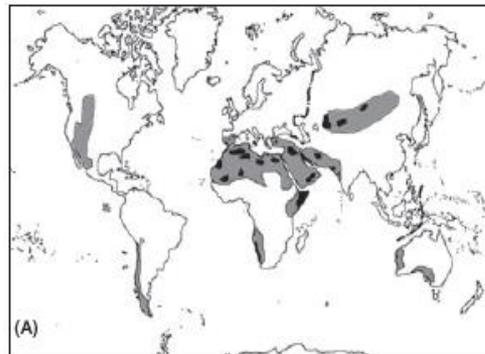
(Convention on Biological Diversity, Rio, 1992.  
United Nation, Environment Program)



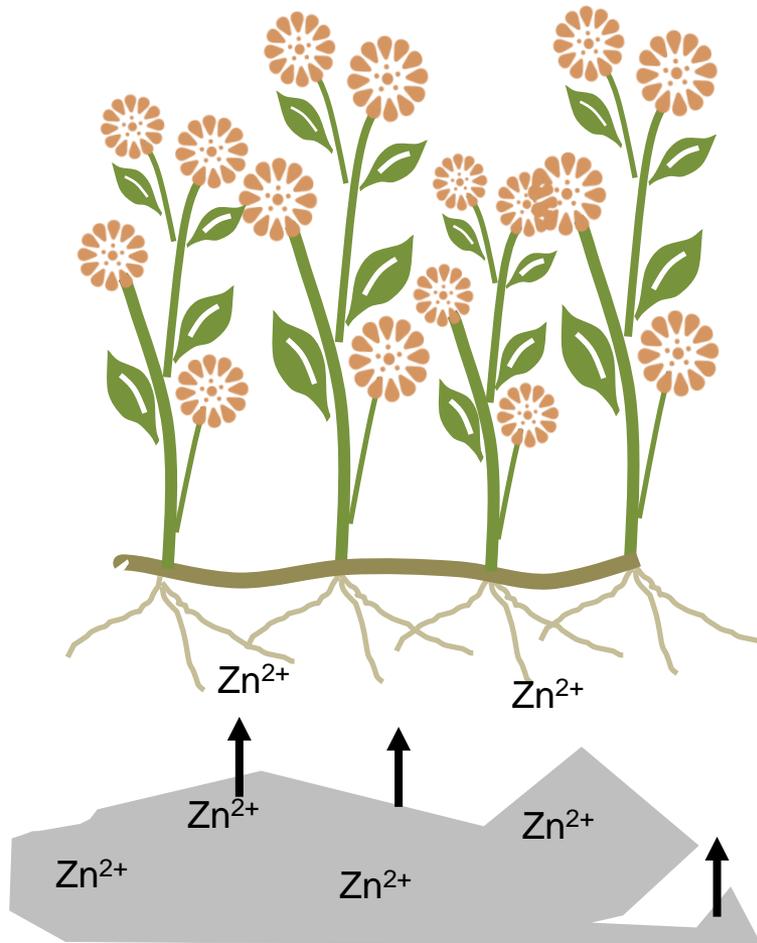
# Biodiversity associated to extreme ecological conditions

