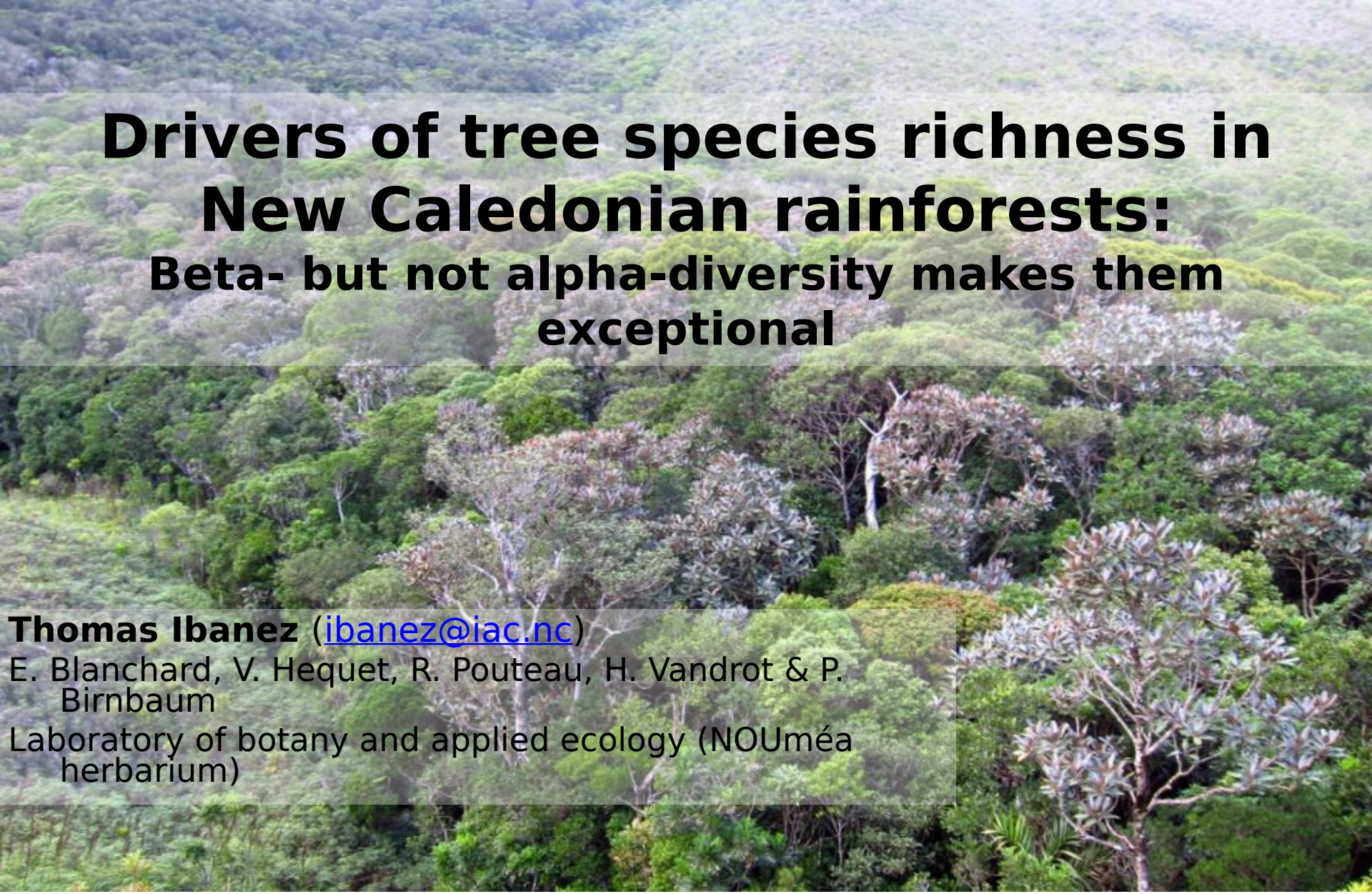
Drivers of tree species richness in New Caledonian rainforests:

Beta- but not alpha-diversity makes them exceptional



Thomas Ibanez (ibanez@iac.nc)
E. Blanchard, V. Hequet, R. Pouteau, H. Vandrot & P. Birnbaum
Laboratory of botany and applied ecology (NOUméa herbarium)

