SER 2016 Best Practice in Restoration
Freising Germany

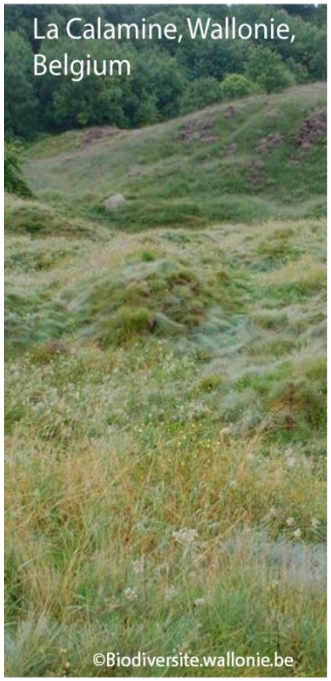
Gembloux Agro-Bio Tech
Université de Liège

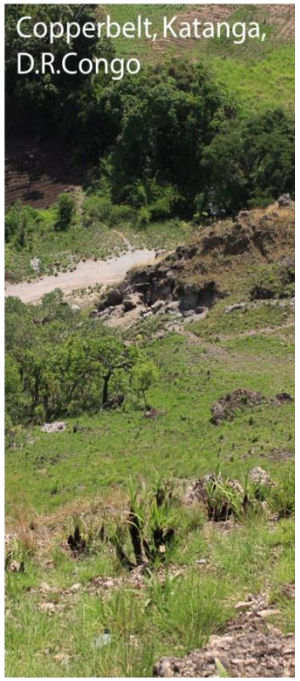
TENKE FUNGURUME Mining
An Affiliate of Freeport-McMoRan Copper & Gold

Is the observer effect significant in vegetation assessment of restored metallicolous grassland?