## Soils with high levels of toxic elements

- z **Heavy Metals (Ni, Zn, Cu, Co,...)**
- z **Gypsum ( $\text{CaSO}_4$ )**



# Metallophytes



**Metallophytes**  
Plant that tolerates high concentrations of heavy metals in soils

Soils with high concentration of heavy metals

Ore body with high concentration of heavy metals

# A diversity of metal ecosystems

## Serpentine ecosystems

> Fe, Mg, Ni, Cr, Co

< Ca, P, K



© Las Pilitas Nursery, Bert Wilson

# A diversity of metal ecosystems



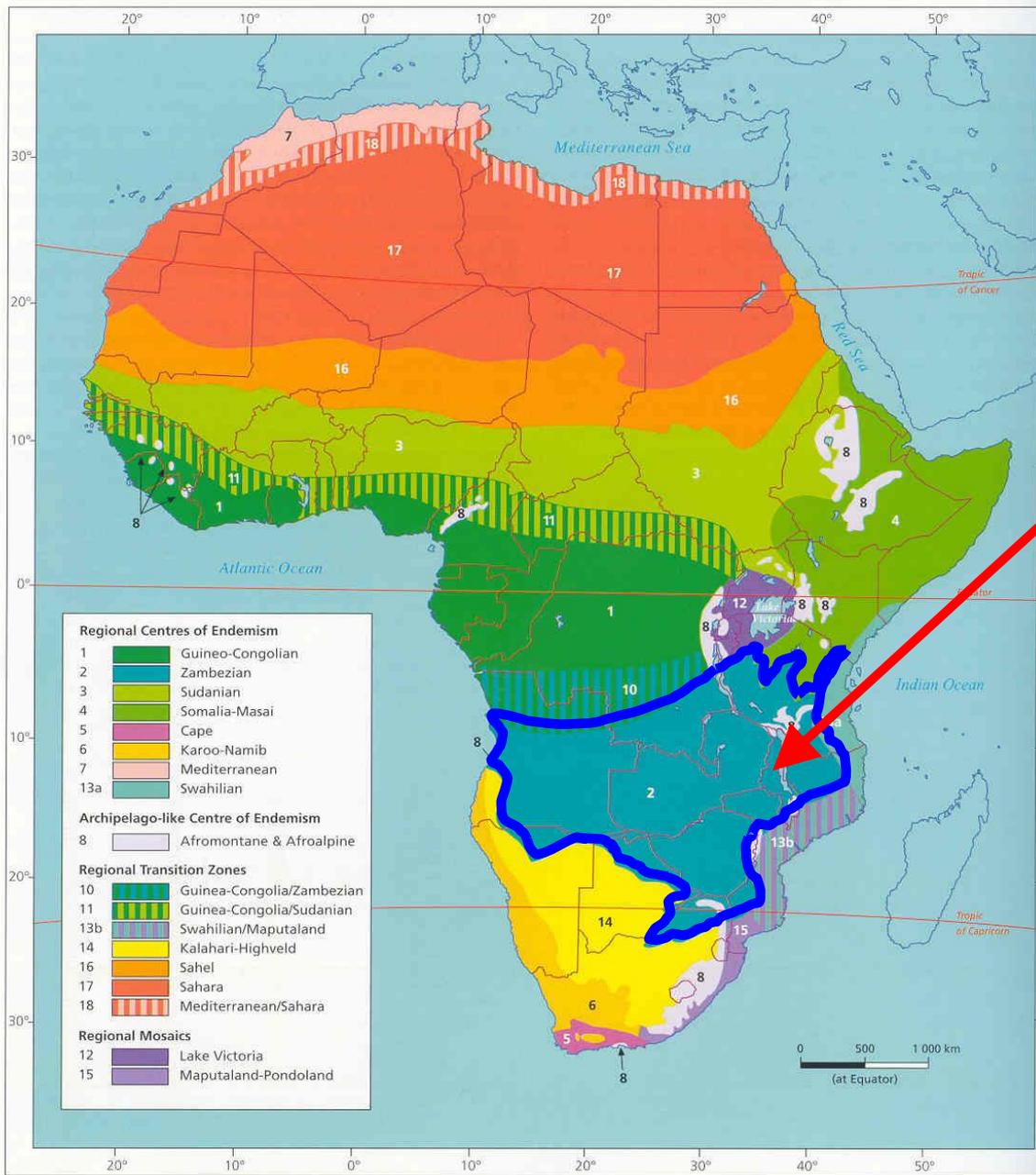
## Calamine ecosystems

> Zn, Pb, Cd

# A diversity of metal ecosystems



**Copper Cobalt Ecosystems**  
> Cu, Co



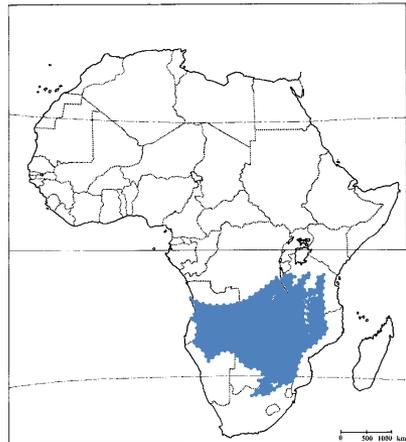
**Zambezi  
regional  
centre  
of  
endemism**

**8,500 spp.  
54% endemics**

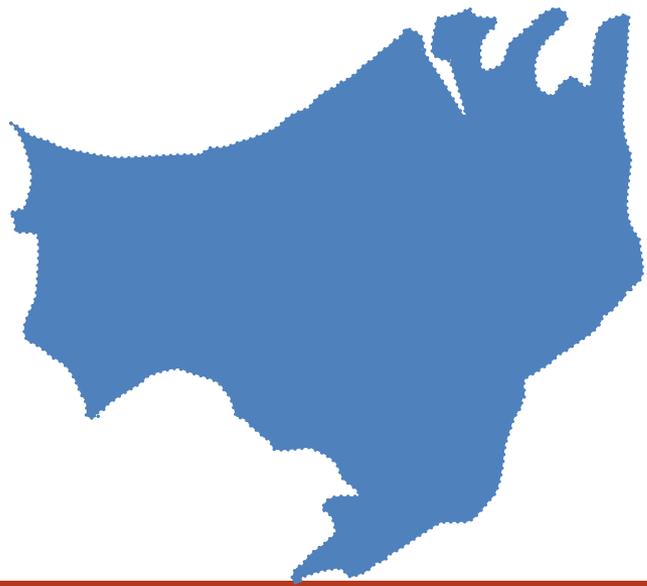
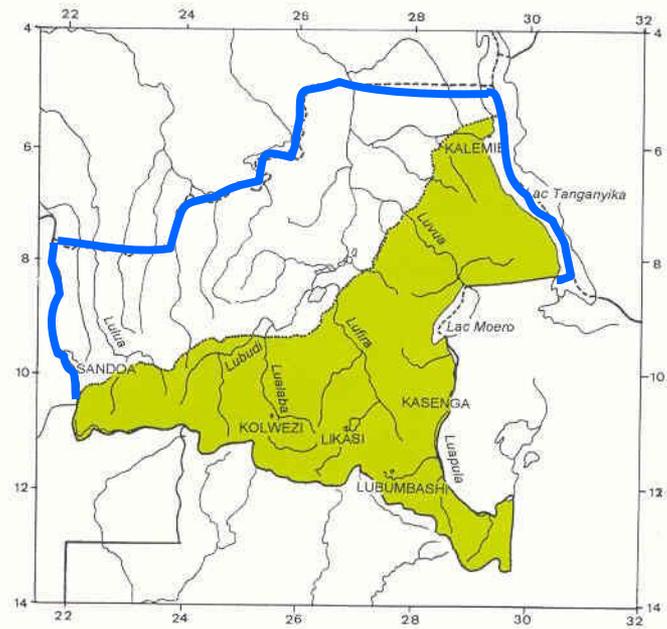
**4,600 endemic  
species**

