# Trees communities and filters to restoration along a periurban gradient of tropical forest degradation.

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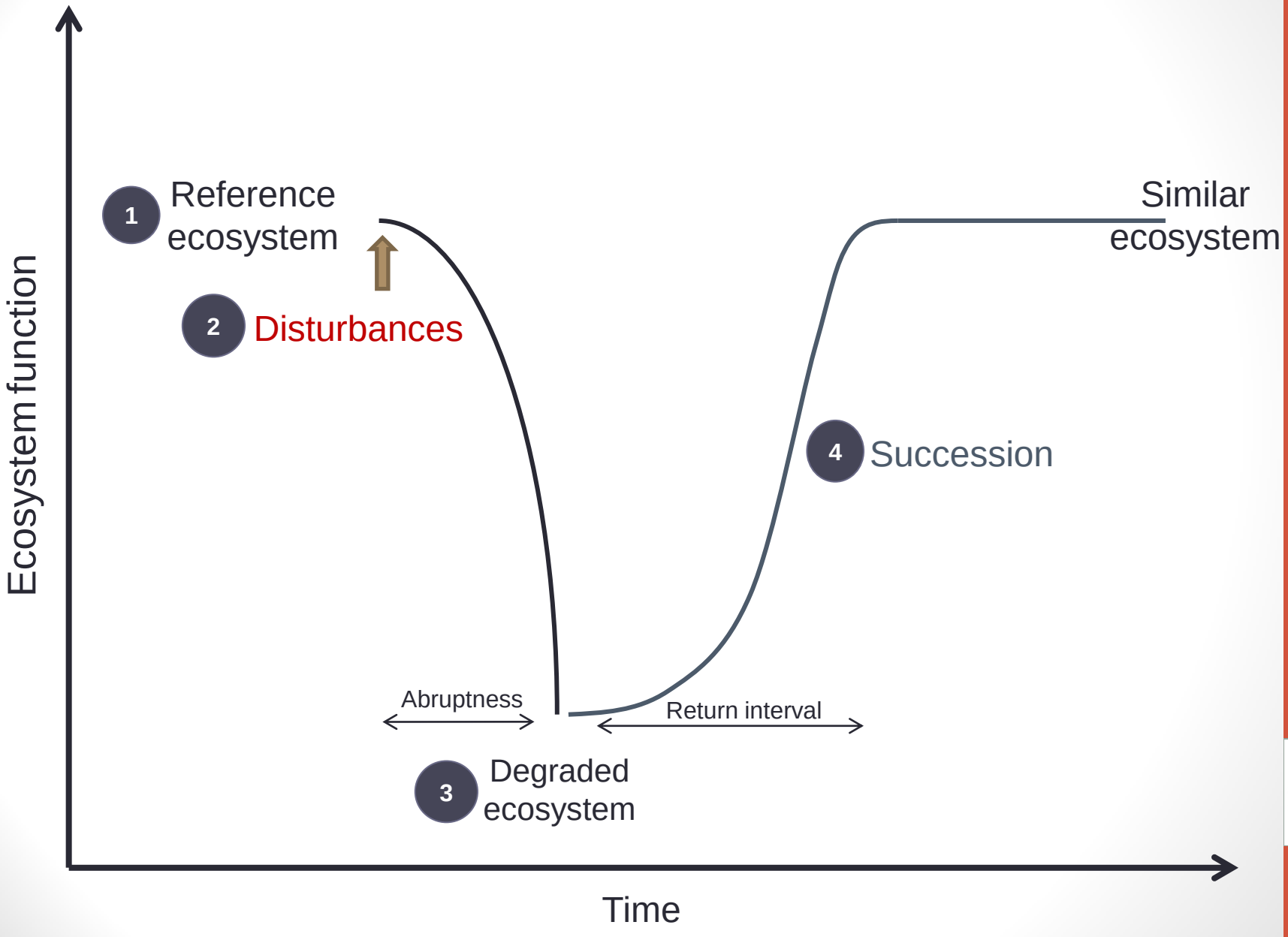
# GENERAL CONCEPTS

# • General concepts



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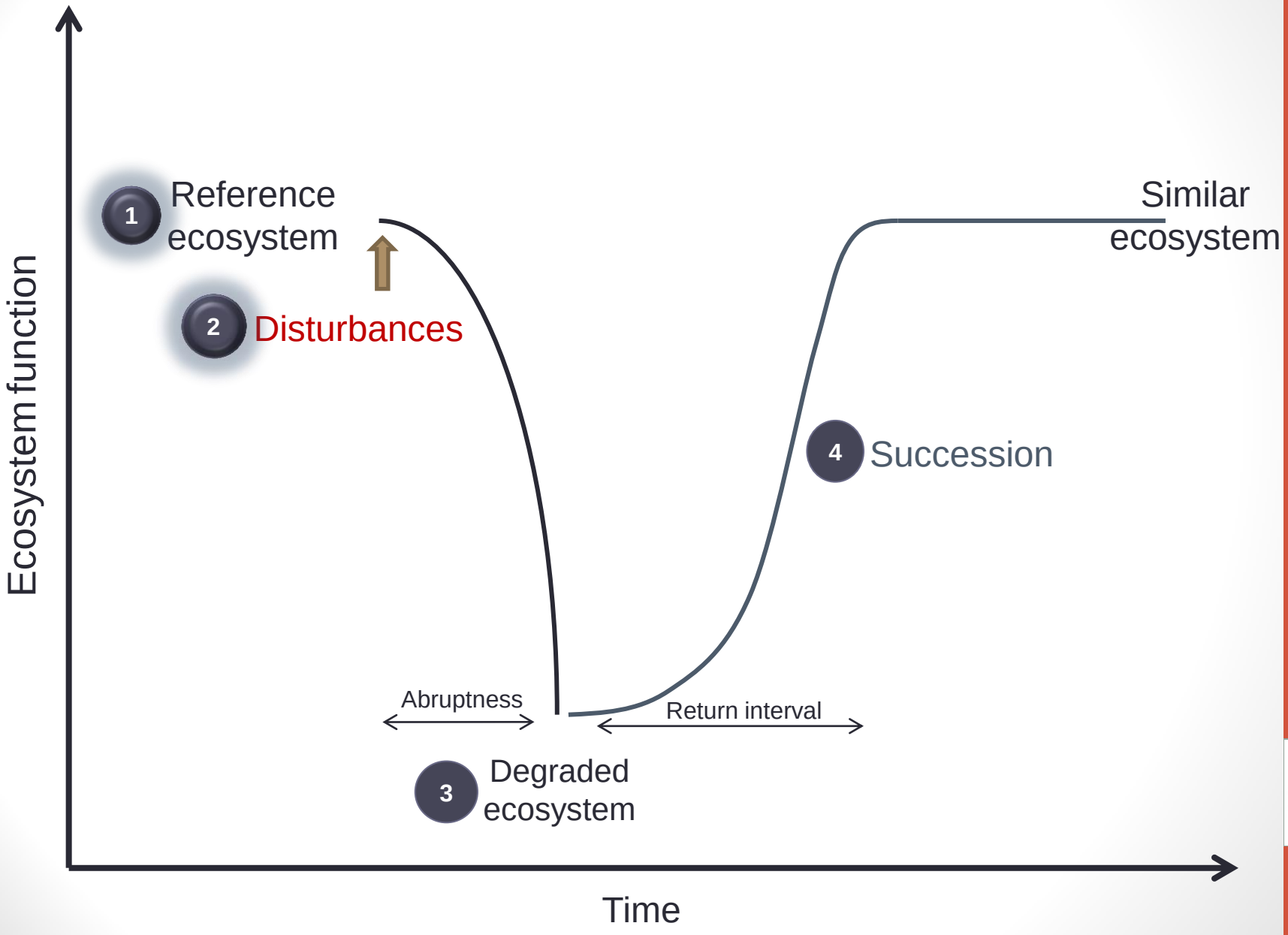
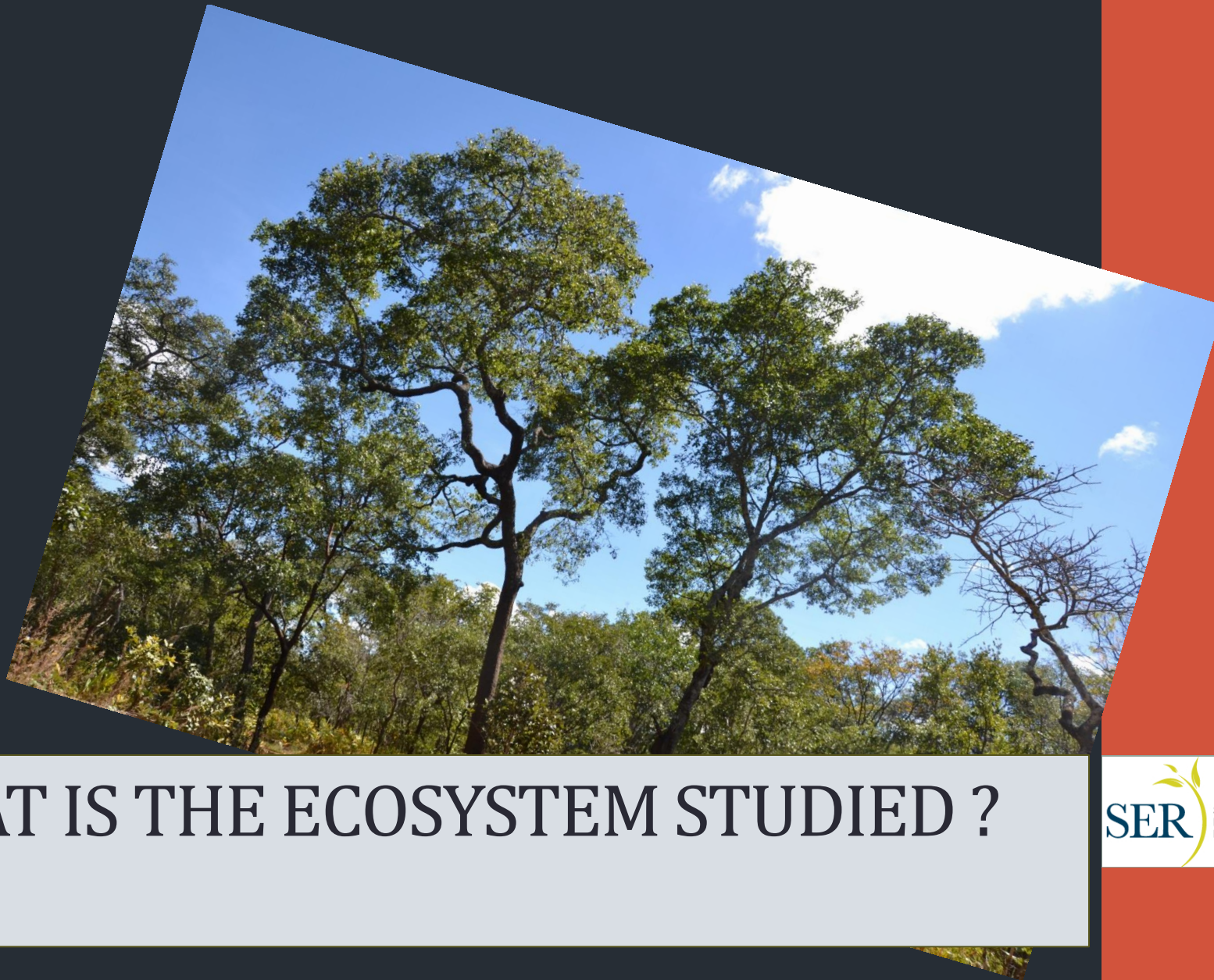
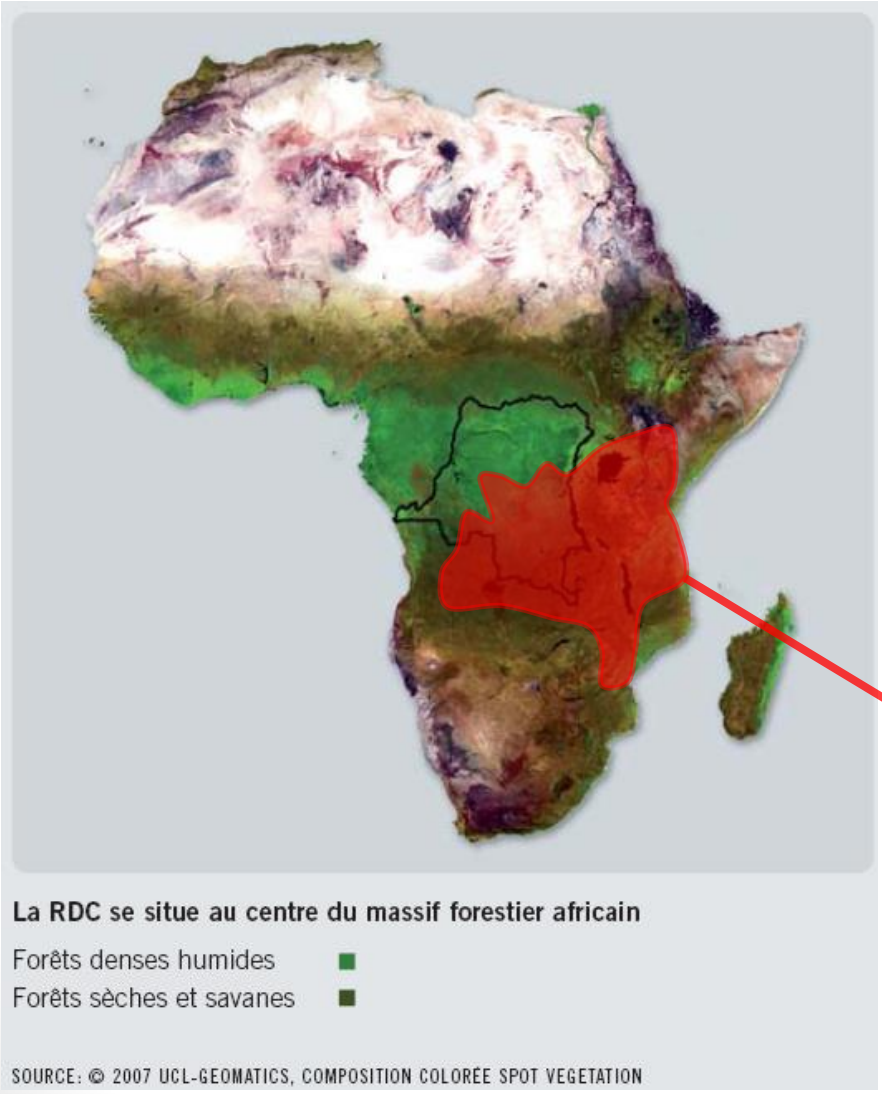