IAC Institut Agronomique néo-Calédonien

AMAP

cirad LA RECHERCHE AGRONOMIQUE POUR LE DÉVELOPPEMENT

IRD Institut de recherche pour le développement

ATBC2015: Resilience of island systems
Biological diversity and climate change

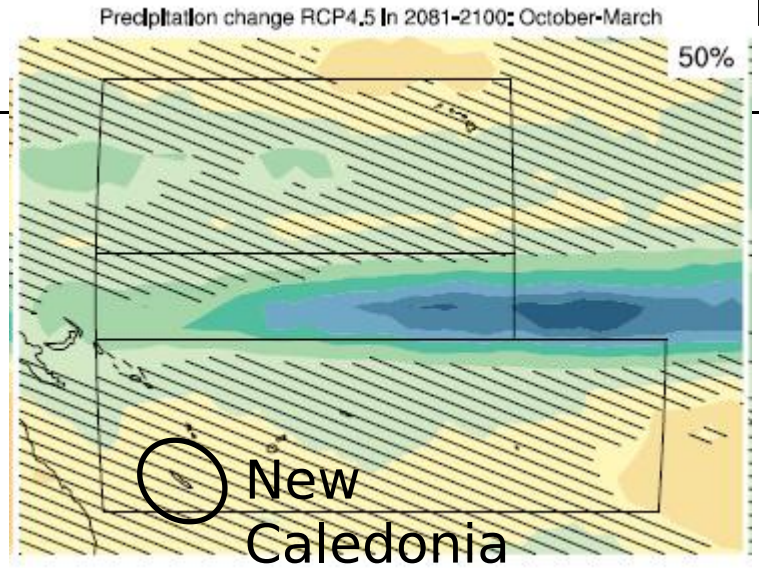
Climate change in tropical islands

- Lots of uncertainty in the nature and extent of changes
- « Small » and « medium » islands do not exist in global mod
- High elevation islands influence local climate (e.g. New Caledonia)

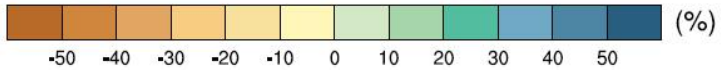
Mont Panié (1628 m), New Caledonia archipelago (SW Pacific)

Climate change in New Caledonia
What do we expect ?

	Last decades	IPCC 2014 (RCP4.5) 2080-2100
Temperature	**+ 0.9 – 1.2°C**	**+ 1 – 2 °C**
Rainfalls	≈	Decrease ?
Cyclones	≈ (Less frequent)	Less frequent more powerful ?
[illegible] r		+ 20 cm



Rainfalls change forecast



Hatching = insignificant trend

Climate change in New Caledonia
How to better manage & conserve diversity?

Let’s start from the beginning,

We have to understand present diversity patterns

Patterns between diversity and elevation gradients

Powerful « natural experiments » for testing the response to environnemental changes (Köner 2007)

New Caledonia (a biodiversity hotspot)