**source : van Wyk & Smith [2001]**

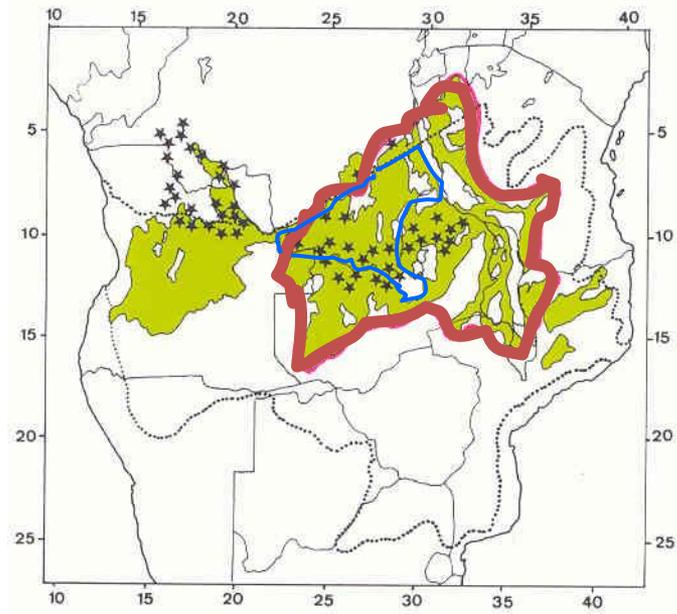
# The Zambezan regional centre of endemism