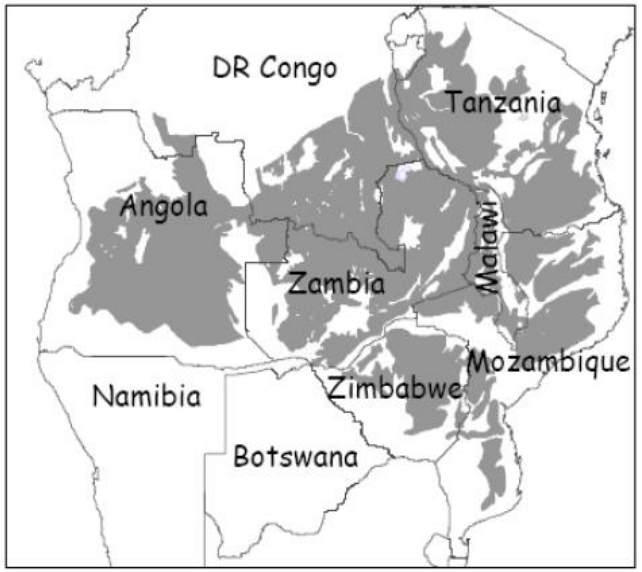


# WHAT IS THE ECOSYSTEM STUDIED ?

# • Focused ecosystem : « Miombo »




In Centro-southern Africa miombo is widespread and covers 2.7 million km$^2$ spread over seven countries :




Miombo's distribution (White 1983)

# • Focused ecosystem : « Miombo »



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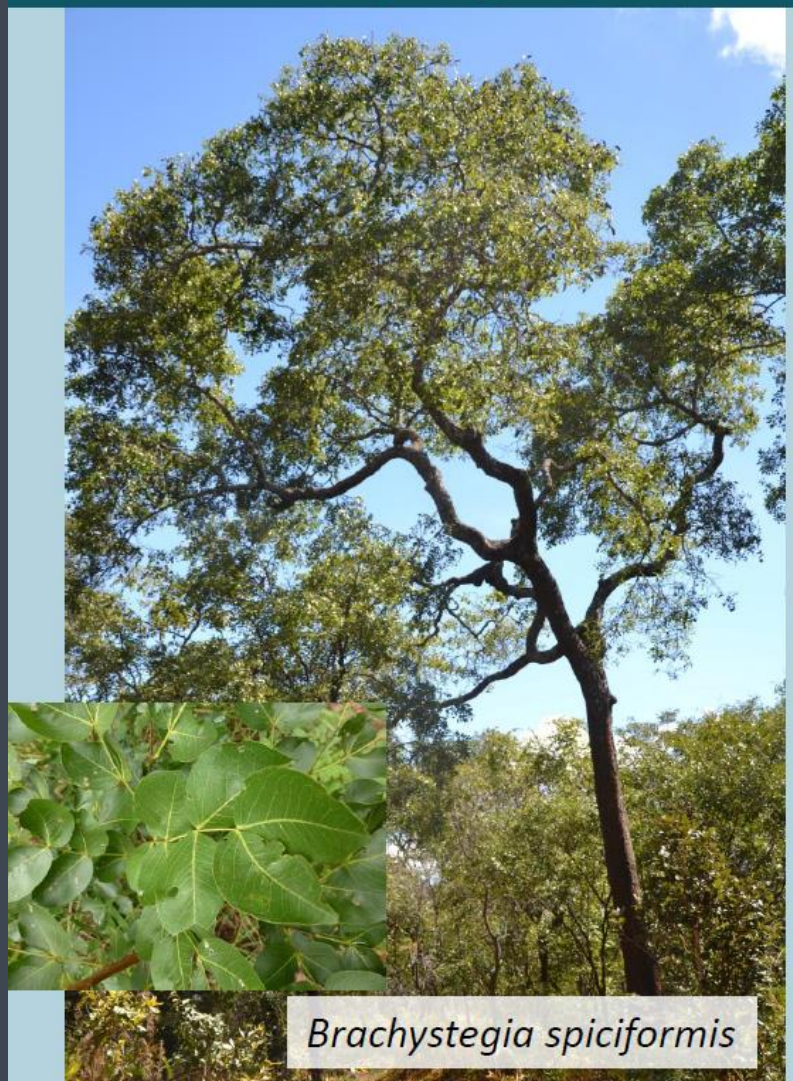
Dominance of Fabaceae, subfamily Caesalpinioideae