An insightful lab to study ecological patterns

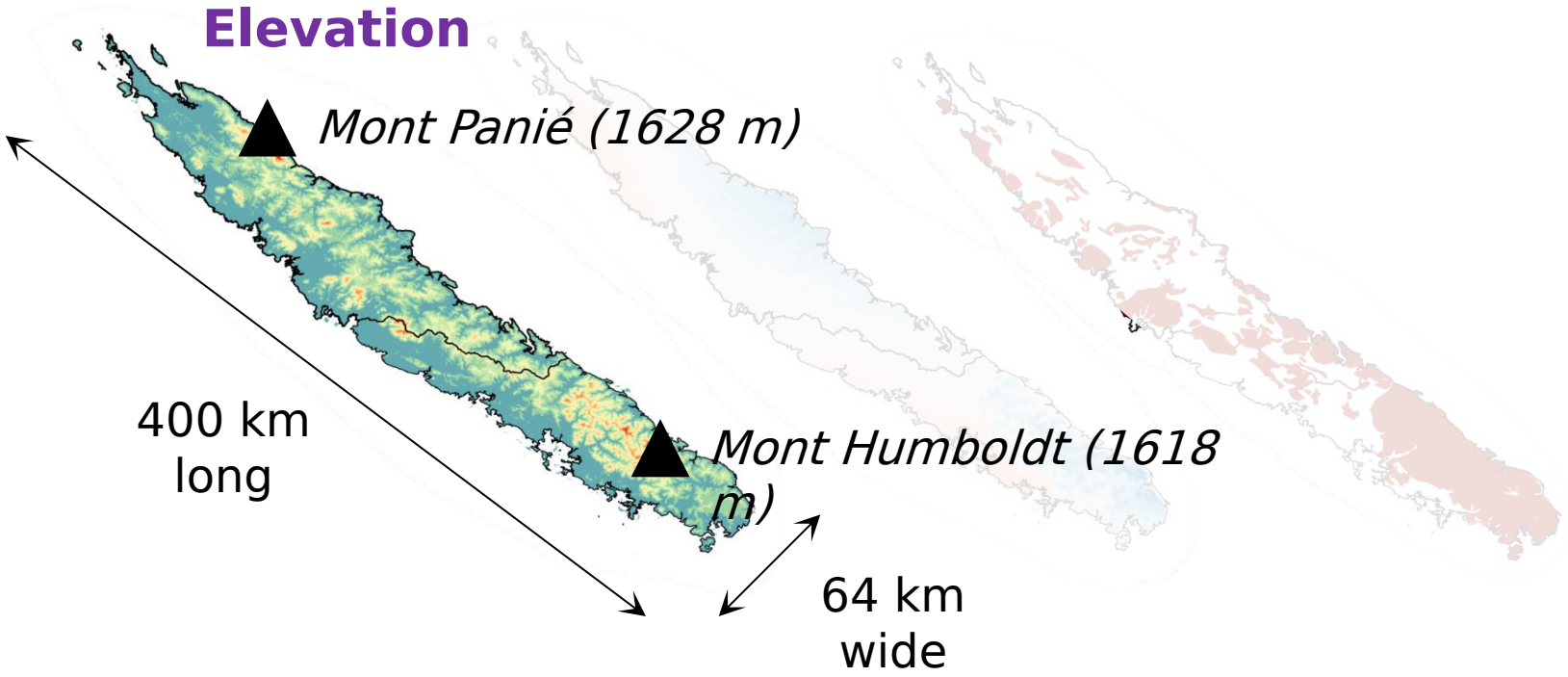
The environmental heterogeneity esis

Biodiversity Letters (1993) 1, 82–87

BIODIVERSITY RESEARCH

The relationship between ecological diversity and floristic diversity in New Caledonia

T. JAFFRÉ *Centre ORSTOM, B.P. A 5, Nouméa, New Caledonia*



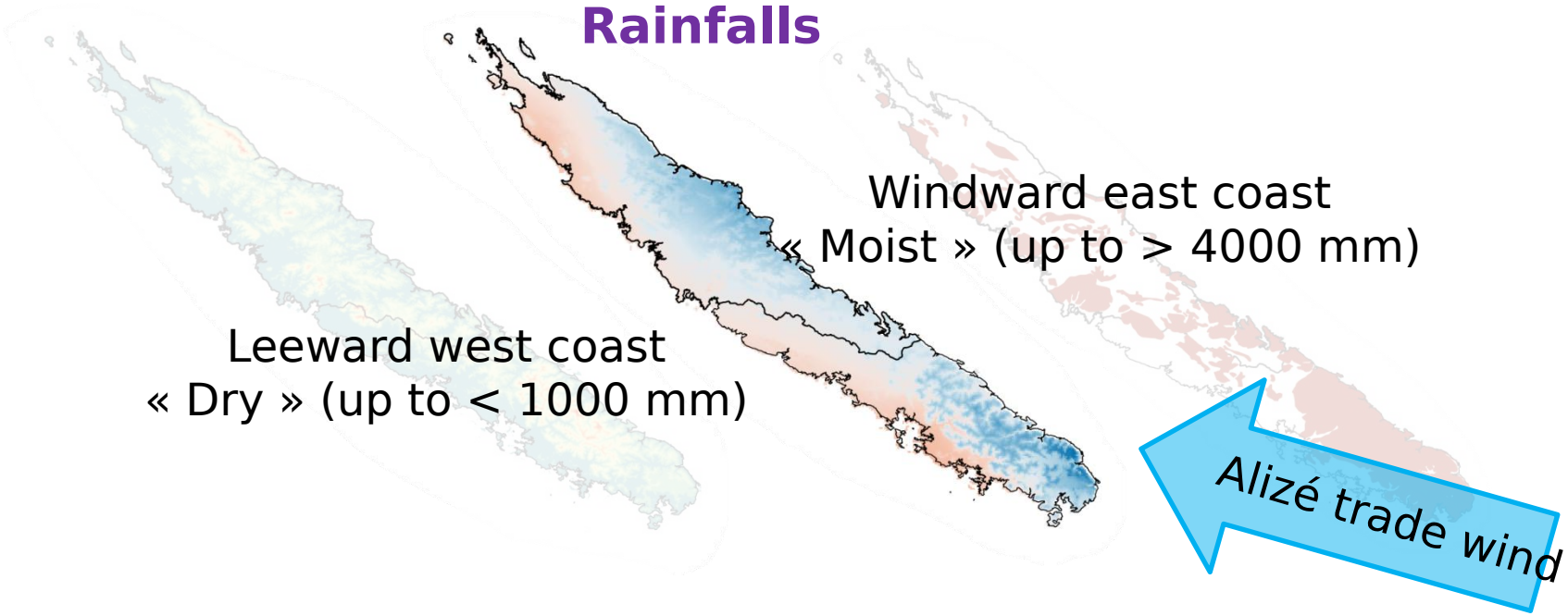
The environmental heterogeneity hypothesis