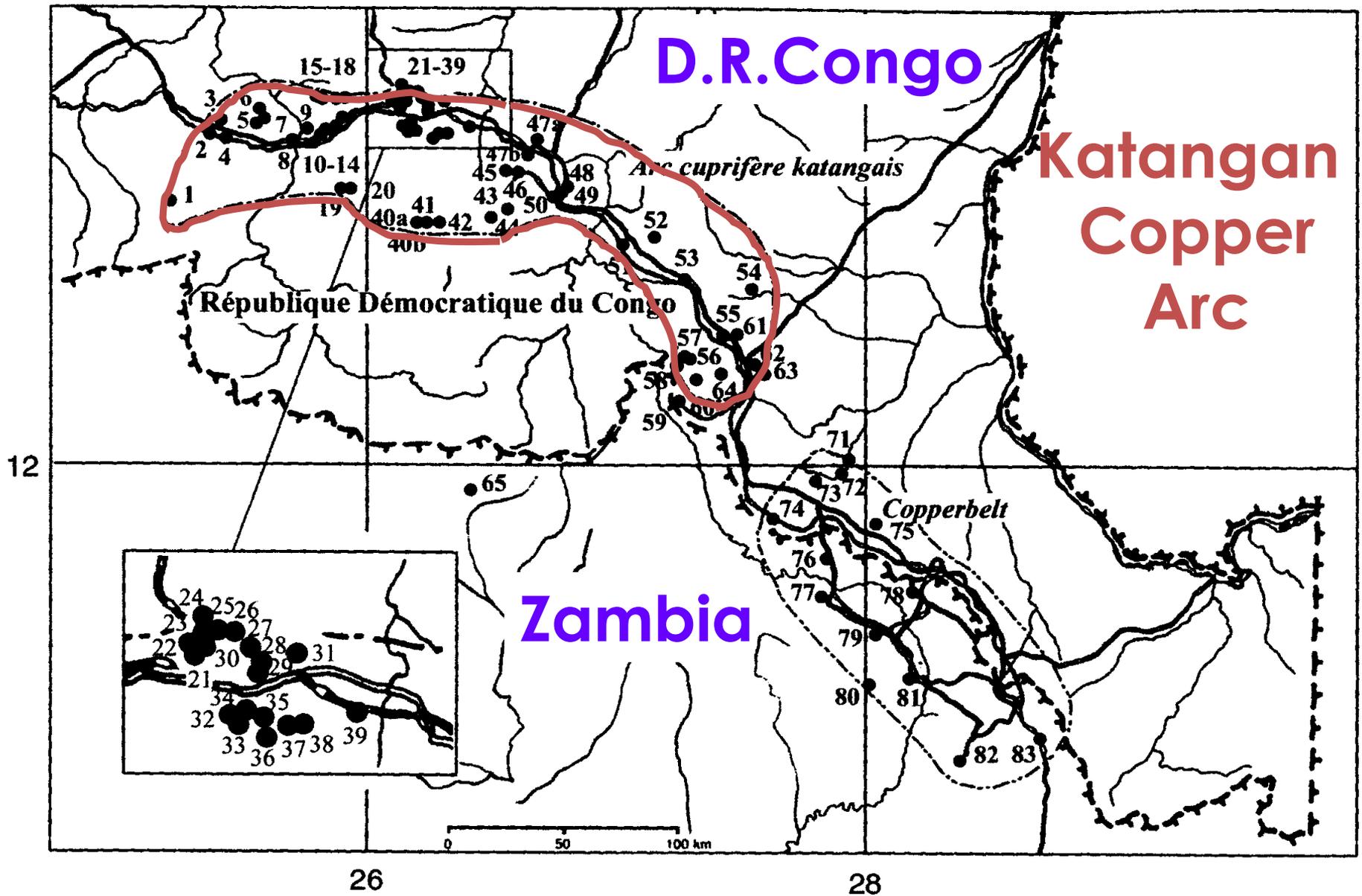
## Upper Katanga



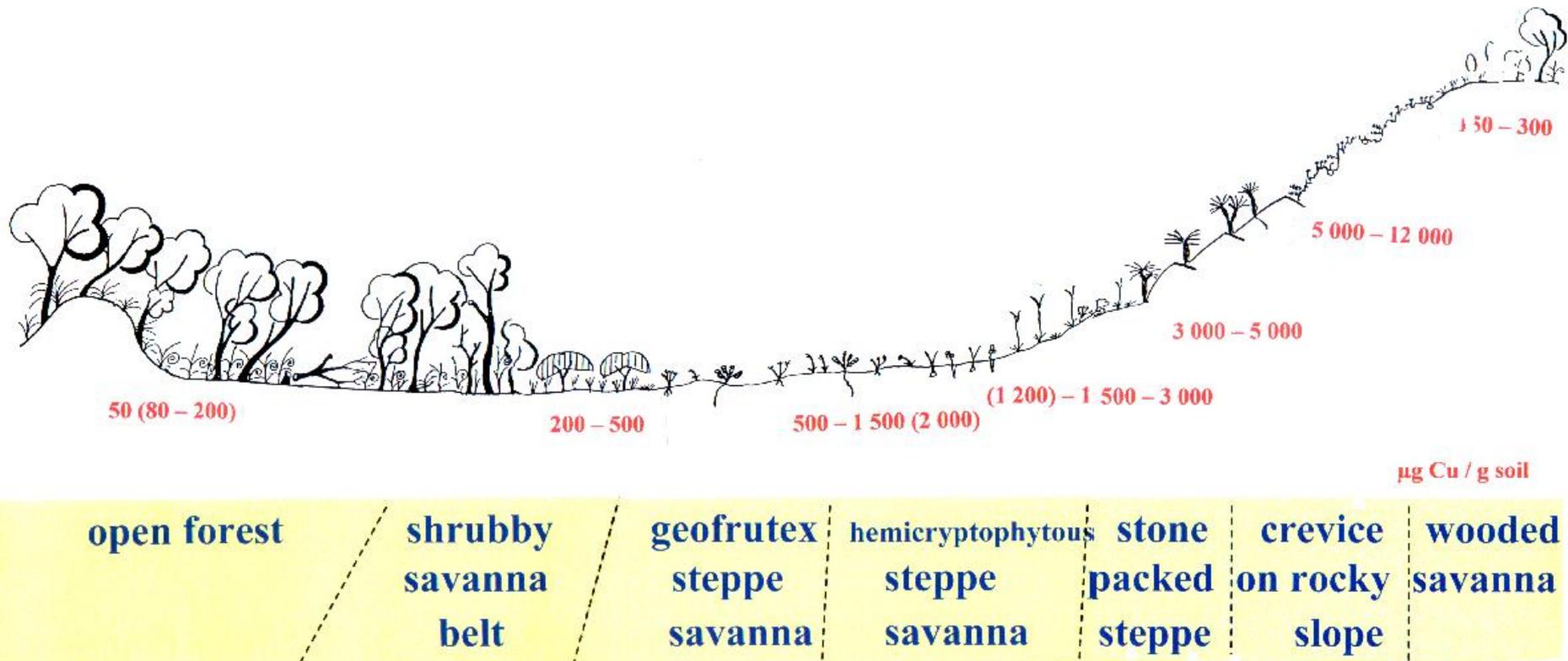
## Bemba domain (Katanga - Zambia domain)