*« Brachystegia – Isoberlinia – Julbernardia »*



*Brachystegia spiciformis*

*Brachystegia longifolia*

# • Focused ecosystem : « Miombo »

Dominance of Fabaceae, subfamily Caesalpinioideae

*« Brachystegia – Isoberlinia – Julbernardia »*

*Julbernardia paniculata*

*Julbernardia globiflora*

# • Focused ecosystem : « Miombo »


*1956*

*Miombo = **85%***

*Pop = 100.000*

*2009*

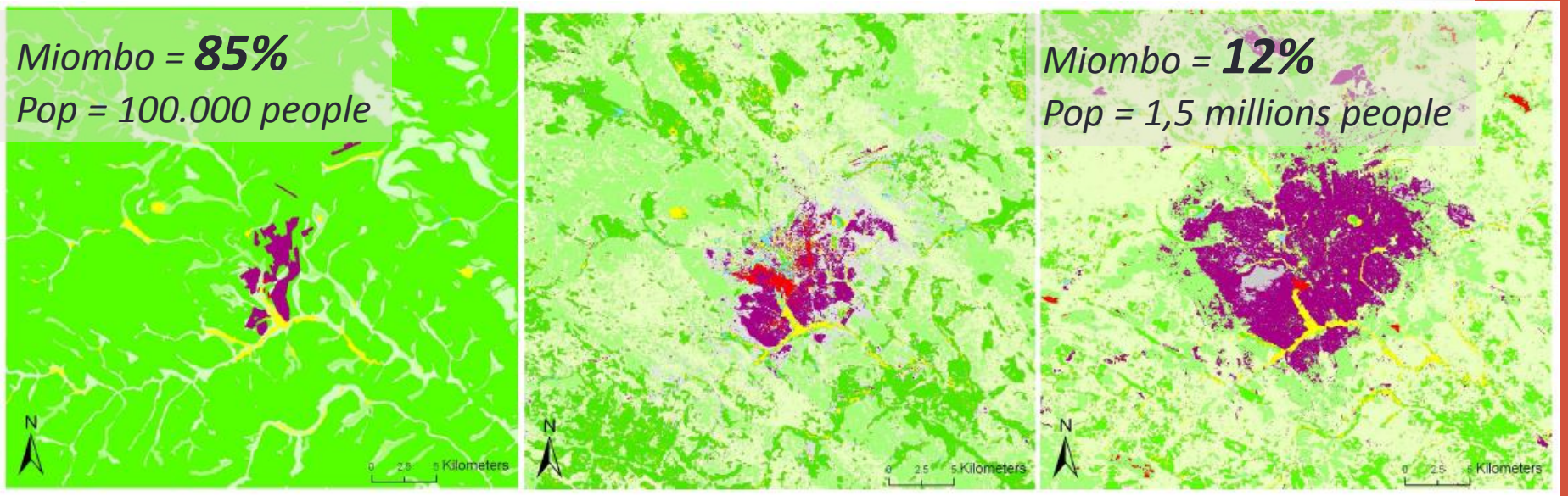
*Miombo = **12%***

*Pop = 1,5 millions hab*

Principal disturbance = cutting

# • Focused ecosystem : « Miombo »

1956 | 1984 | 2009

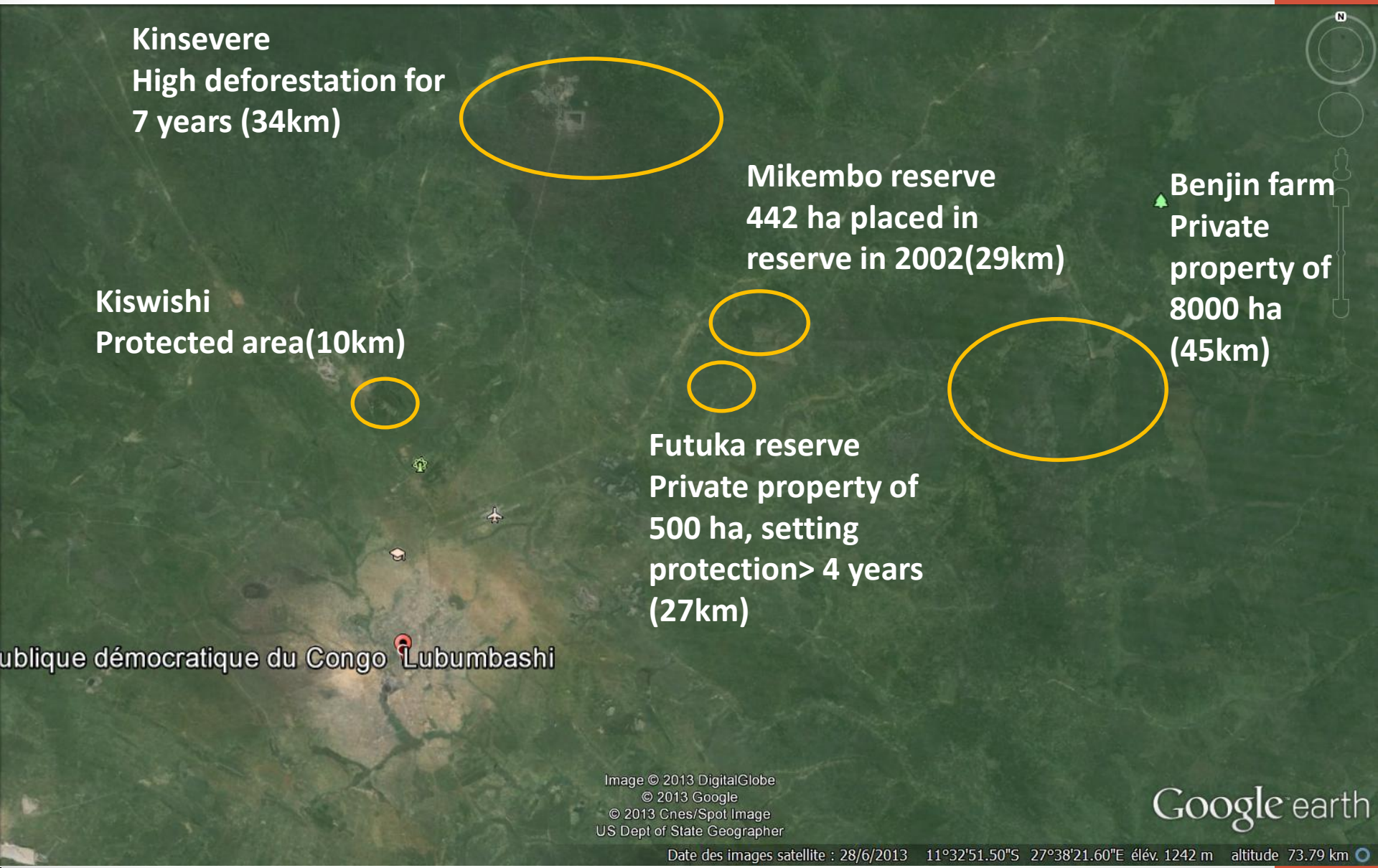



Miombo

Lubumbashi

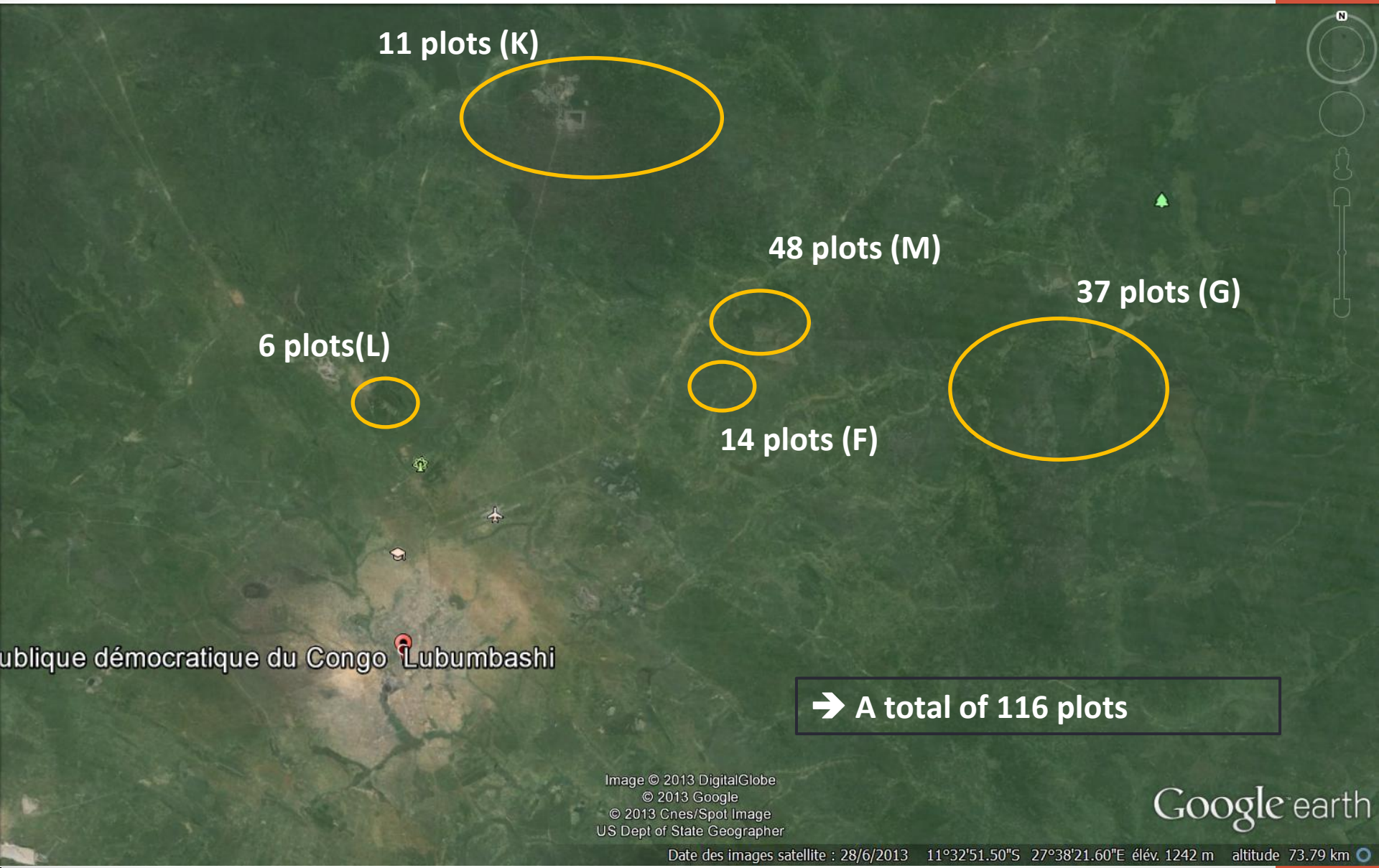
Munyemba Kankumbi F. (2010)

# • Méthodoly


Kinsevere
High deforestation for 7 years (34km)
Mikembo reserve 442 ha placed in reserve in 2002(29km)
Benjin farm Private property of 8000 ha (45km)
Kiswishi
Protected area(10km)
Futuka reserve
Private property of 500 ha, setting protection> 4 years (27km)
ublique démocratique du Congo
Lubumbashi
Image © 2013 DigitalGlobe
© 2013 Google
© 2013 Cnes/Spot Image
US Dept of State Geographer
Google earth
Date des images satellite : 28/6/2013 11°32'51.50"S 27°38'21.60"E élév. 1242 m altitude 73.79 km