Sylvain Boisson & Grégory Mahy

Natural metallicolous grasslands





High distinctive plant species and community diversity

Small size

Extreme ecological conditions

Ecologically isolated

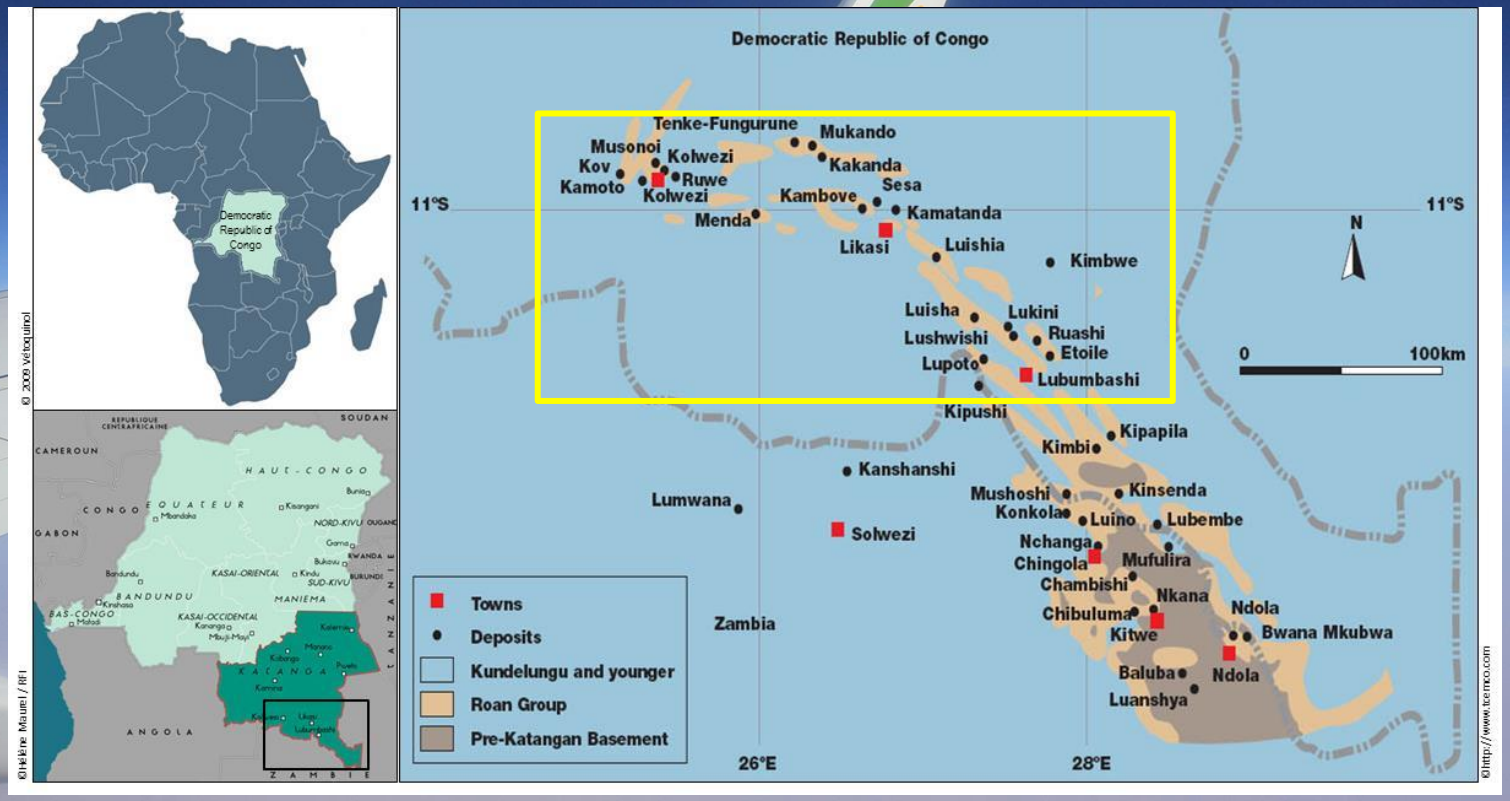
→ **Island process**

High genetic diversity

Speciation

→ Endemic and specialized species to metal and other constraints

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



The Copperbelt

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

Triumfetta likasiensis

Tinnea coerulea var. *obovata*

species

Endemic

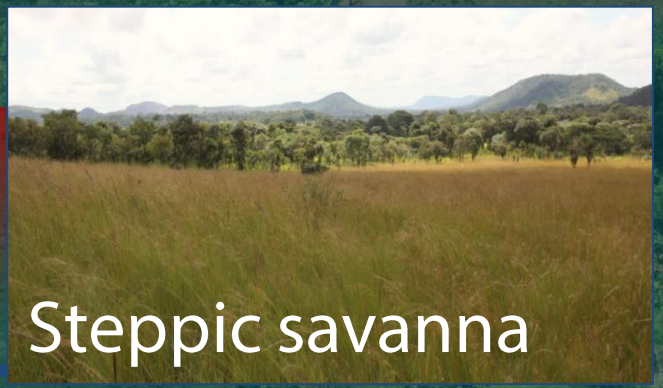
Sopubia neptunii

Commelina zigzag

form

of life

Diversity



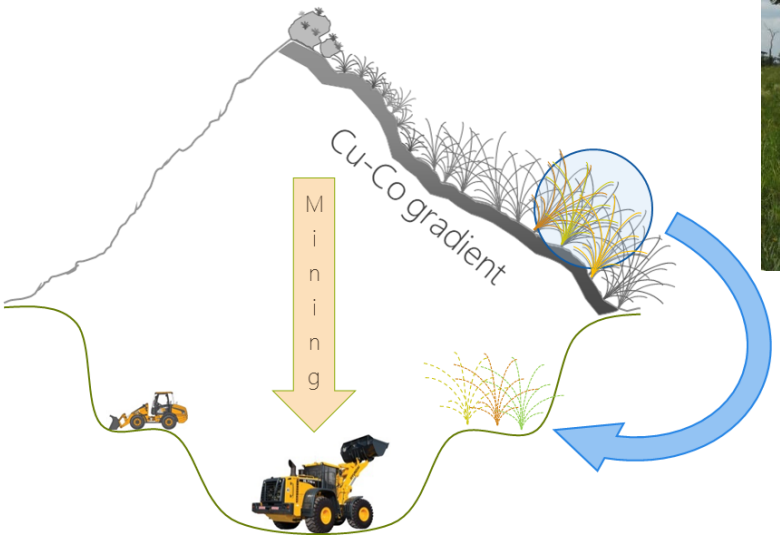
Cu (ppm)	100	10 000
Co (ppm)	1	1000

Saad et al. 2012
Séleck et al. 2013
Ilunga wa Ilunga et al 2013
Faucon et al 2016