Biodiversity Letters (1993) 1, 82–87

BIODIVERSITY RESEARCH

The relationship between ecological diversity and floristic diversity in New Caledonia

T. JAFFRÉ *Centre ORSTOM, B.P. A 5, Nouméa, New Caledonia*



The environmental heterogeneity hypothesis

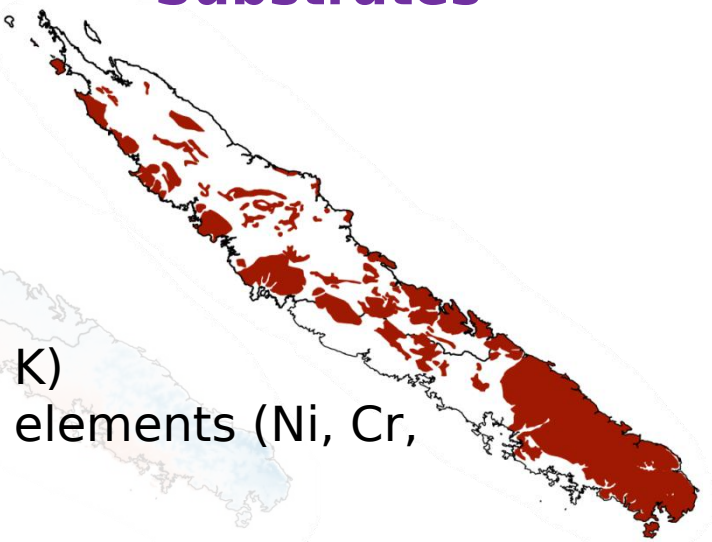
Biodiversity Letters (1993) 1, 82–87

BIODIVERSITY RESEARCH

The relationship between ecological diversity and floristic diversity in New Caledonia

T. JAFFRÉ *Centre ORSTOM, B.P. A 5, Nouméa, New Caledonia*

Substrates



Ultramafic substrates

≈ 1/3 of the main island

à Low levels of macronutrients (P, Ca, K)

à High levels of potentially phytotoxic elements (Ni, Cr, Mn)

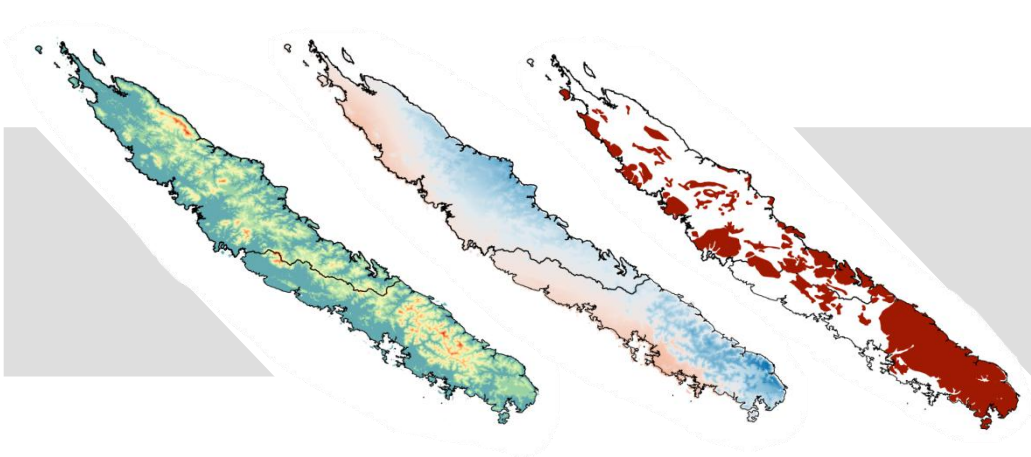
The environmental heterogeneity hypothesis

Biodiversity Letters (1993) 1, 82–87

BIODIVERSITY RESEARCH

The relationship between ecological diversity and floristic diversity in New Caledonia

T. JAFFRÉ *Centre ORSTOM, B.P. A 5, Nouméa, New Caledonia*



?