# • Méthodoly

## Stratified sampling



# • Méthodoly

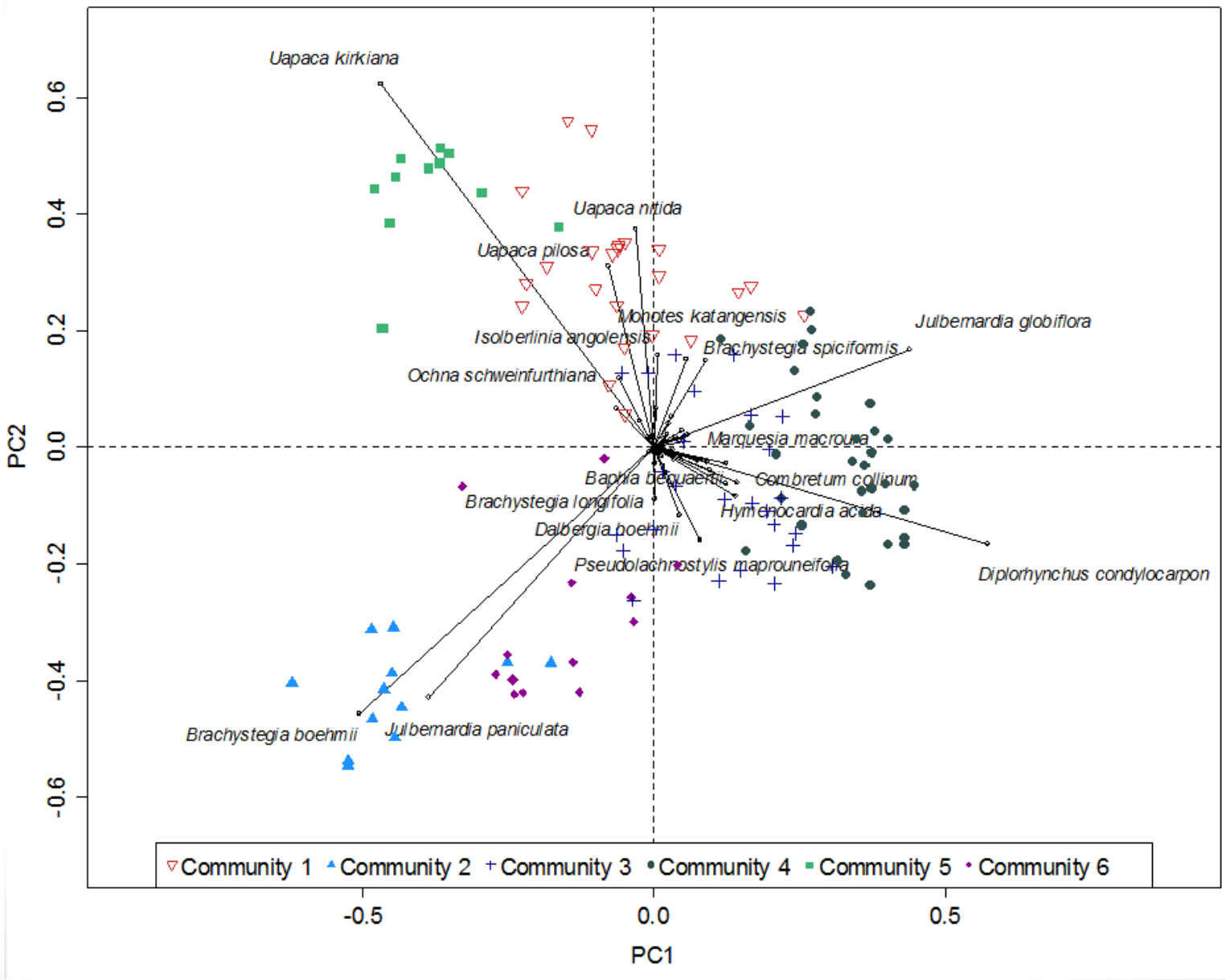
- **circular plots** of 18 m radius (10 acres)

On each plot:

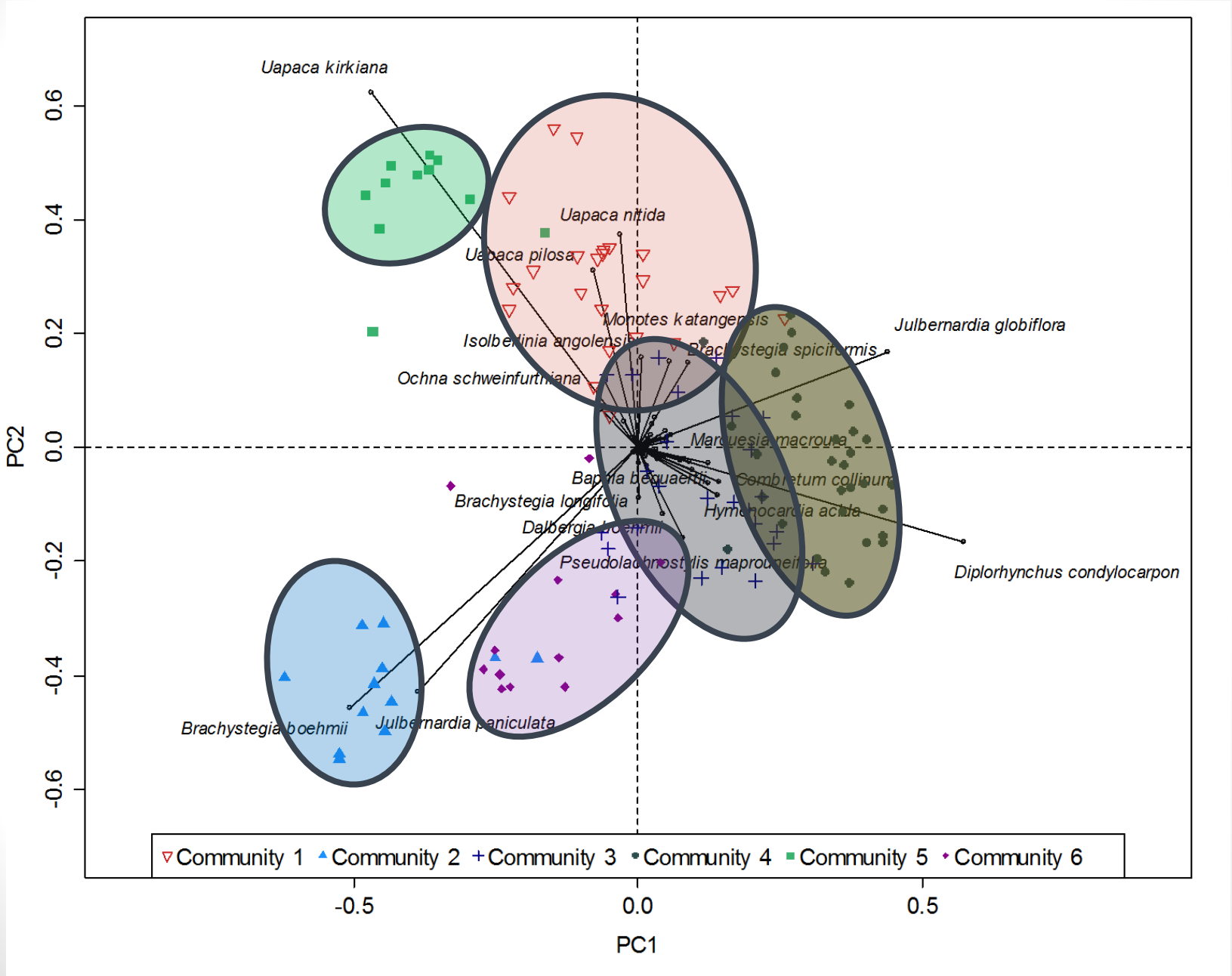
- Identification of all species of tree diameter> 2 cm (1.3 m dbh)
- Physical description of the soil
- Composite soil sample (20cm deep) for chemical analysis

| P | K | Mg | Na | Ca | pH KCl | C | Mn | N |
|---|---|---|---|---|---|---|---|---|

# • Results


Uapaca kirkiana
Uapaca nitida
Uapaca pilosa
Monotes katangensis
Julbernardia globiflora
Isolberlinia angolensis
Brachystegia spiciformis
Ochna schweinfurthiana
Marquesia macroura
Baphia bequaertii
Combretum collinum
Brachystegia longifolia
Hymenocardia acida
Dalbergia boehmii
Pseudolachnostylis maprouneifolia
Diplorhynchus condylocarpon
Brachystegia boehmii
Julbernardia paniculata
Community 1
Community 2
Community 3
Community 4
Community 5
Community 6
PC1
PC2
-0.5
0.0
0.5
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6

# • Results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PC1
PC2
-0.5
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0.5
-0.6
-0.4
-0.2
0.0
0.2
0.4
0.6

# • Results

COMMUNITY 1 :

Indicator species = *Uapaca nitida, Monotes katangensis, Uapaca pilosa*

Dominant species = *Uapaca nitida, Uapaca pilosa, Julbernardia globiflora*

COMMUNITY 2

*Lannea discolor, Brachystegia boehmii, Annona senelagensis* = Indicator species

*Brachystegia boehmii, Julbernardia paniculata, P. maprouneifolia* = Dominant species

COMMUNITY 3 :

Indicator species = *Anisophyllea boehmi, Syzygium guineense, Marquesia macroura*

Dominant species = *D. condylocarpon, Baphia bequaertii, Marquesia macroura*

COMMUNITY 4

*Julbernardia globiflora, Brachystegia taxifolia* = Indicator species

*Julbernardia globiflora, D. condylocarpon, Dalbergia boehmii* = Dominant species

COMMUNITY 5 :

Indicator species = *Uapaca kirkiana, Olax obtusifolia*

Dominant species = *Uapaca kirkiana, Ochna schweinfurthiana, Uapaca nitida*

COMMUNITY 6

*D. condylocarpon, P. maprouneifolia, Julbernardia paniculata* = Indicator species

*Julbernardia paniculata, D. condylocarpon, P. maprouneifolia* = Dominant species

# • Results

COMMUNITY 1 :

Indicator species = ***Uapaca nitida***, *Monotes katangensis*, ***Uapaca pilosa***

Dominant species = ***Uapaca nitida***, ***Uapaca pilosa***, *Julbernardia globiflora*

COMMUNITY 2

*Lannea discolor*, ***Brachystegia boehmii***, *Annona senelagensis* = Indicator species

***Brachystegia boehmii***, *Julbernardia paniculata*, *P. maprouneifolia* = Dominant species

COMMUNITY 3 :

Indicator species = *Anisophyllea boehmi*, *Syzygium guineense*, ***Marquesia macroura***

Dominant species = *D. condylocarpon*, *Baphia bequaertii*, ***Marquesia macroura***

COMMUNITY 4

***Julbernardia globiflora***, *Brachystegia taxifolia* = Indicator species

***Julbernardia globiflora***, *D. condylocarpon*, *Dalbergia boehmii* = Dominant species

COMMUNITY 5 :

Indicator species = ***Uapaca kirkiana***, *Olax obtusifolia*

Dominant species = ***Uapaca kirkiana***, *Ochna schweinfurthiana*, *Uapaca nitida*