Mining activities

Ecosystem reconstruction

Le Stradic et al In prep

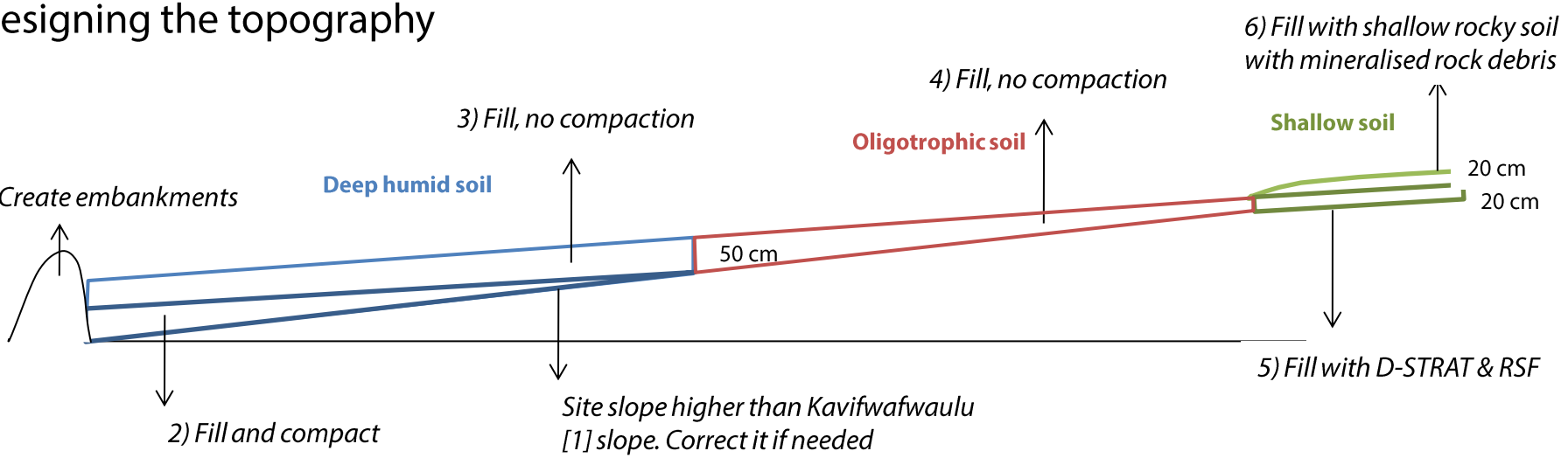


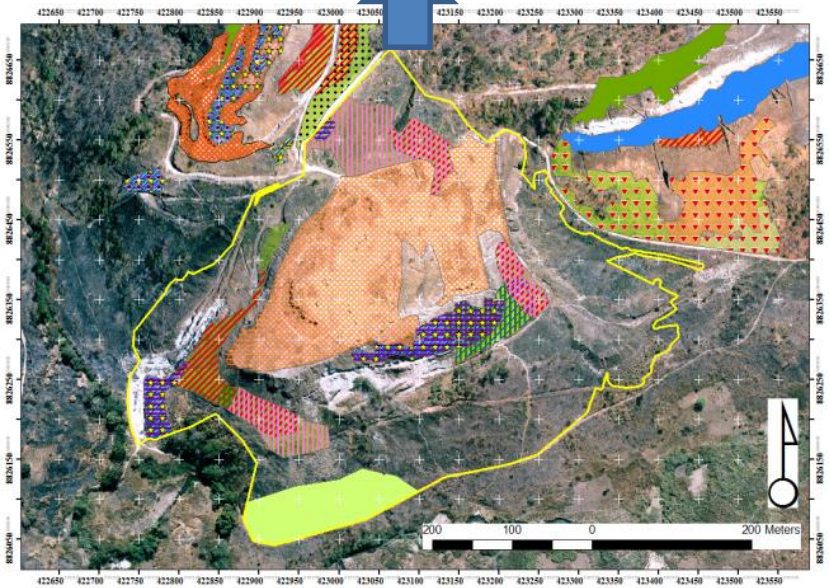
Natural metallicolous grassland

« Restored » metallicolous grassland

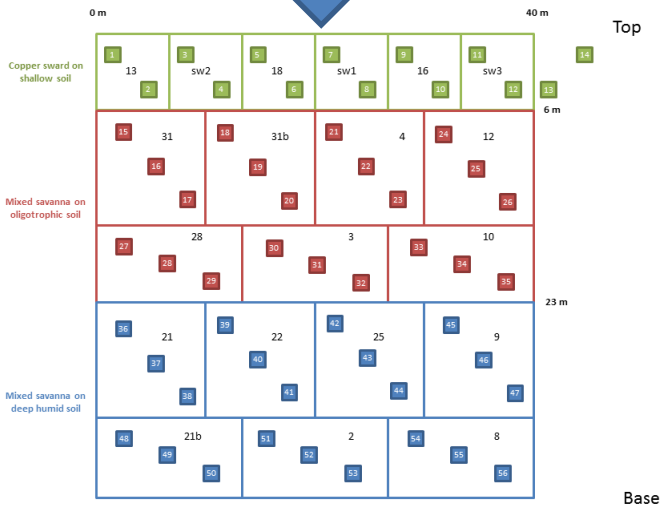
Ecosystem reconstruction – How?

Designing the topography



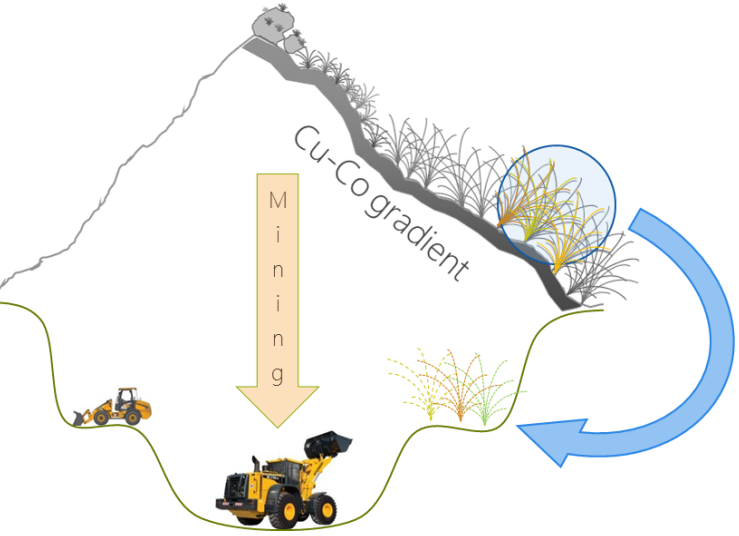


Mapping the natural plant communities



Mapping the restored plant communities

Ecosystem reconstruction – How?