# Transect of copper outcrops in the Katangan Copper Arc





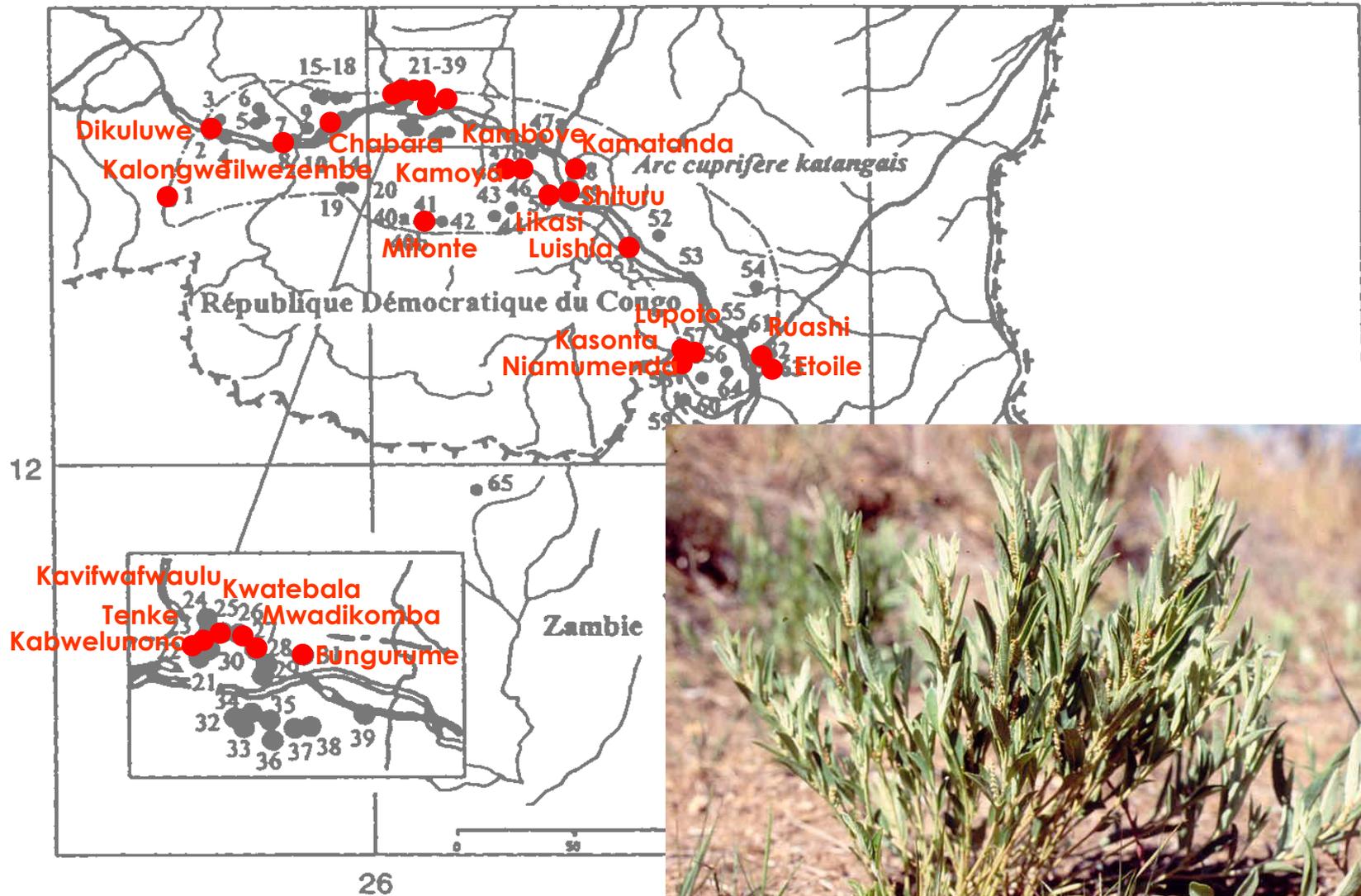
## Copper and Biodiversity

> 600 species, with:

- 32 strict metallophytes endemics
  - 23 broad metallophytes endemics
- = conservation challenges
- Hyperaccumulator and tolerant species
- = biotechnological resources