COMMUNITY 6

***D. condylocarpon, P. maprouneifolia, Julbernardia paniculata*** = Indicator species

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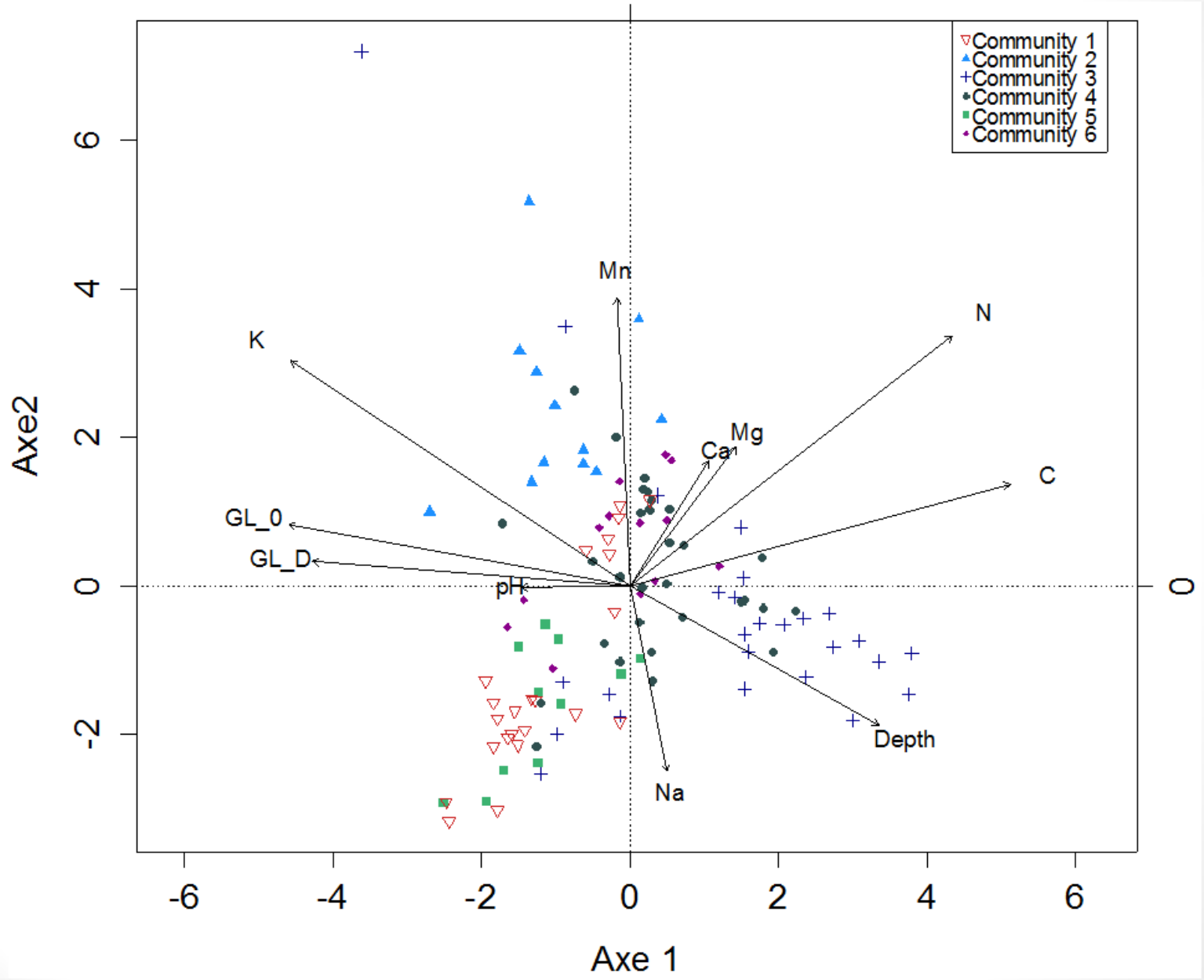
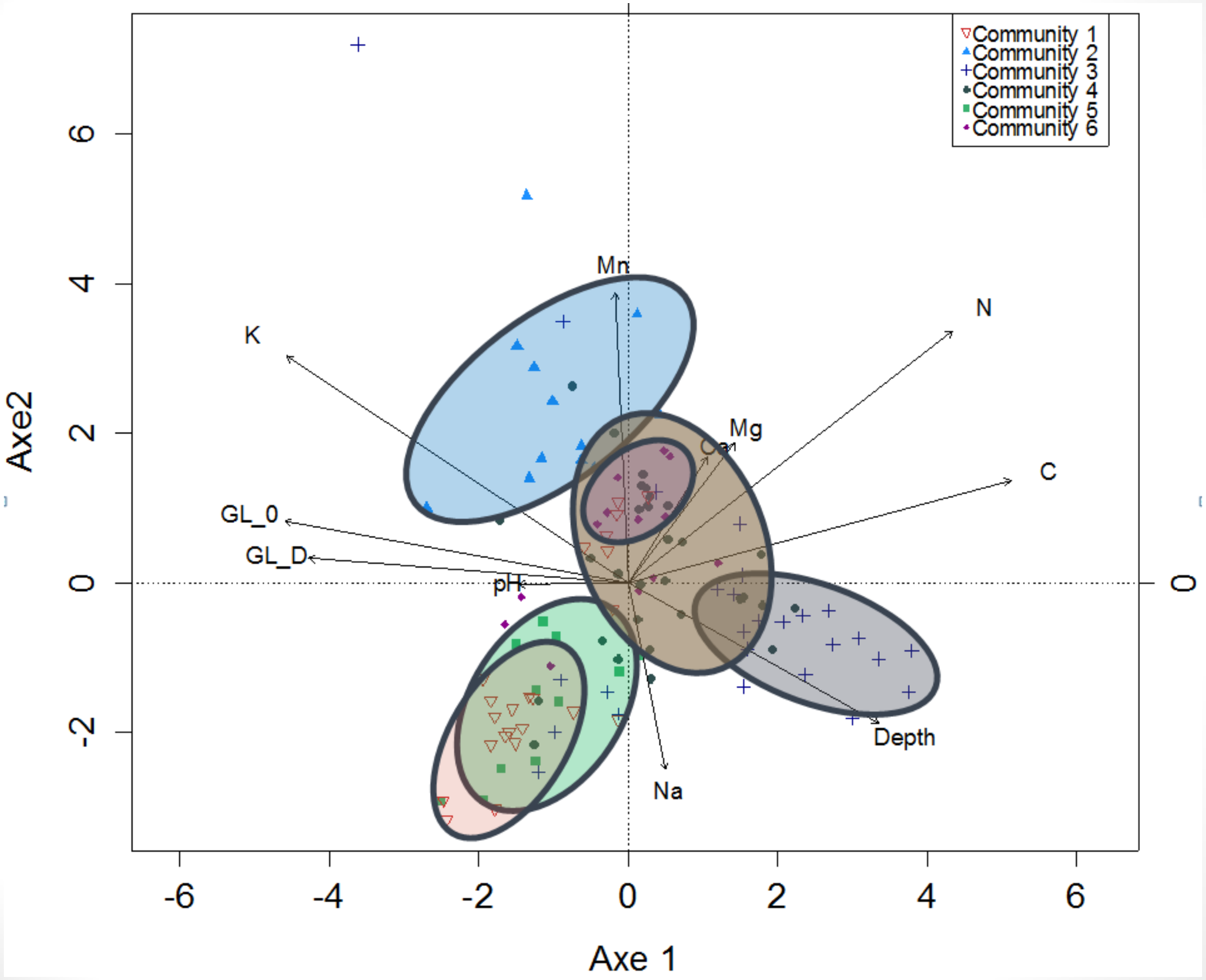
# • Results


Community 1
Community 2
Community 3
Community 4
Community 5
Community 6
Mn
N
K
Mg
Ca
C
GL_0
GL_D
pH
Depth
Na
Axe2
Axe 1
6
4
2
0
-2
-6
-4
-2
0
2
4
6
0

# • Results


Community 1
Community 2
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Mn
K
N
Mg
C
GL_0
GL_D
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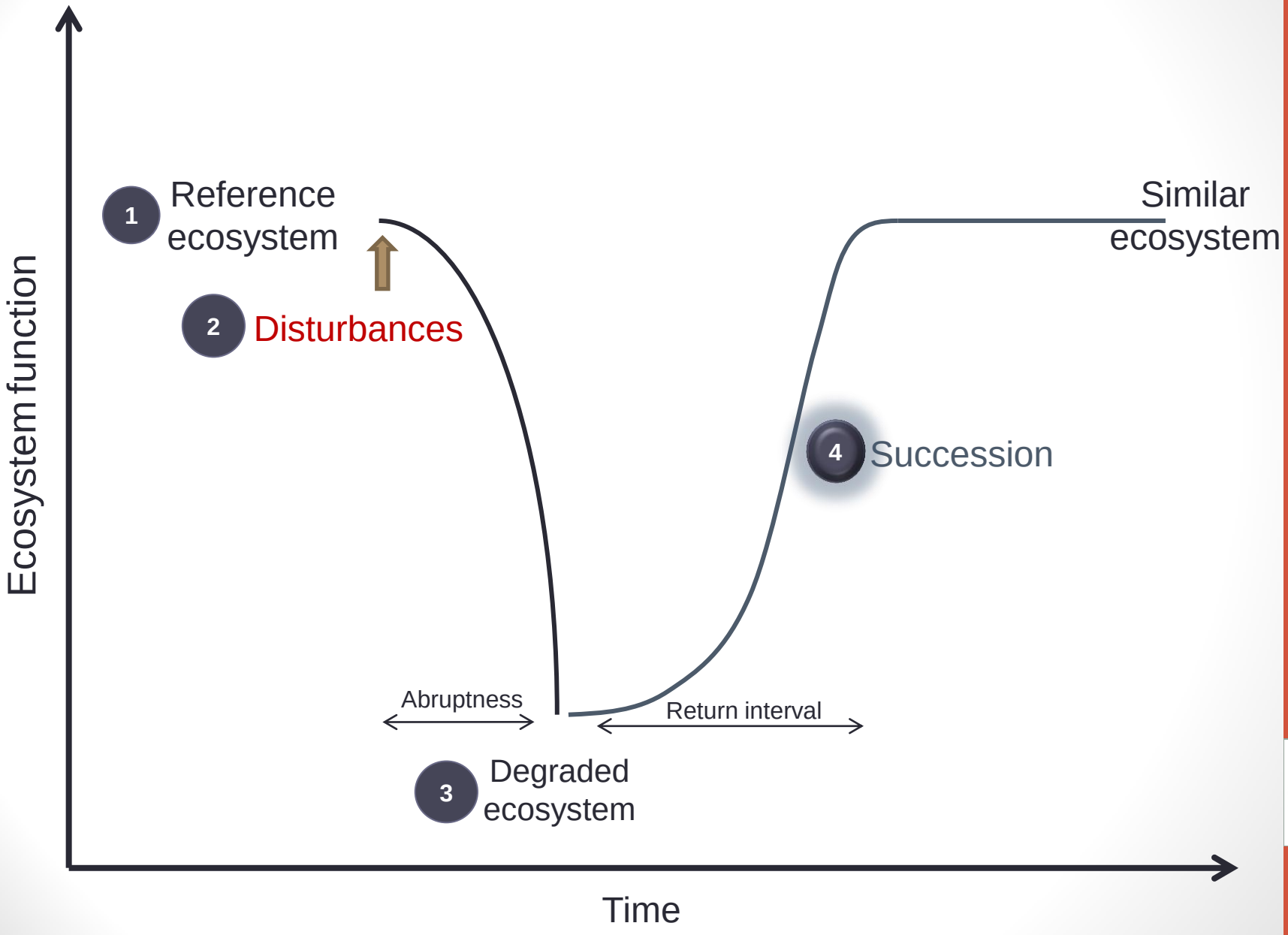
Na
Axe2
Axe 1
6
4
2
0
-2
-6
-4
-2
0
2
4
6
0