Ecosystem reconstruction – The results

Ecosystem restoration process

To continue actions
If needed

Success

Time

Restored ecosystem

To monitor the restored ecosystem

To evaluate actions

To study the reference ecosystem

Degraded ecosystem

To perform actions

Ecosystem restoration process

Time

To continue actions
If needed

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To evaluate actions

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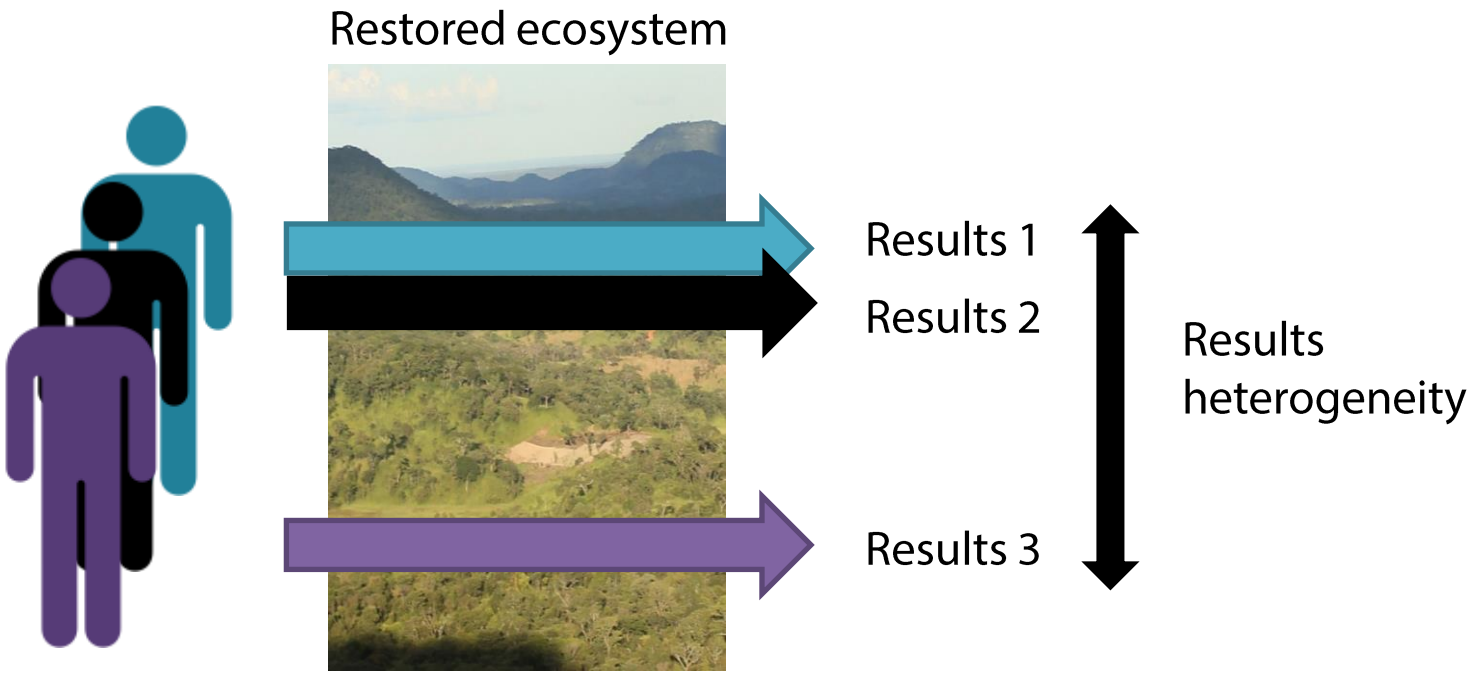
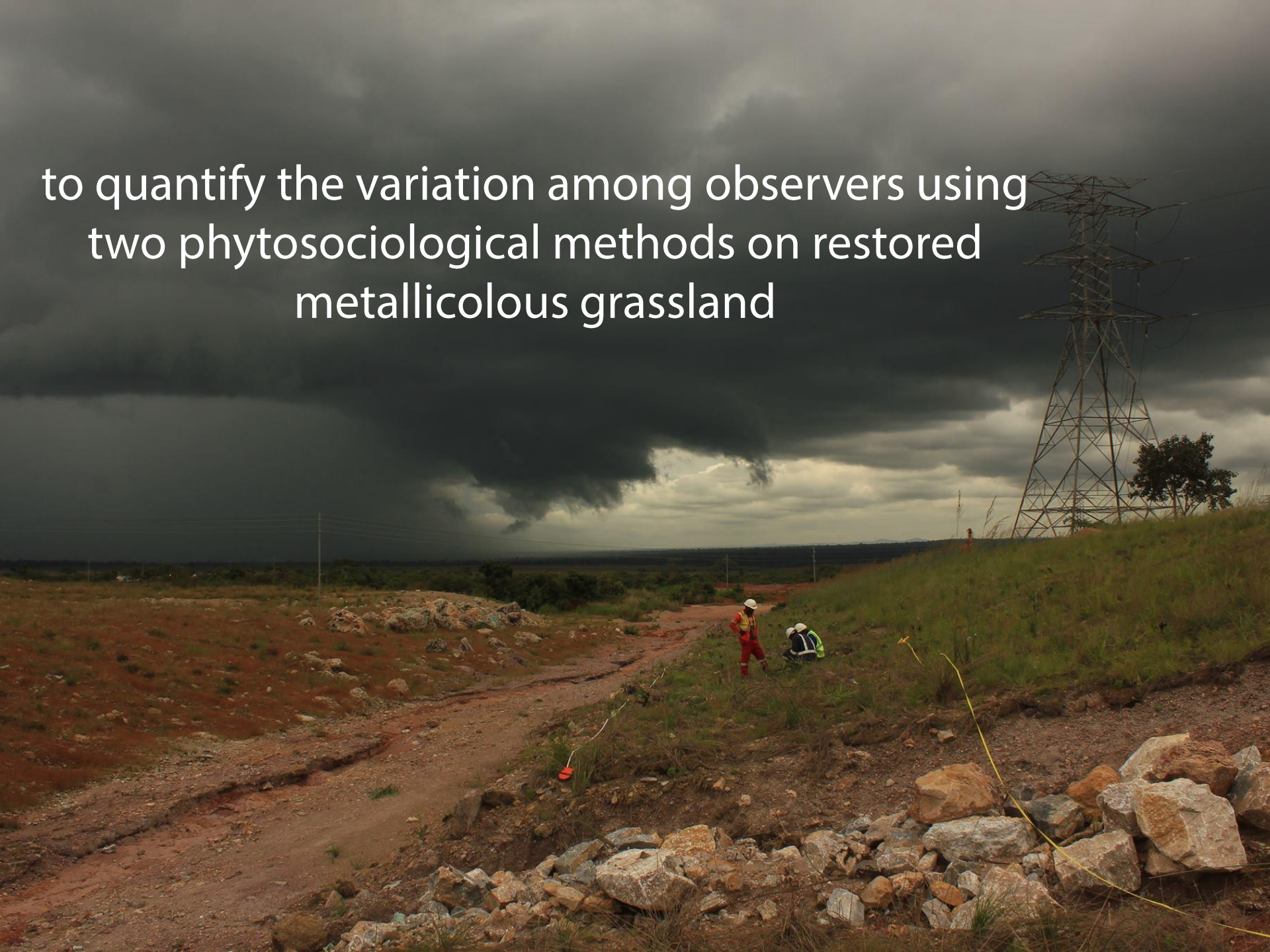
Degraded ecosystem

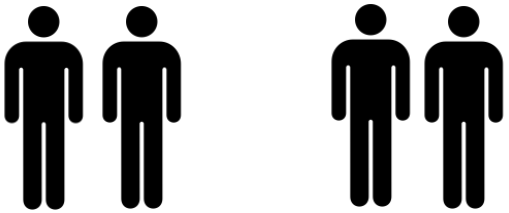
To perform actions

Differents workers = different results ?




to quantify the variation among observers using two phytosociological methods on restored metallicolous grassland

Experimental design



From environmental departement

X

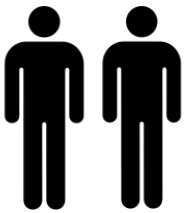
X

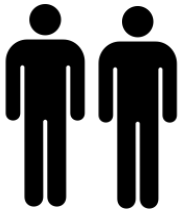
2 Vegetation units : steppe and steppic savannah