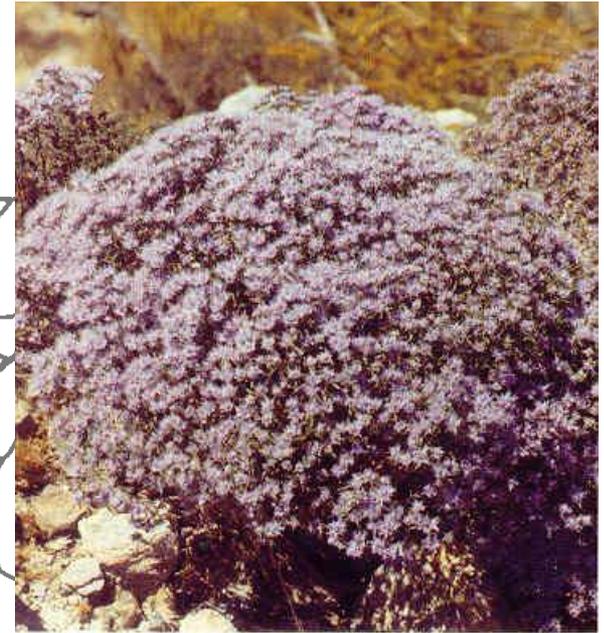


# “panarc” distribution

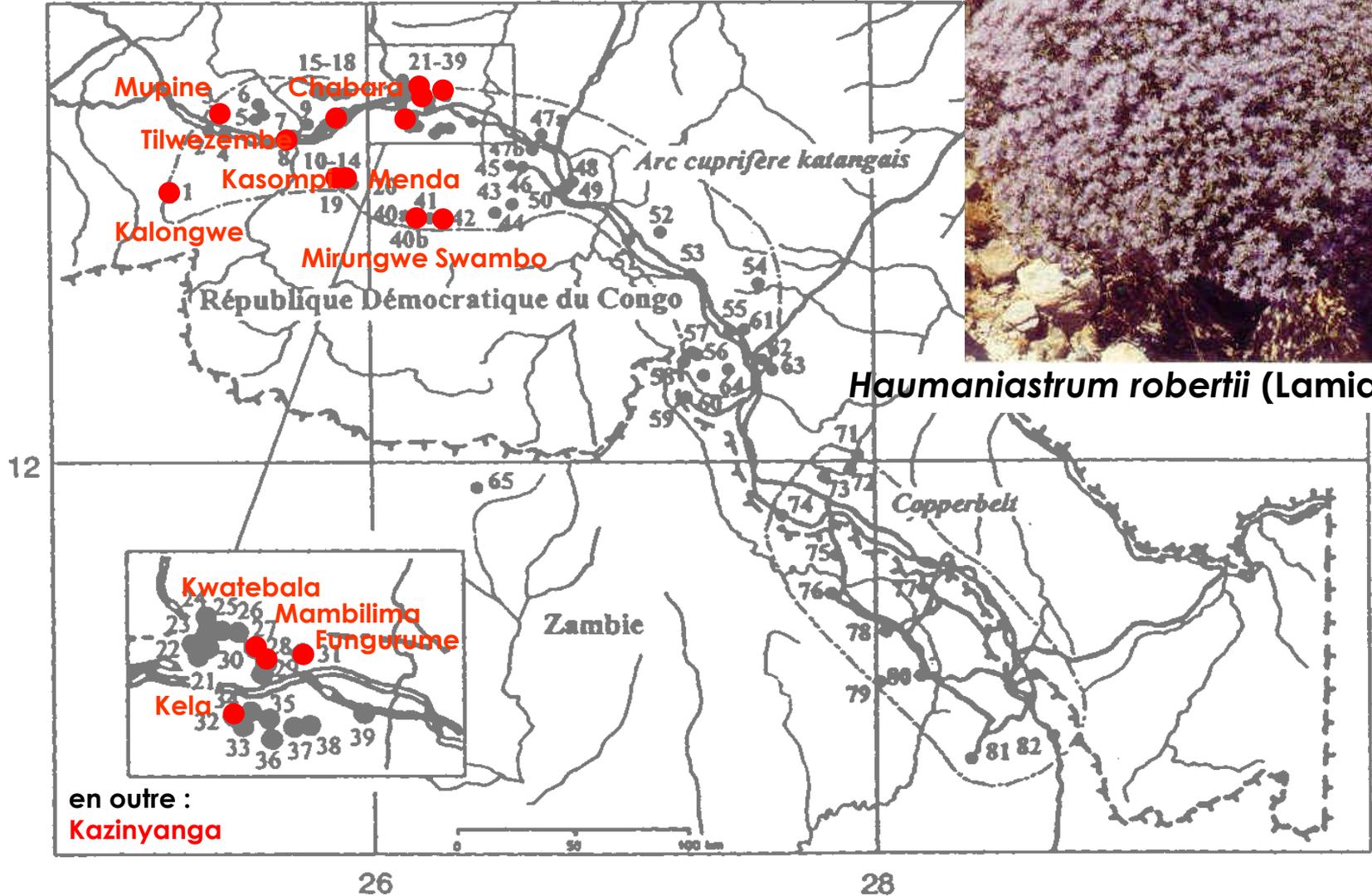


*Acalypha cupricola* (Euphorbiaceae)