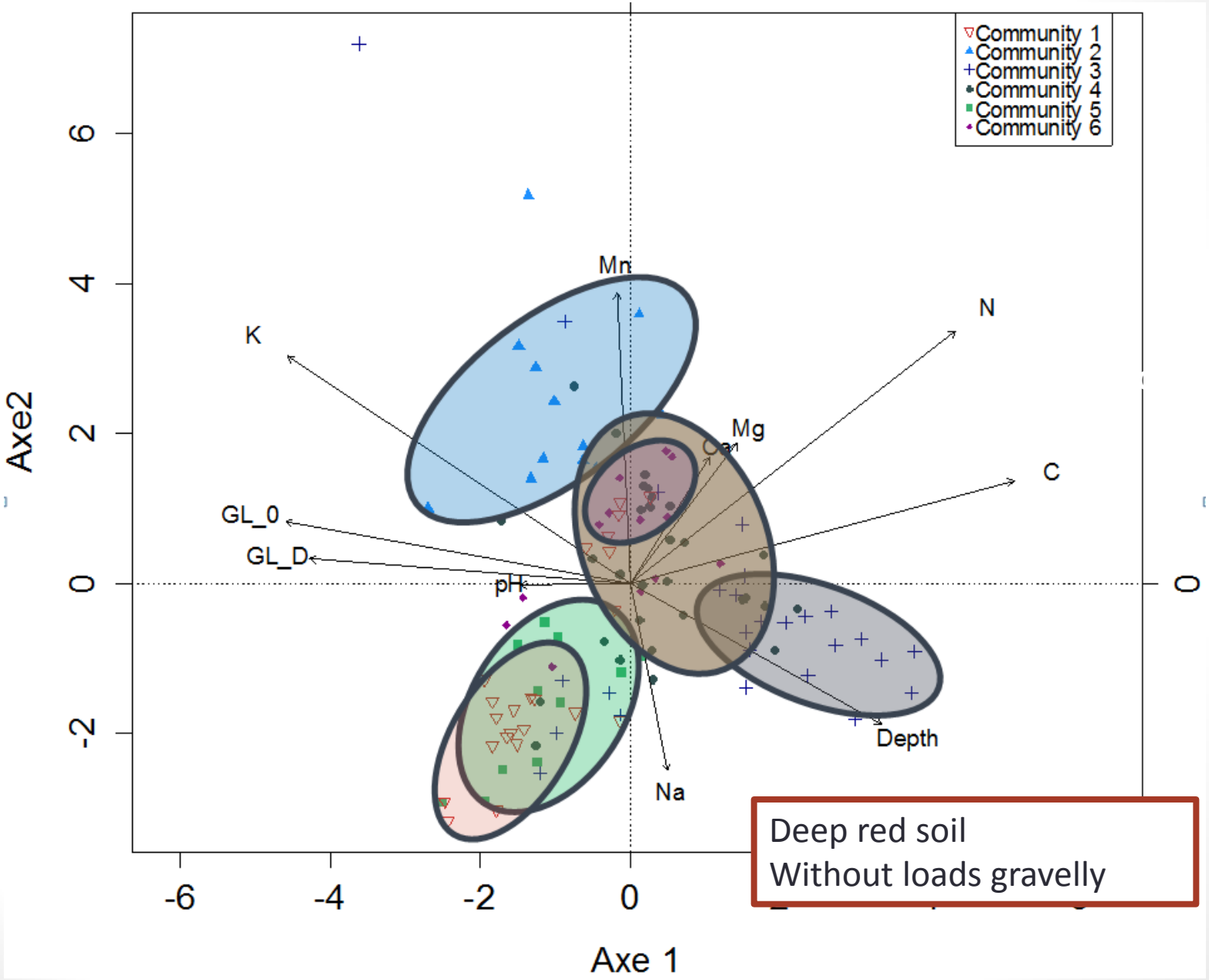
# • General concepts



TREES COMMUNITIES ⟺ DEGRADATION GRADIENT

SOIL CONDITIONS ⟺ DEGRADATION GRADIENT

# • General concepts



# • Méthodoly

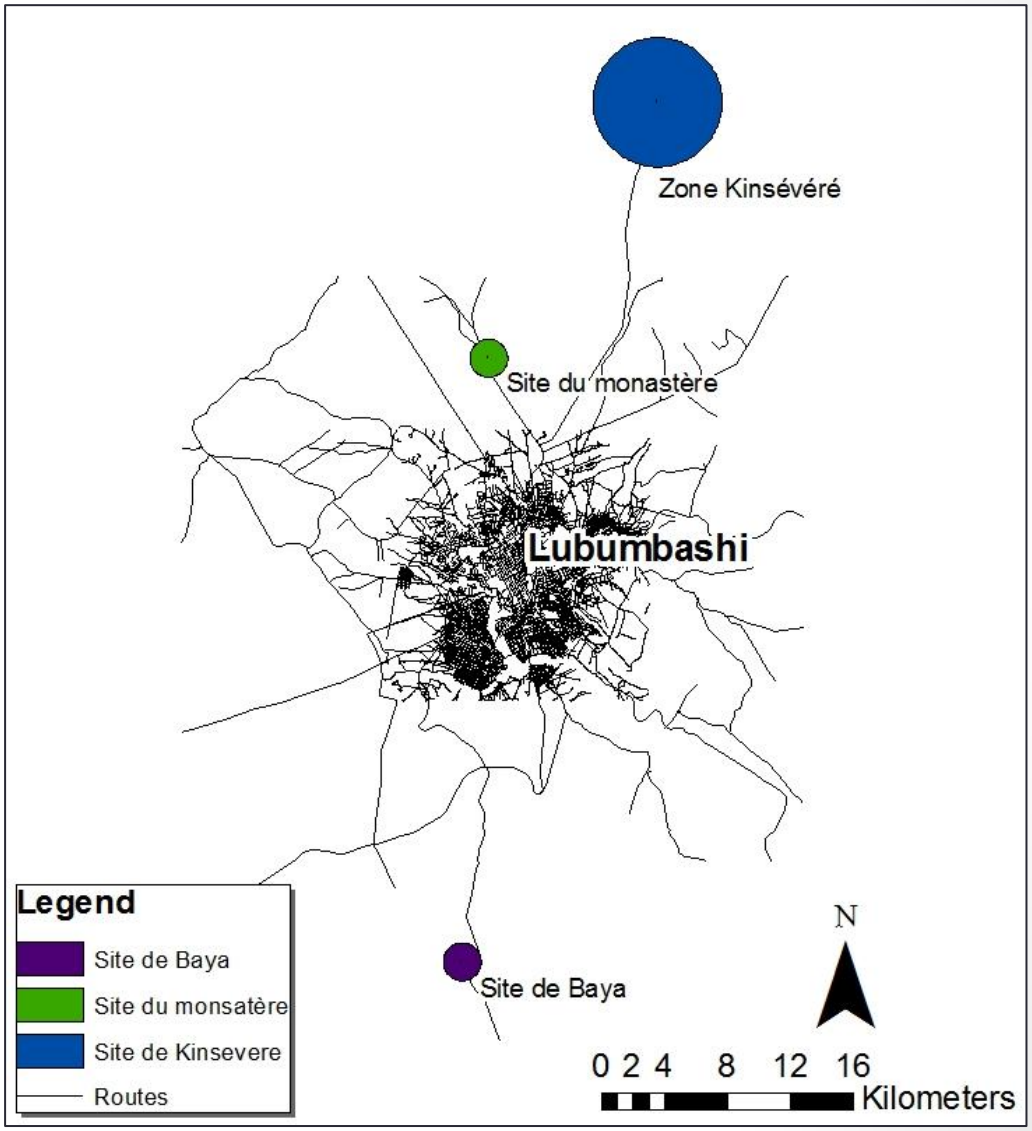
Three study sites:

***Kinsevere***

***Kiswishi***

***Baya***

- 30 km south of Lubumbashi
- Private concession



# • Méthodoly

- **53 circular plots** of 18 m radius (10 acres)

- 5 different stages of the degradation/regeneration gradient defined on vegetation physiognomy :

Grassland savannah > Bush savannah, Wooded savannah > Degraded forest > Forest

… spread over 3 sites.