X

3 replicates =
3 permanent quadrat (1m^2)

Measures and statistical analysis





Detailled vegetation survey

Simplified vegetation survey

Quadrat-scale measures

Maximum height of vegetation
% cover grasses
% cover rocks
% of bare soil
Number of species
Number of endemic species

Other measures

+ Species list (% cover/sp)

Time was measured for each quadrat and observer

To compare parameters values between the observers → ANOVA

To compare the similarity of the species list → Correspondance analysis

Results and discussion – Quadrats parameters

	Observer (4)		Vegetation unit		Interaction	
	F	p-value	F	p-value	F	p-value
Vegetation height	0.87	0.457	92.22	**<0.001**		
% Grass	5.67	**<0.01**	22.8	**<0.001**		
% Bare soil					6.96	**<0.001**
% Rocks					3.25	**< 0.05**
Number of species	0.21	0.887	77.25	**<0.001**		
Number of endemic species	0.56	0.643	39.54	**<0.001**		

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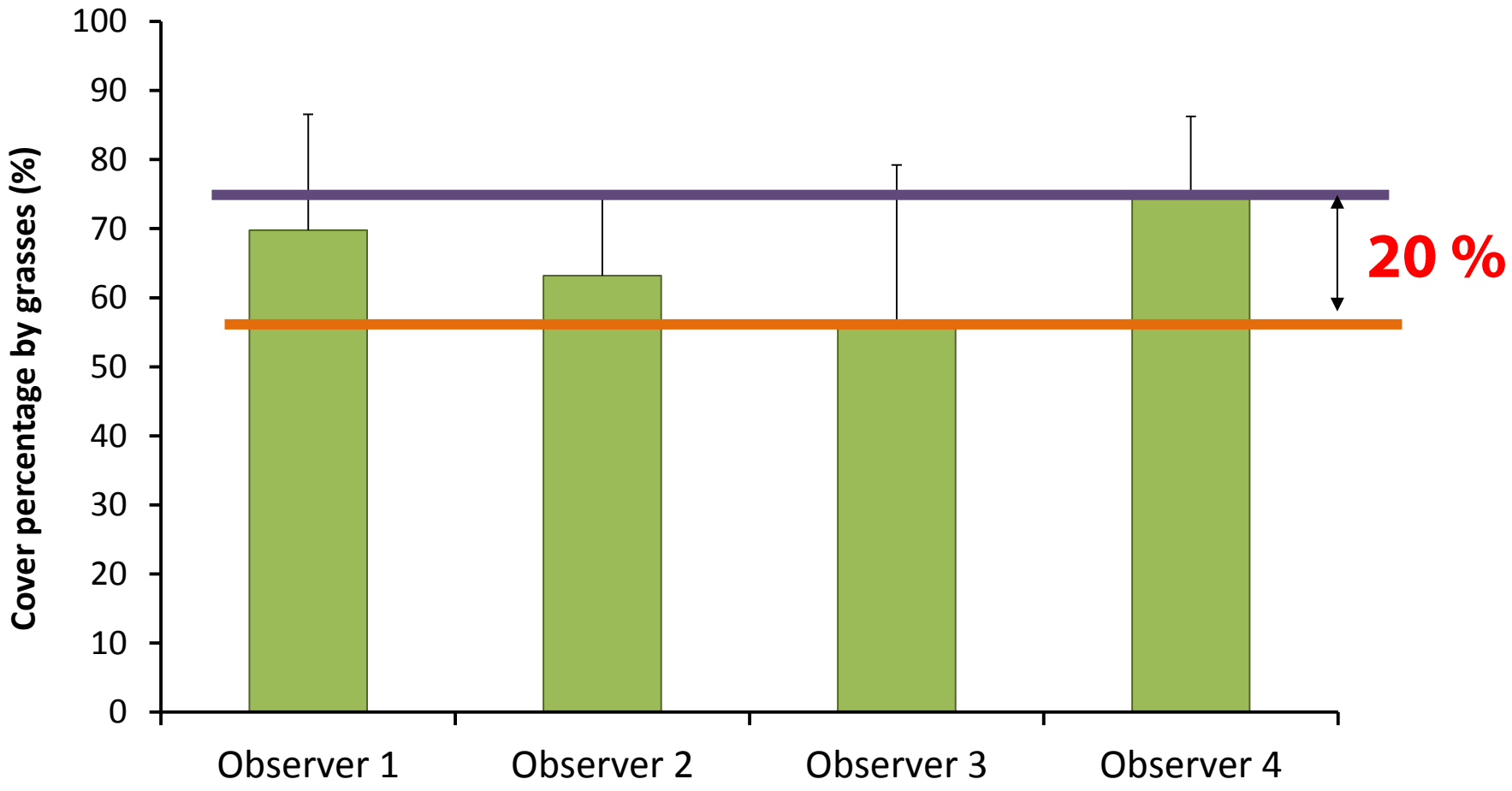
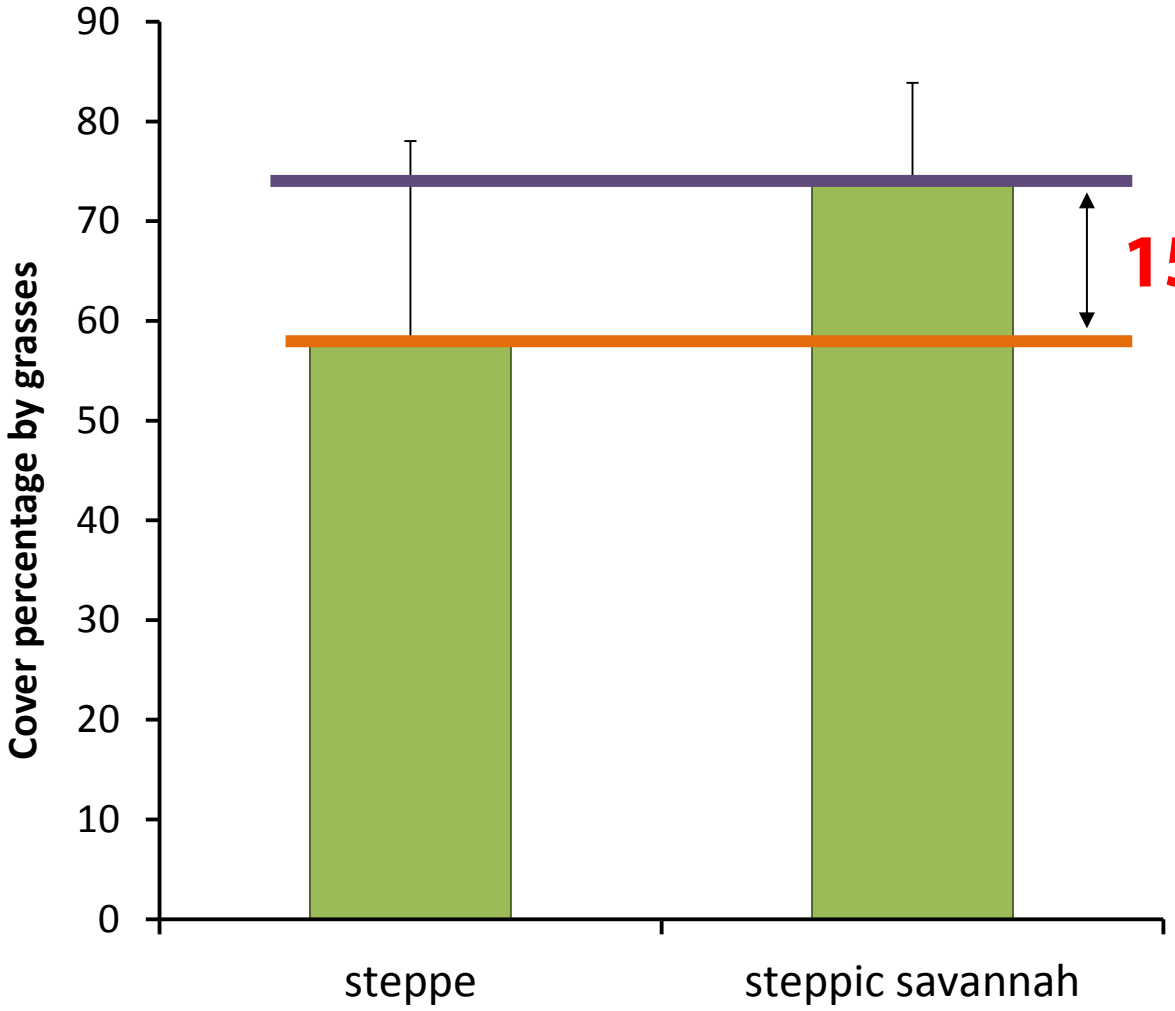
Methodology used for the measure of the percentage of cover lead to heterogenous results