Diversity patterns

"Need for standardized plant survey to better understand these drivers" **(T. Jaffré 1993)**

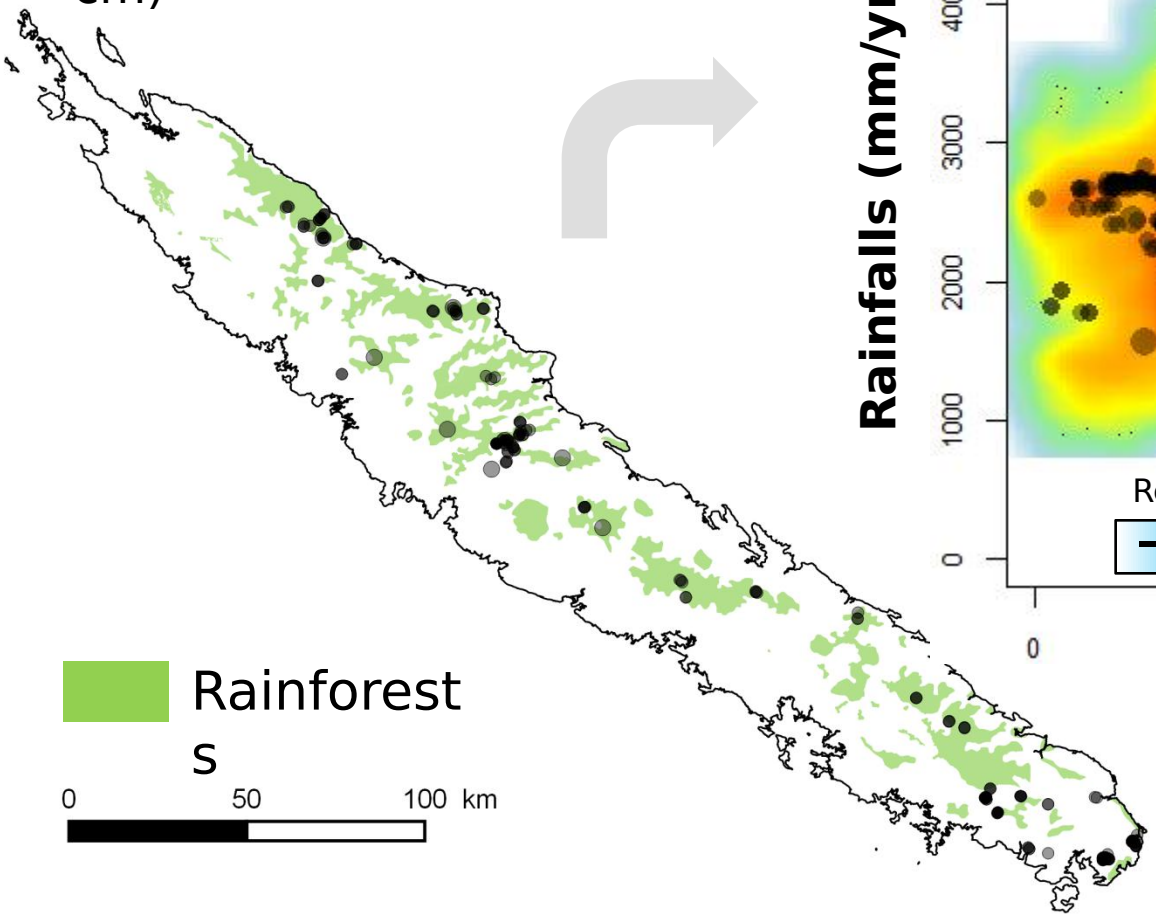
New Caledonian Plant Inventory and Permanent Plot Network (NC-PIPPN) 2005-Now