# • Méthodoly

On each plot:

- **Identification and abundance of tree species (All)**
- Diameter and height (trees >2cm dbh)
- Soil samples (analyzed for N, P, K, C, Ca, Mn, Cu, pH)
- Samples of the biomass of the herbaceous layer

# • Méthodoly

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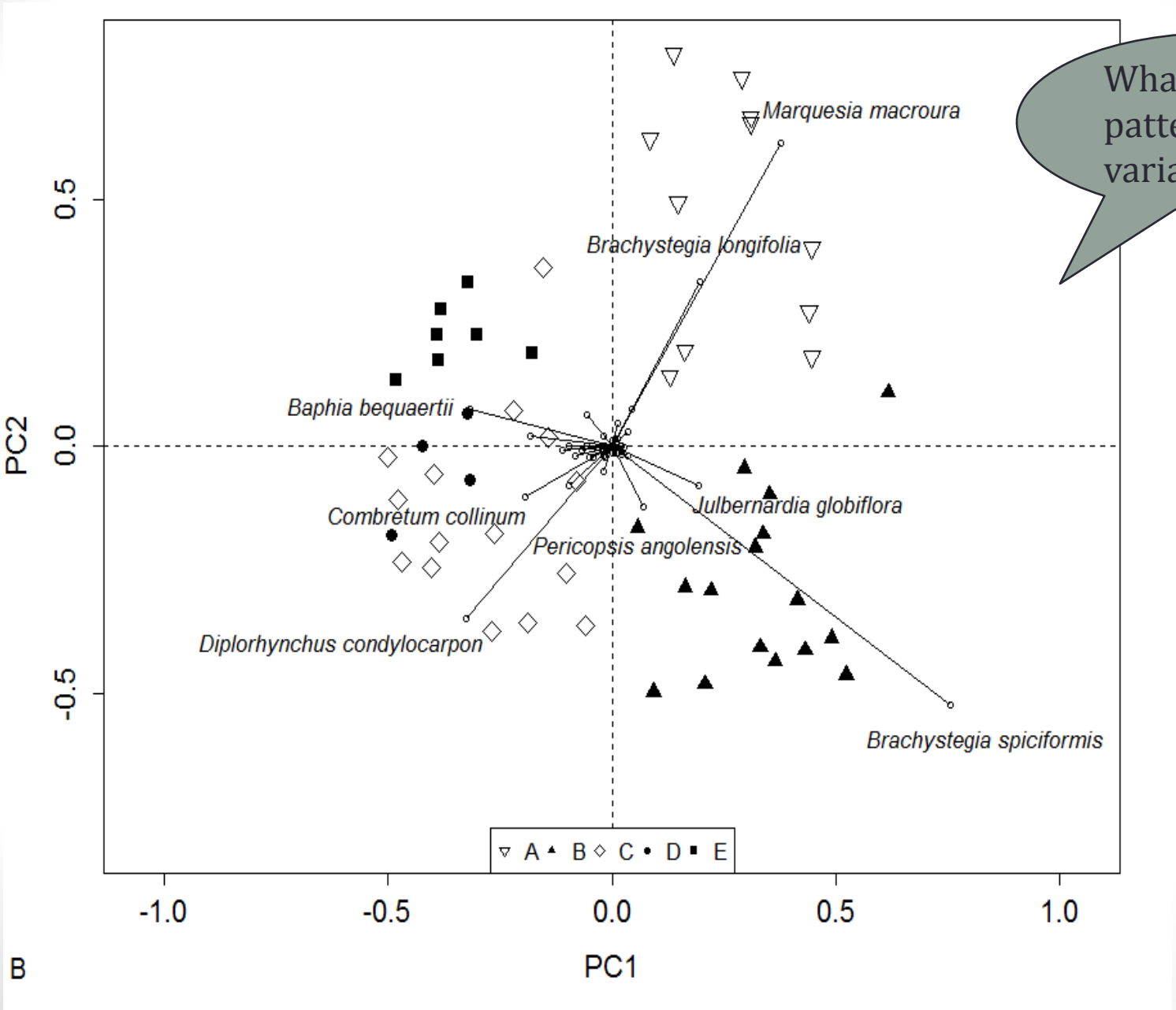
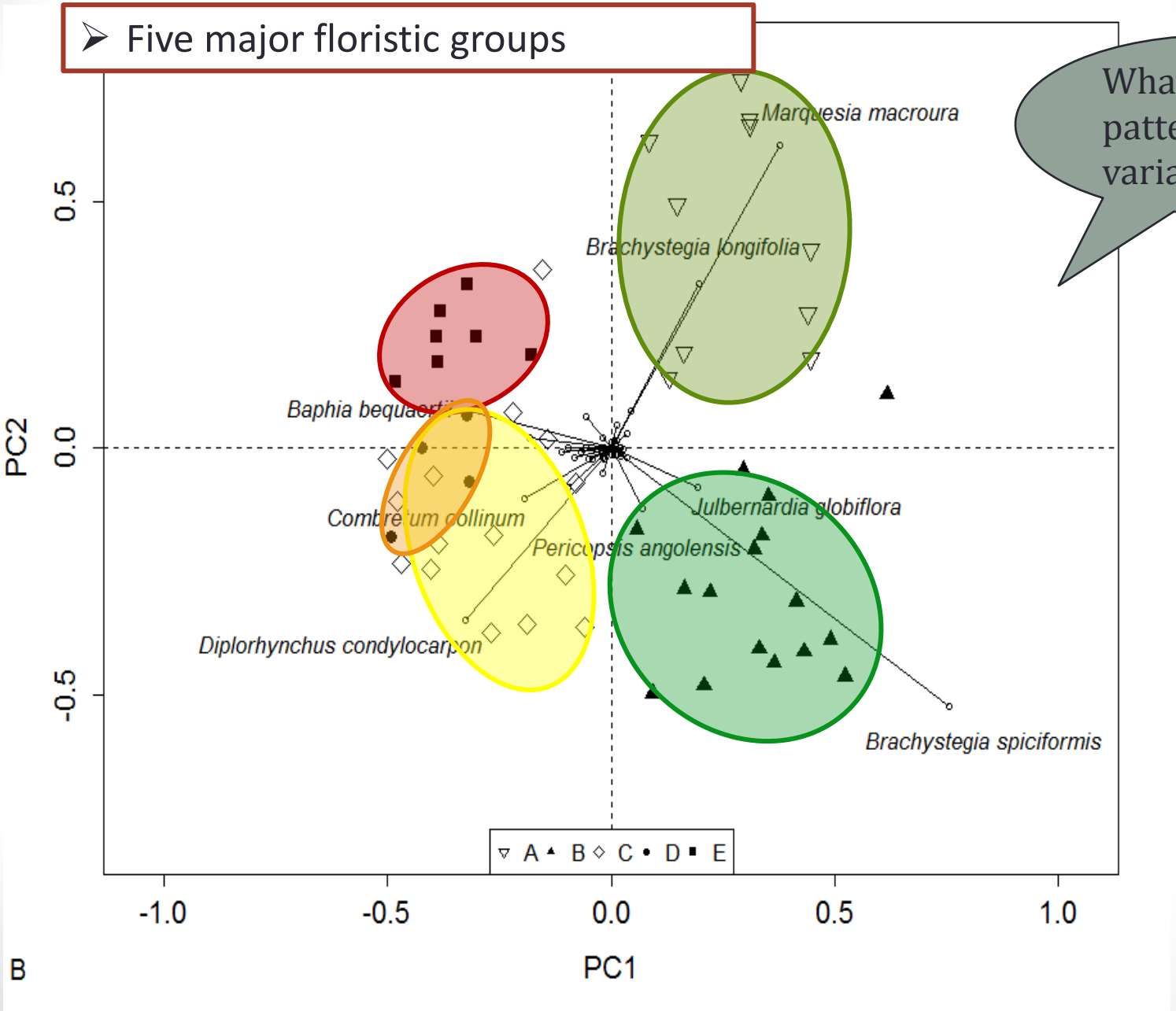
# • Results




What is the pattern of floristic variation?

# • Results

➢ Five major floristic groups




What is the pattern of floristic variation?

# • Results

➢ Five major floristic groups

| Community | Typology | Basal area ($m^2$/ha) | Density (tree/ha) | Species richness (Tree stand) | Species richness (Regeneration) |
|---|---|---|---|---|---|
| A | Forests and degraded forests | 23.19 | 921 | 48 | 48 |
| B | Forests and degraded forests | 19.57 | 724 | 47 | 53 |
| C | Degraded forests, wooded savannahs and bush savannahs | 12.11 | 1146 | 45 | 52 |
| D | Bush savannahs | 5.21 | 698 | 25 | 33 |
| E | Grassland savannahs | 1.49 | 435 | 28 | 36 |

Grassland savannah > Bush savannah > Wooded savannah > Degraded forest > Forest

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Grassland savannah > Bush savannah > Wooded savannah > Degraded forest > Forest

# • Results

COMMUNITY A :

Indicator species = ***Marquesia macroura***, *Brachystegia longifolia, Parinari curatellifolia*

Dominant species = *D. condylocarpon*, ***Marquesia macroura***, *Baphia bequaertii*

COMMUNITY B

***Brachystegia spciformis*** = Indicator species

*Baphia bequaertii, D. condylocarpon,* ***Brachystegia spiciformis*** = Dominant species

COMMUNITY C :

Indicator species = ***D. condylocarpon***

Dominant species = ***D. condylocarpon***, *Baphia bequaertii, Syzygium guineense*

COMMUNITY D

***Combretum collinum***, *Securidaca longepedunculata* = Indicator species

***Combretum collinum***, *Hymenocardia acida, P. maprouneifolia* = Dominant species

COMMUNITY E :

Indicator species = ***/***

Dominant species = *Baphia bequaertii, Pterocarpus angolensis, Syzygium guineense*

# • Results

- Competition with grasses is significantly depending on the state of degradation