Results and discussion – % cover by grasses



Results and discussion – % cover by grasses



20 % variation between observers

15 % variation between vegetation units

~ same range of variation !

Results and discussion – Vegetation units had been highlighted

	Observer (4)		Vegetation unit		Interaction	
	F	p-value	F	p-value	F	p-value
Vegetation height	0.87	0.457	92.22	**<0.001**		
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Number of species	0.21	0.887	77.25	**<0.001**		
Number of species of concern	0.56	0.643	39.54	**<0.001**		

Even if differences had been highlighted between observers, measures permitted to distinguish steppic savannah and steppe

Results and discussion – Vegetation units had been highlighted

Steppe (High metal concentrations in soils)

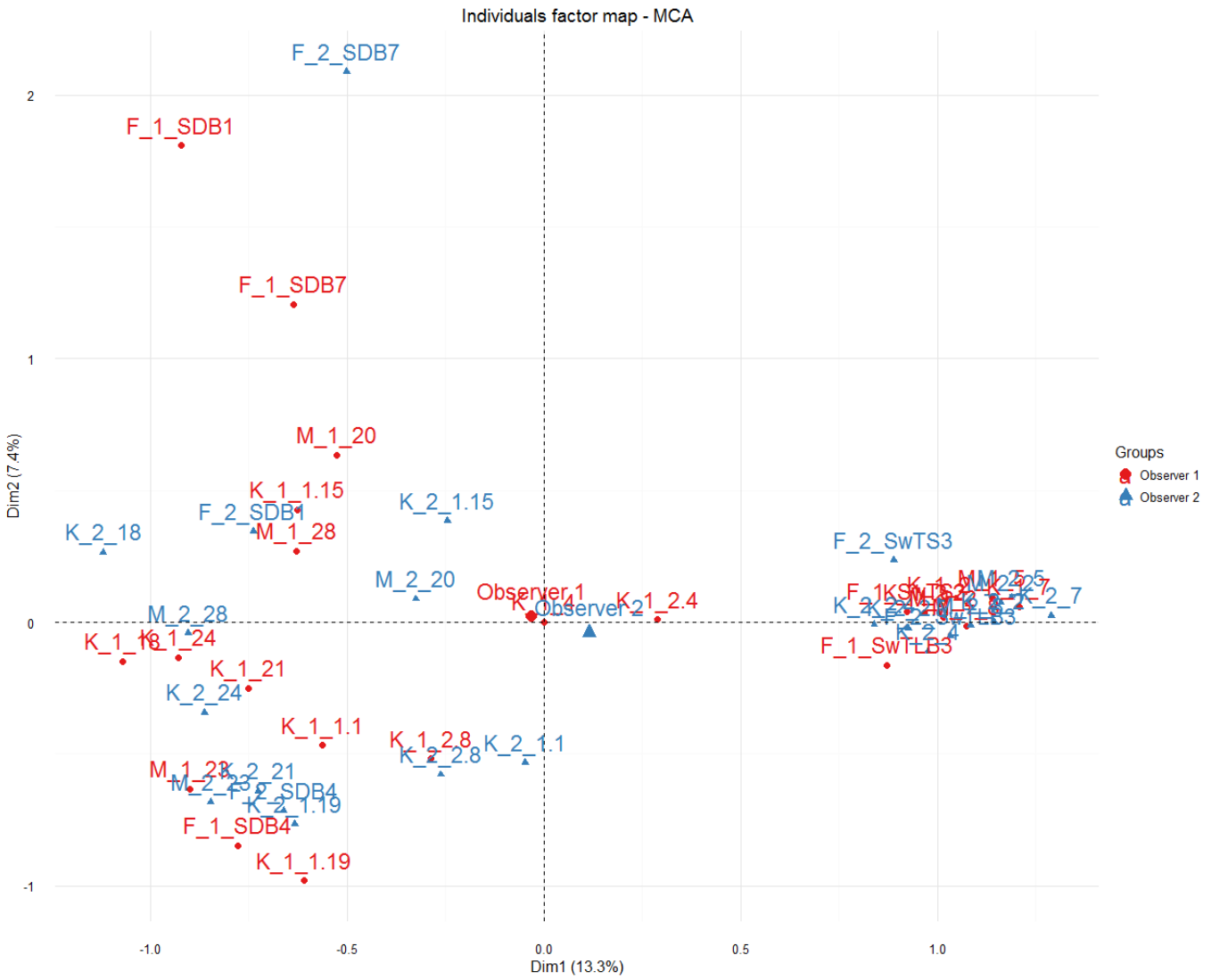
Low vegetation height
High % of bare soil
High % of rocks
Low % of grasses
Low number of species
Great number of endemic species