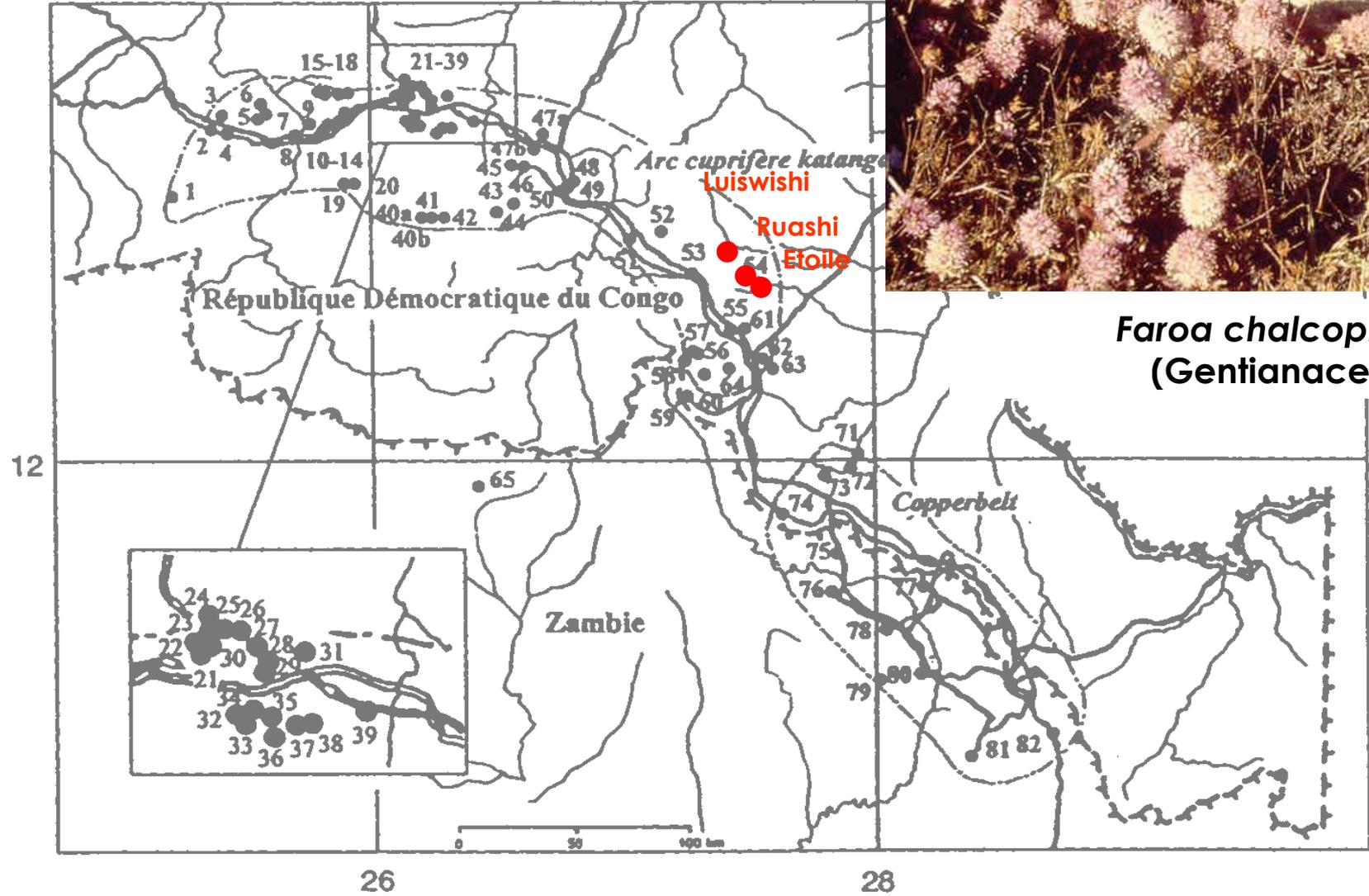
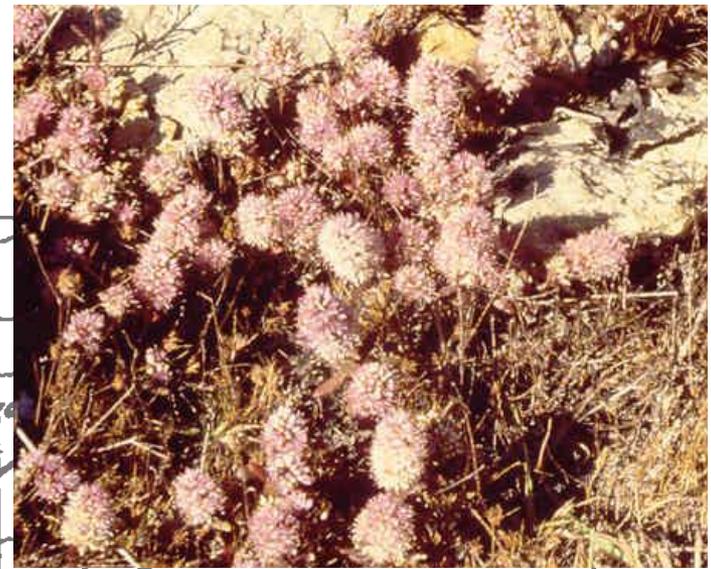
# “north-west” distribution



*Haumaniastrum robertii* (Lamiaceae)