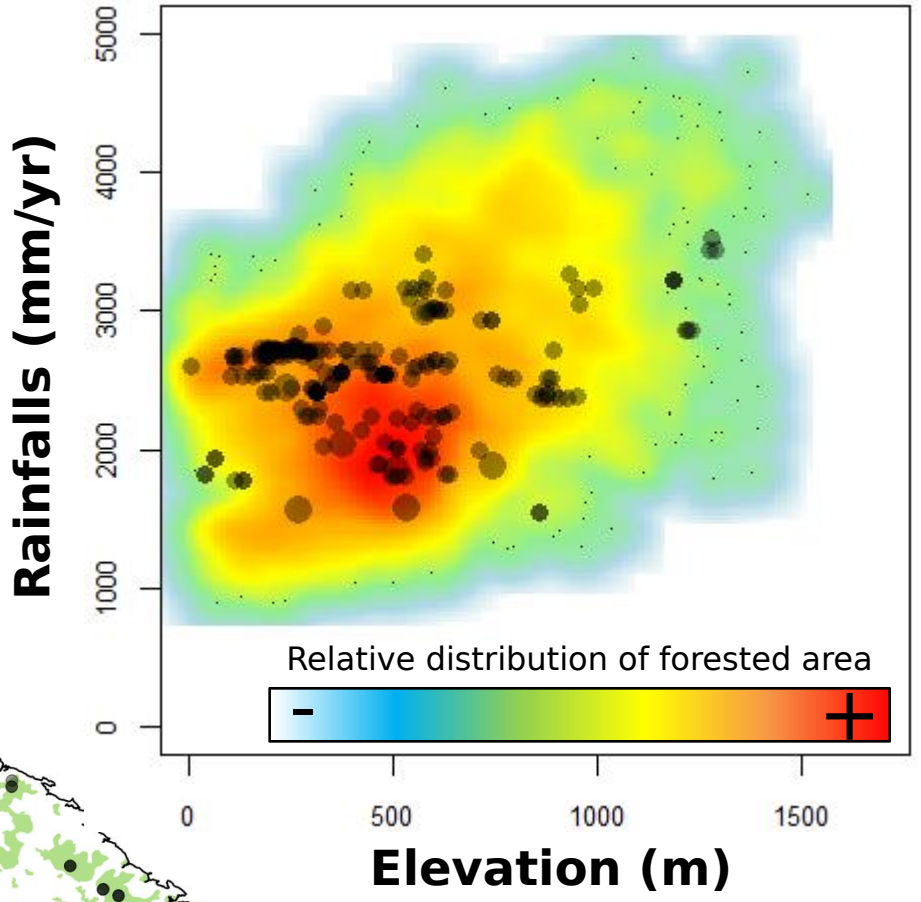
Permanent Plot Network

« Small » and « large » plots to explore large-scale variability

Geographical and environmental distribution of plots

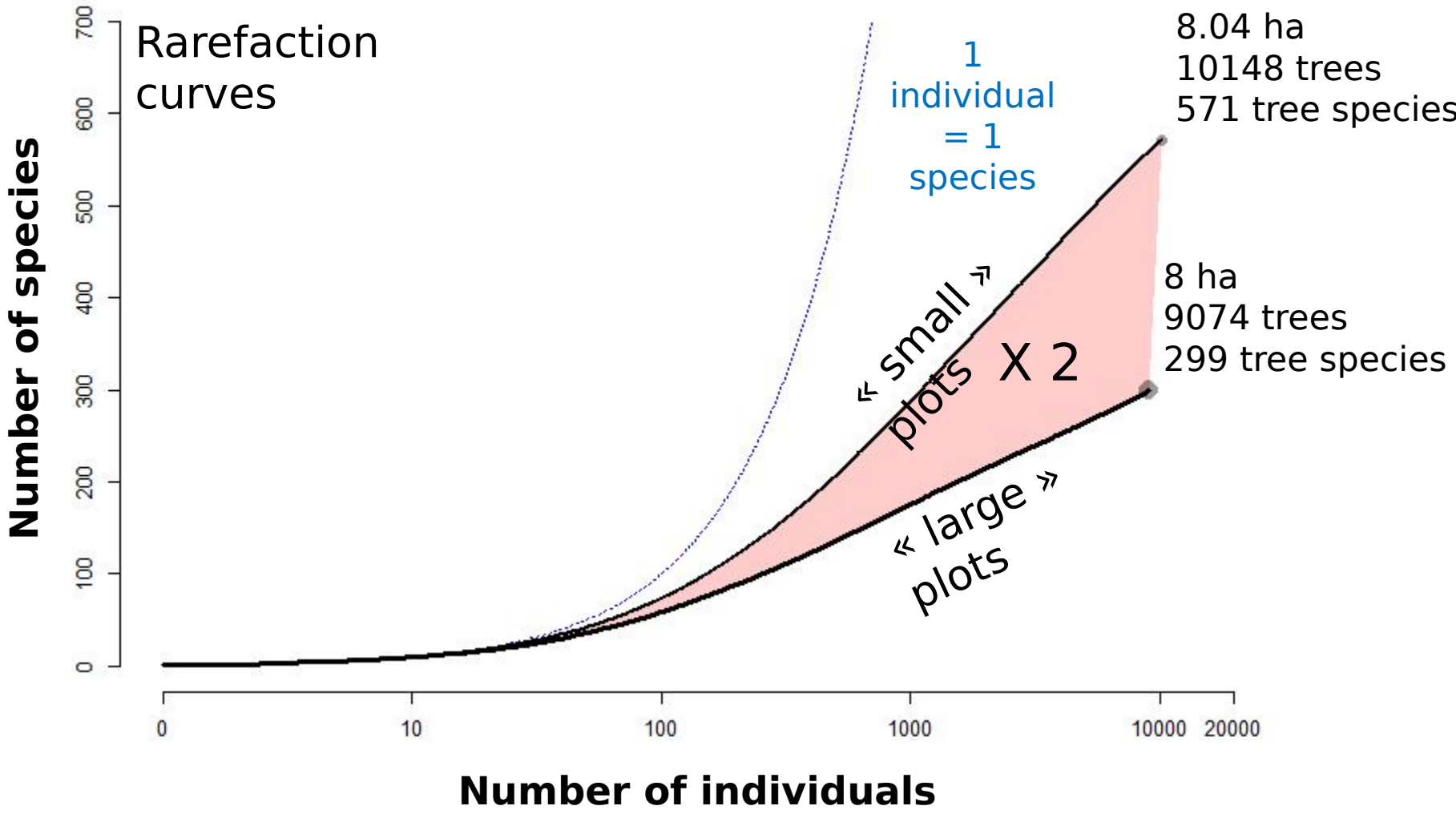
- 8 × 1 ha plots (DBH ≥ 10 cm)
- 201 × 0.04 ha plots (DBH ≥ 5 cm)