Steppic savannah (Low metal concentrations in soils)

High vegetation height
Low % of bare soil
Low % of rocks
High % of grasses
High number of species
Low number of endemic species

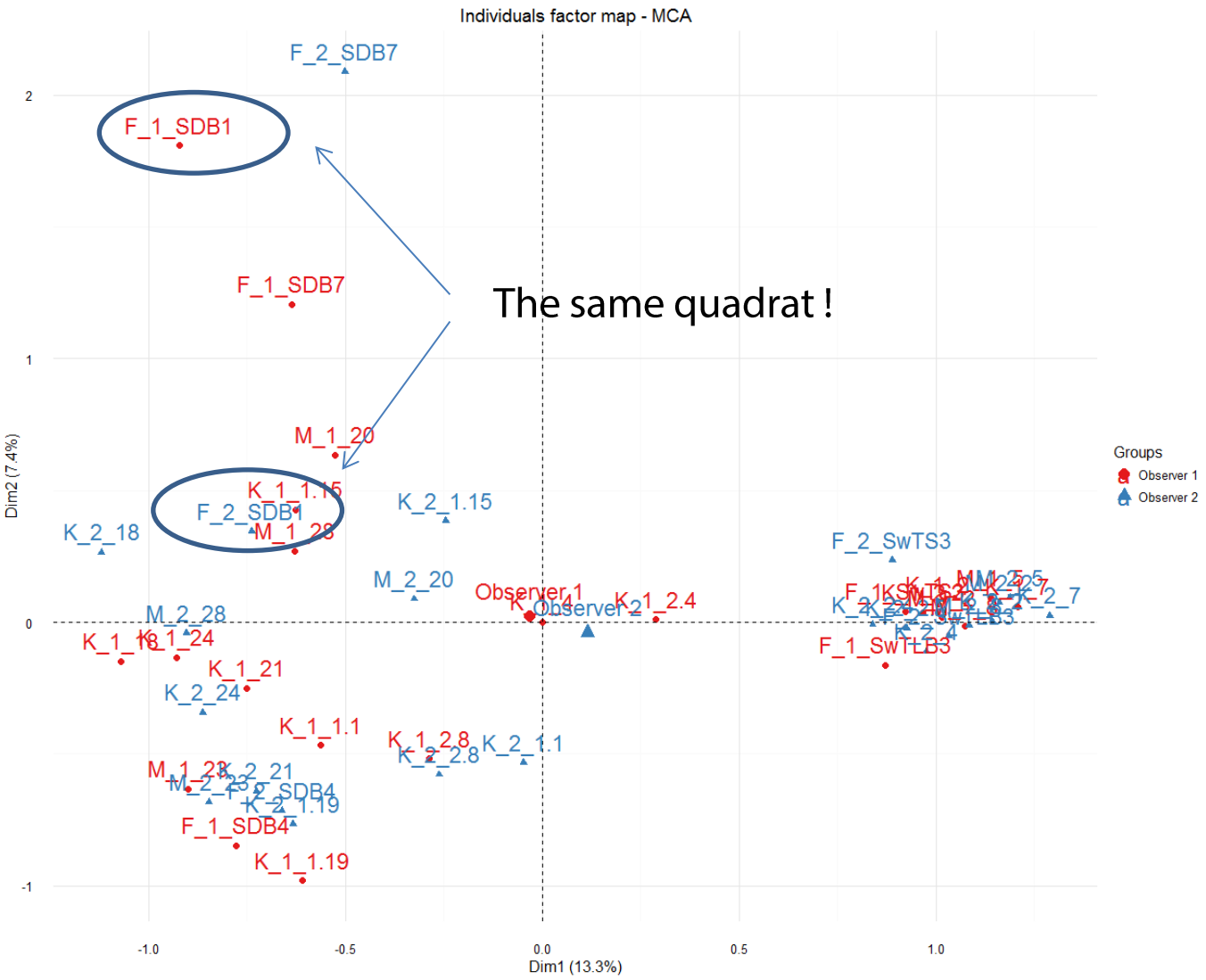
Results and discussion – Focus on the species lists