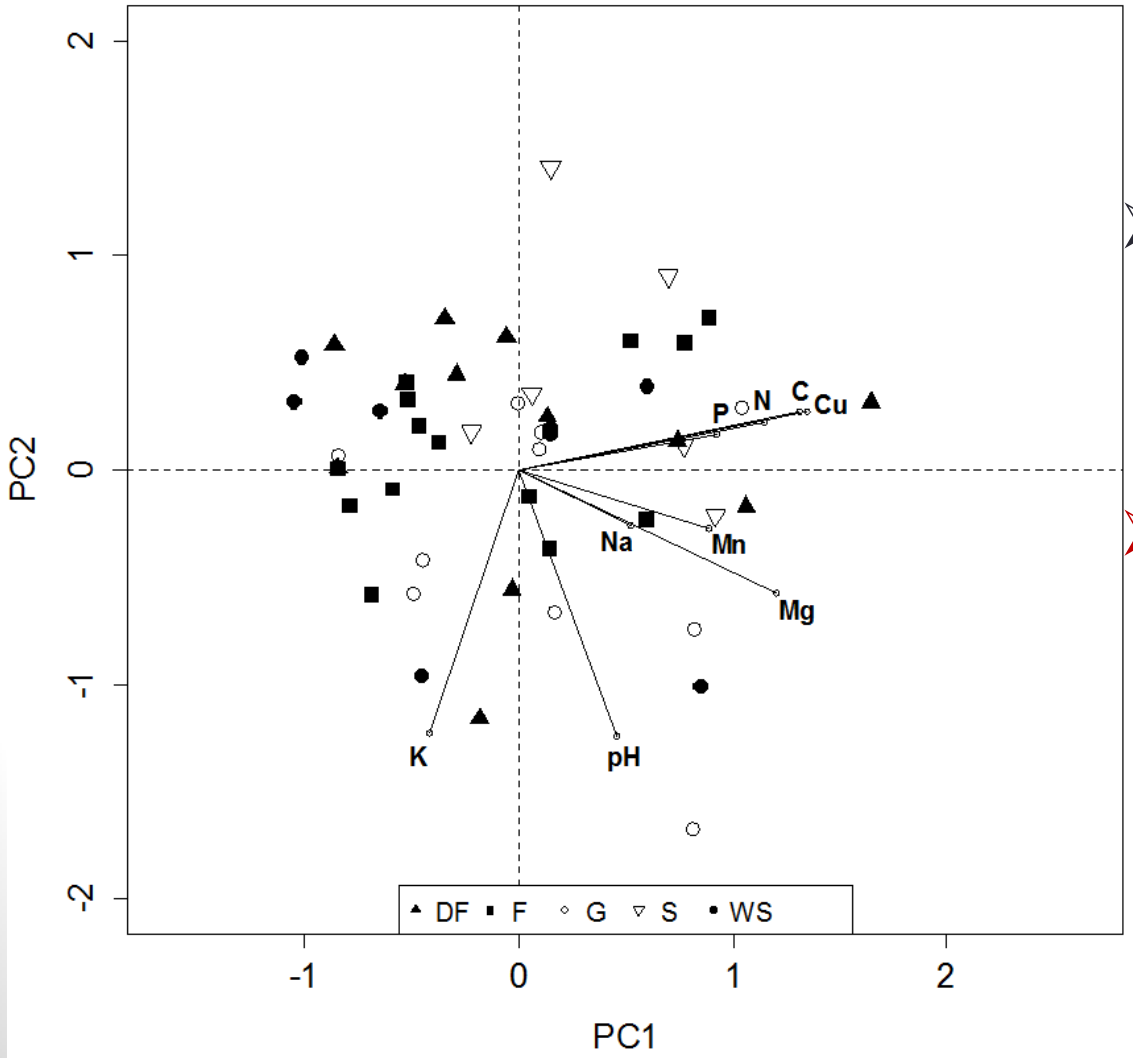
7248.06 kg/ha

2256.67 kg/ha

Grassland savannah > Bush savannah, Wooded savannah > Degraded forest > Forest

# • Results

Soil conditions ⟺ Degradation gradient

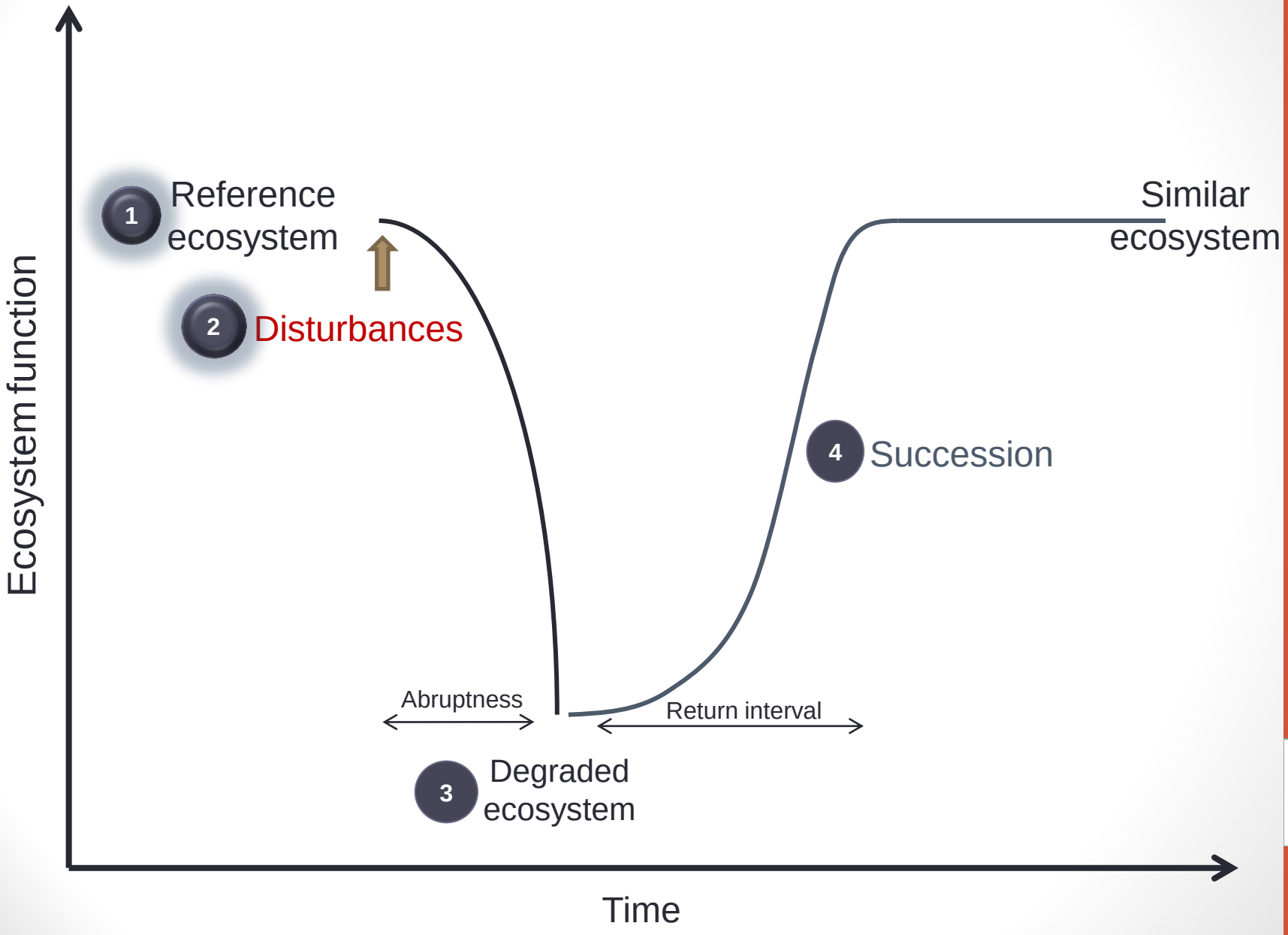



(ANOVA 1)

- P, K, Mg, Na, Cu, Mn and pH ➔not depending
- Carbon and nitrogen vary significantly according to the gradient

# CONCLUSION AND IMPLICATIONS FOR RESTORATION

# • Conclusion and implications for restoration



# • Conclusion and implications for restoration

1 Reference ecosystem

*Brachystegia boehmii* community

*Uapaca nitida* and *Uapaca pilosa* community

*Uapaca kirkiana* community

*Marquesia macroura* community

*Julbernardia globiflora* community

*D. condylocarpon, P. maprouneifolia, J. paniculata* community

# • Conclusion and implications for restoration

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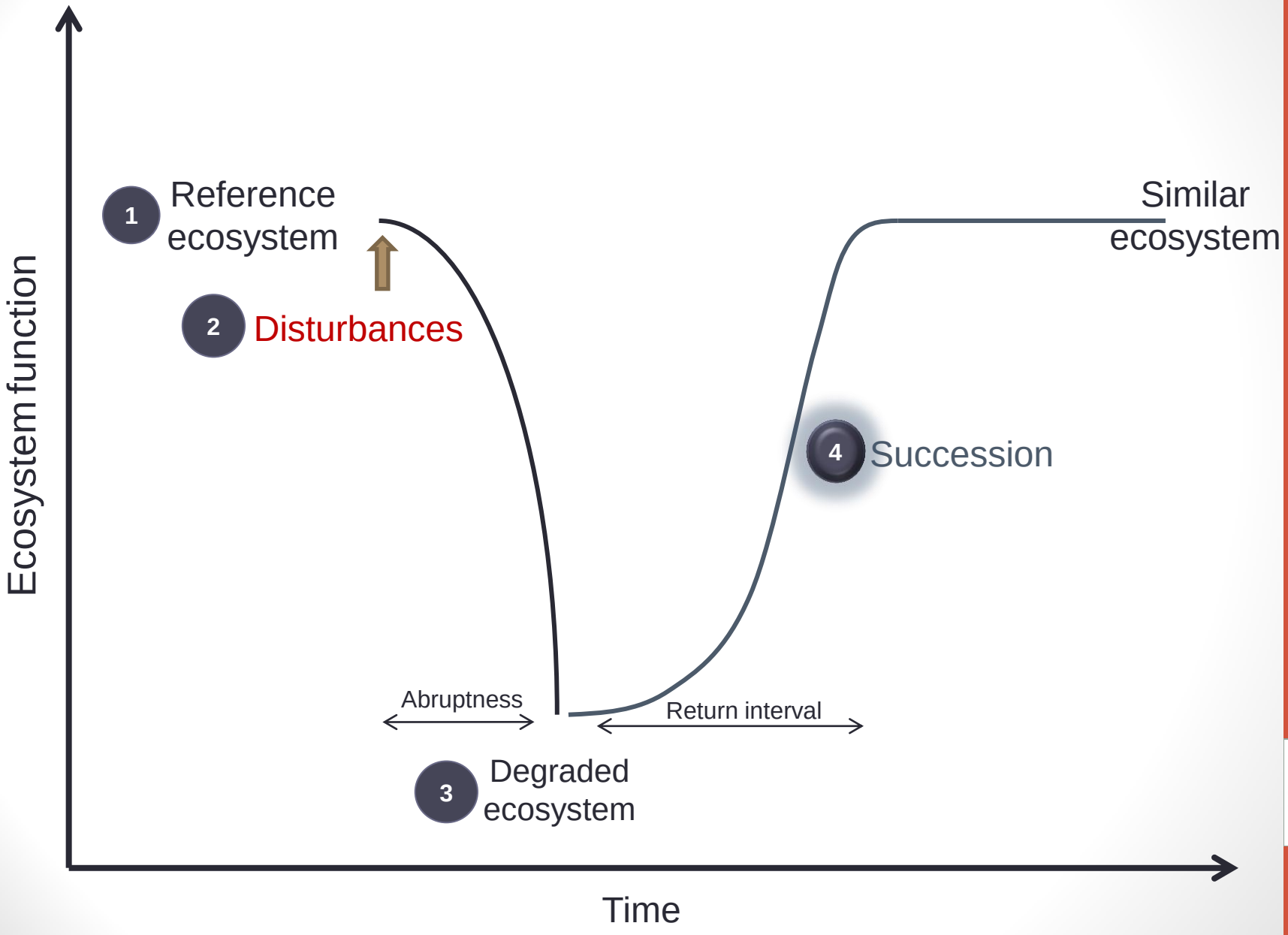
Soil conditions

# • Conclusion and implications for restoration



# • Conclusion and implications for restoration

4 Succession

For depth red soil :

Community A

Community B

Community C

Community D

Community E

Degradation gradient

# • Conclusion and implications for restoration

4 Succession

Soil conditions C and N

Degradation gradient


Thank for your attention