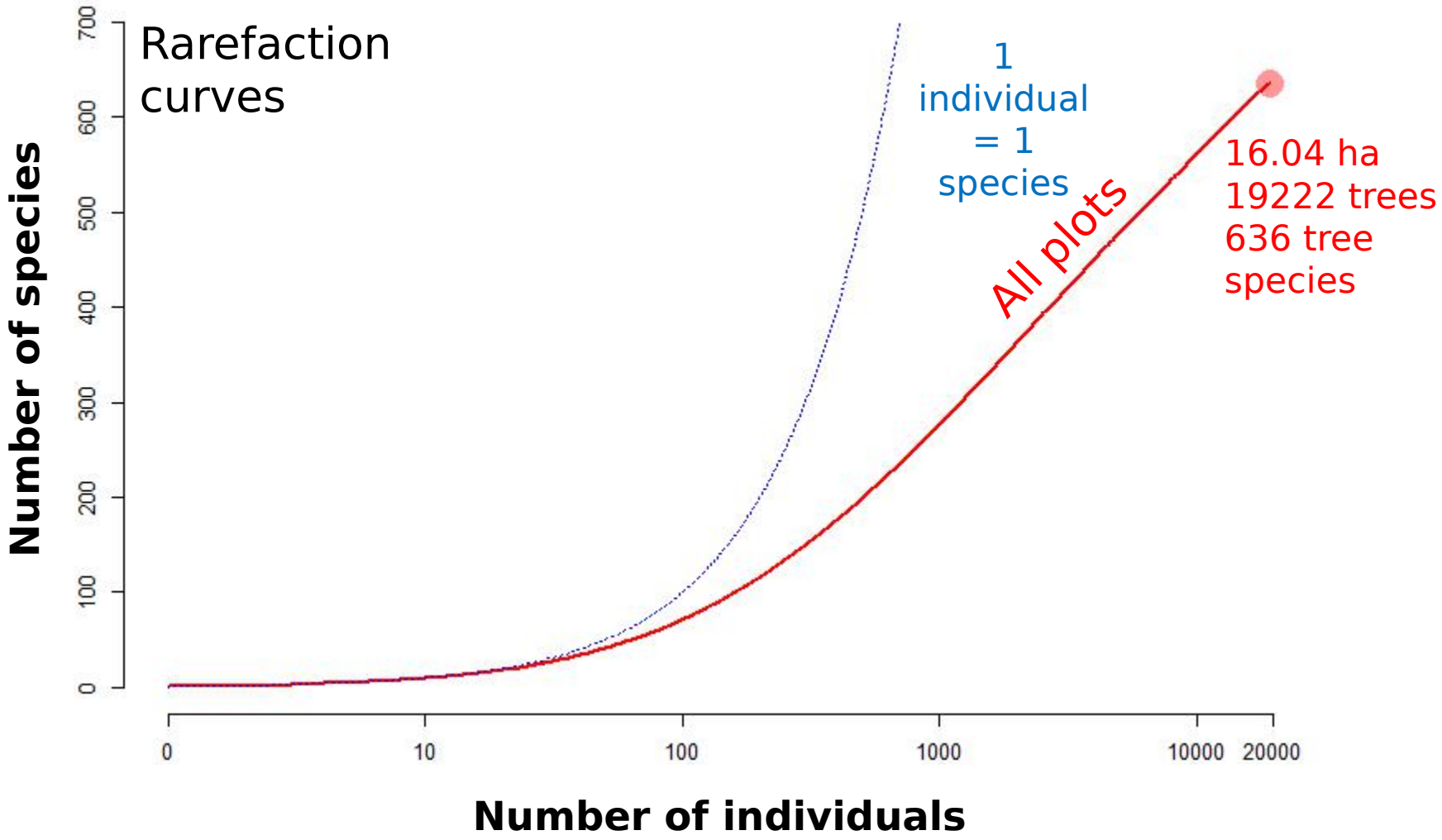
Permanent Plot Network

« Small » vs « Large » plots
« Small » plots = faster species accumulation (x2)
« Large » plots = more reliable species communities