Correspondance analysis of the quadrats composition grouped by observers



Results and discussion – Focus on the species lists

Correspondance analysis of the quadrats composition grouped by observers



Results and discussion – Detailed species list

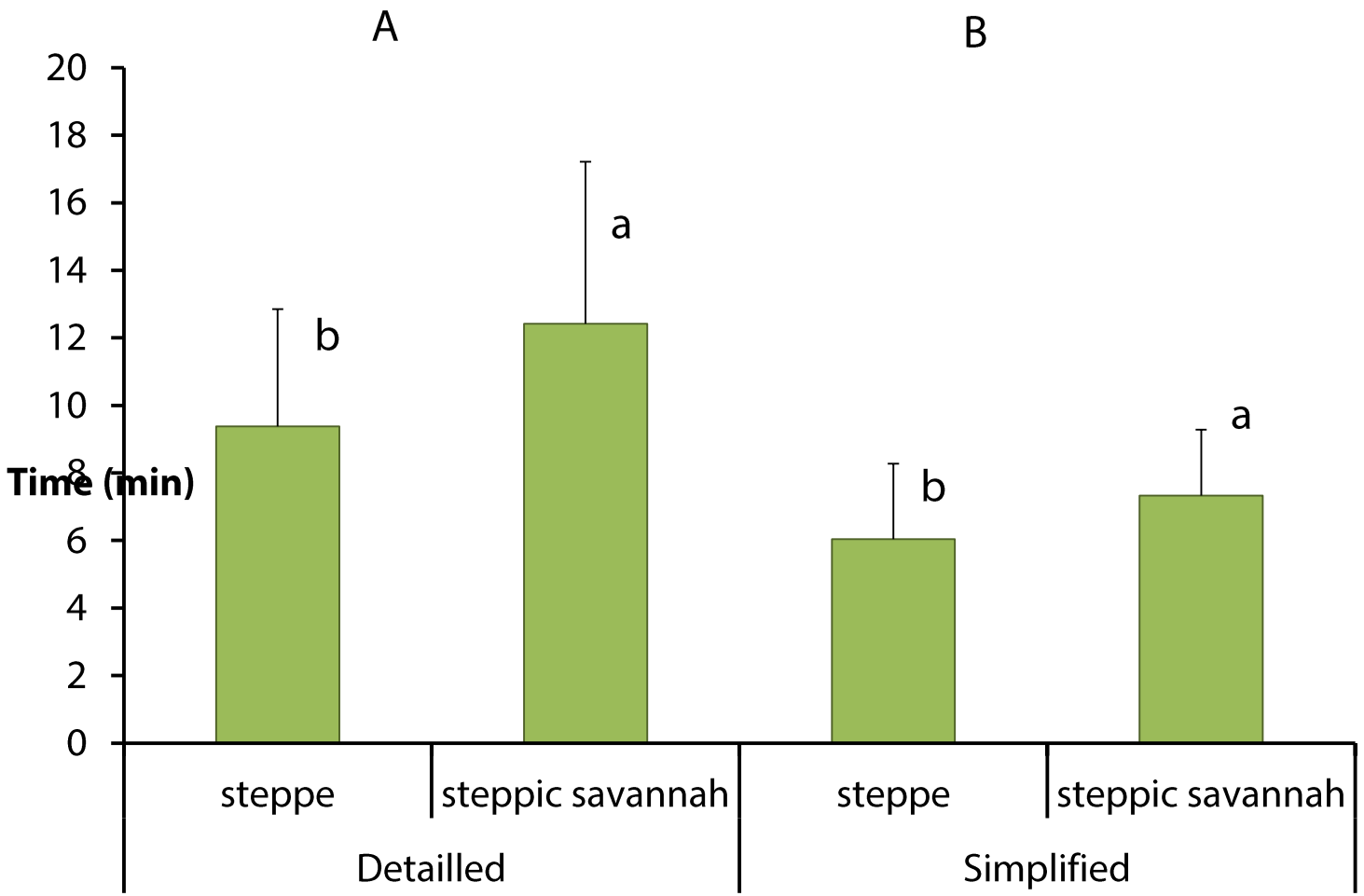
% of cover		Quadrat SDB 1	
		Observer 1	**Observer 2**
Endemic species	Bul_cup	1.5	5
	Gla_led	0.1	0
	Dip_mar	20	3
	Eup_cup	5	10
Other species	**Hau_ros**	0	2
	All_sem	0	2
	Bra_ser	25	10
	Cha_pra	1	0
	cf_Com_vel	5	0
	Cra_rub	0	1
	Cry_mar	15	4
	Dig_dia	15	4
	Hau_pre	3	0
	Hyp_dip	0	2
	Gla_gre	2.5	1
	Mic_kun	2	0
	Mon_cer	0	3
	Rhy_rot	10	0
	Tra_spi	50	0
	Tri_beq	30	30
	Dip_mar	20	3
	Eup_cup	5	10
	End_dis	2	0
	Mic_alt	15	0
	Dic_ano	4	0
	Ast_rud	1	4
TOTAL		**21**	**16**

11 species were identified by both observers

15 species were not identified by the observer 1 or 2

1 species had the same % of cover

Results and discussion – Time / method and vegetation



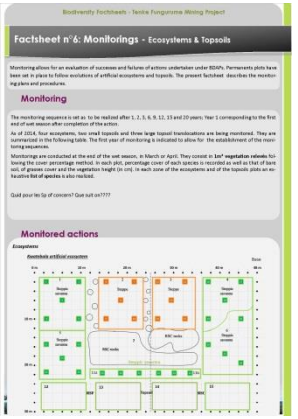
Conclusion – Recommendations

→Study highlights that measures taken by distinct observers could be heterogenous

→Large differences between vegetation units can be observed

→Problem in species identification/observation

- To create comprehensive factsheets with methods


Factsheet n°6: Monitorings - Ecosystems & Topsoils

Monitoring

Monitored actions

- To perform a support on field
  - For method
  - For species identification (Guide?)

- To create a quality assessment method for the protocols and the learning

Conclusion – Recommendations

- The simplified method take less time
  - → Useful at large scale
  - → But do not permit to know the species
- What is the impact of the error between years?


Thank you!