# south-east distribution

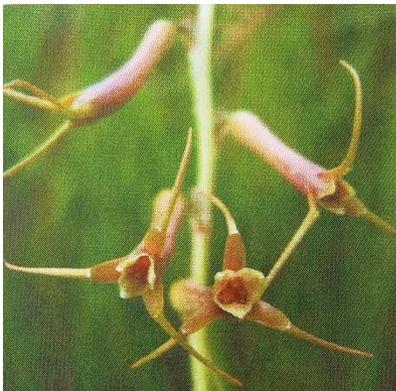


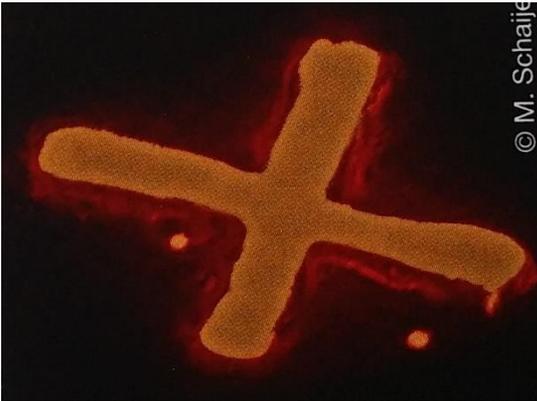


New species for science

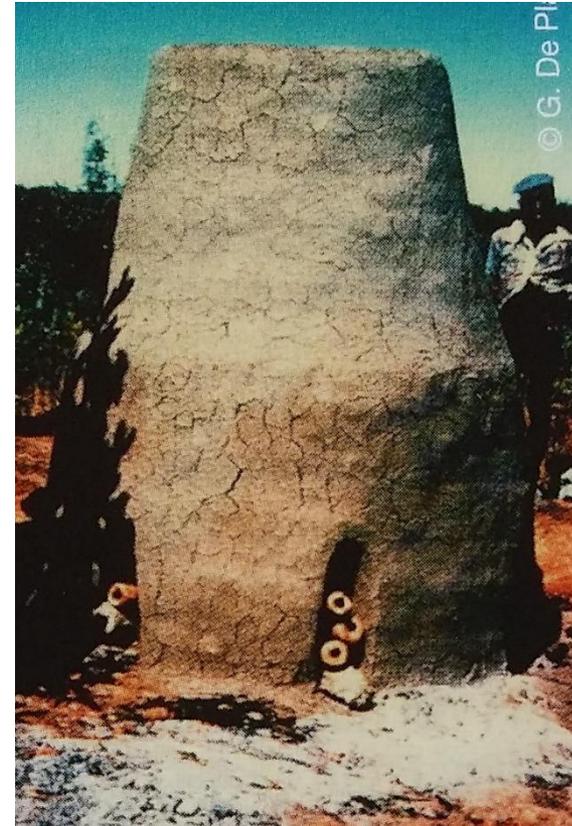


Unexplored biodiversity





Precolonial copper metallurgy  
5th century AC





## Copper and Biodiversity

### Biodiversity conservation challenges



# Anthropogenic metalliferous soils



# Anthropogenic metalliferous soils

Copper and Biodiversity

Rehabilitation challenges



~~Code minier - RDC~~



## Guidance Note 6 Biodiversity Conservation and Sustainable Natural Resource Management



## Guidance Note 6 Biodiversity Conservation and Sustainable Natural Resource Management

April 30, 2006

G18. Critical habitat is a subset of both natural and modified habitat and is determined by the presence of high biodiversity value based on one or more of the following criteria:

- i) large numbers of endemic or restricted-range species found only in a specific area
- ii) the presence of known critically endangered or endangered species
- iii) habitat that is required for the survival of particular migratory species or to support globally significant concentrations or numbers of individuals of congregatory species
- iv) unique assemblages of species that cannot be found anywhere else
- v) areas that have key scientific value due to the evolutionary or ecological attributes present
- vi) areas that include biodiversity that has significant social, cultural, or economic importance to local communities
- vii) areas recognized as particularly important for the protection of ecosystem services (such as aquifer protection).



## Copper endemism in the Congolese flora: a database of copper affinity and conservational value of cuprophytes

Michel-Pierre Faucon<sup>1,2,6,7</sup>, Arthur Meersseman<sup>1,7</sup>, Mylor Ngoy Shutcha<sup>3</sup>, Grégory Mahy<sup>4</sup>,  
Michel Ngongo Luhembwe<sup>3</sup>, François Malaisse<sup>4</sup> & Pierre Meerts<sup>1,5\*</sup>

**Table 1 – Plant taxa strictly endemic of Cu-rich soil in Katanga, D.R.Congo (absolute metallophytes), with their IUCN status, habitat and number of sites.**

EX: extinct, CR: critically endangered, EN: endangered, VU: vulnerable, DD: data deficient. P: Primary habitats. S: Secondary habitats. S1 with substrate (often mine debris) disturbed and reworked by mining industry, S2: contaminated by atmospheric fallout from metal smelter

Taxon (accepted name and synonyms)	Family	Sites	IUCN red list status	Habitat
<i>Acalypha cupricola</i> W.Robyns ex G.A.Levin	Euphorbiaceae	51	(EN B2a + 3d)	P, S1
<i>Acalypha dikuluwensis</i> P.A.Duvign. & Dewit	Euphorbiaceae	1	EX	P
<i>Actiniopteris kornasii</i> Medwecka-Kornas	Pteridaceae	4	(CR B2a+(b(i,ii,iii,iv)))	P
<i>Aeollanthus saxatilis</i> P.A.Duvign. & Denaeyer	Lamiaceae	4	(CR B2a+(b(i,ii,iii,iv)))	P
<i>Basananthe cupricola</i> A.Robyns	Passifloraceae	1	EX	P
<i>Batopedina pulvinellata</i> Robbr. subsp. <i>glabrifolia</i> Robbr.	Rubiaceae	4	(CR B2a+(b(i,ii,iii,iv)))	P
<i>Bulbostylis fusiformis</i> Goetgh.	Cyperaceae	3	(CR B2a+(b(i,ii,iii,iv)+(c(iii))))	P, S1
<i>Cheilanthes inaequalis</i> (Kunze) Mett. var. <i>lanopetiolata</i> P.A.Duvign. ( <i>Notolaena inaequalis</i> Kunze var. <i>lanopetiolata</i> P.A.Duvign.)	Pteridaceae	1	(CR B1a+(b(i,ii,iii,iv)))	P
<i>Commelina mwatavamvoana</i> P.A.Duvign. & Dewit	Commelinaceae	2	(CR B2a+(b(i,ii,iii,iv)))	P

# BIODIVERSITY ACTION PLAN

## Tenke Fungurume Mining 2007-2018

**Tenke Fungurume Mining Sarl**



**Gembloux Agro Bio Tech – ULg  
Biodiversity and Landscape Unit**

**Belgian National  
Botanical Garden**

**Lubumbashi University  
Faculty of Agronomy**

**ULB**

**Lab Plant ecology and  
biogeochemistry**

**GxABt**

**Soil Science Unit**

**Institut polytechnique  
Beauvais La Salle, Fr**