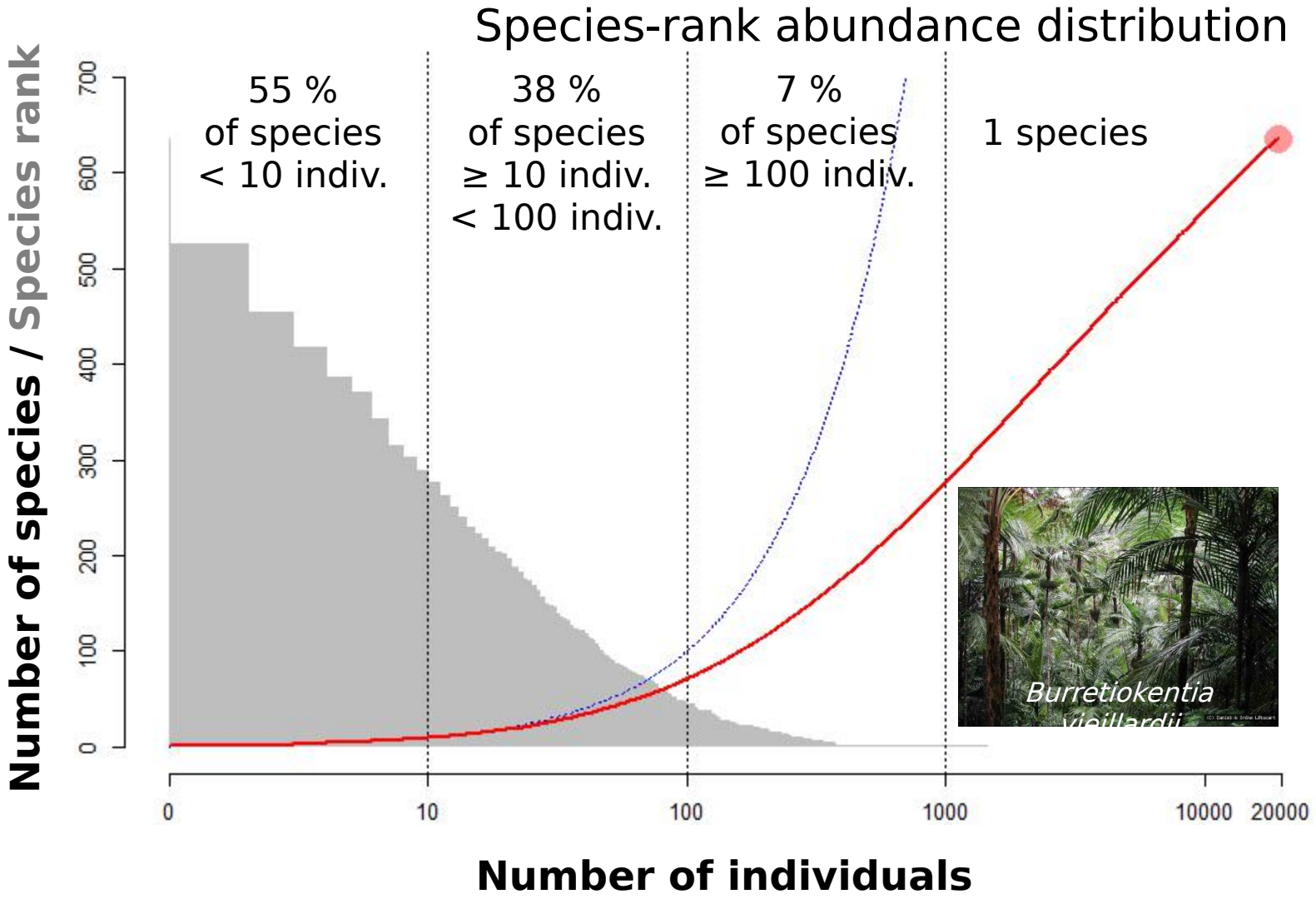
Permanent Plot Network

« Small » + « large plots »
≈ 20 000 trees (DBH ≥ 10 cm)
= 636 tree species



Permanent Plot Network

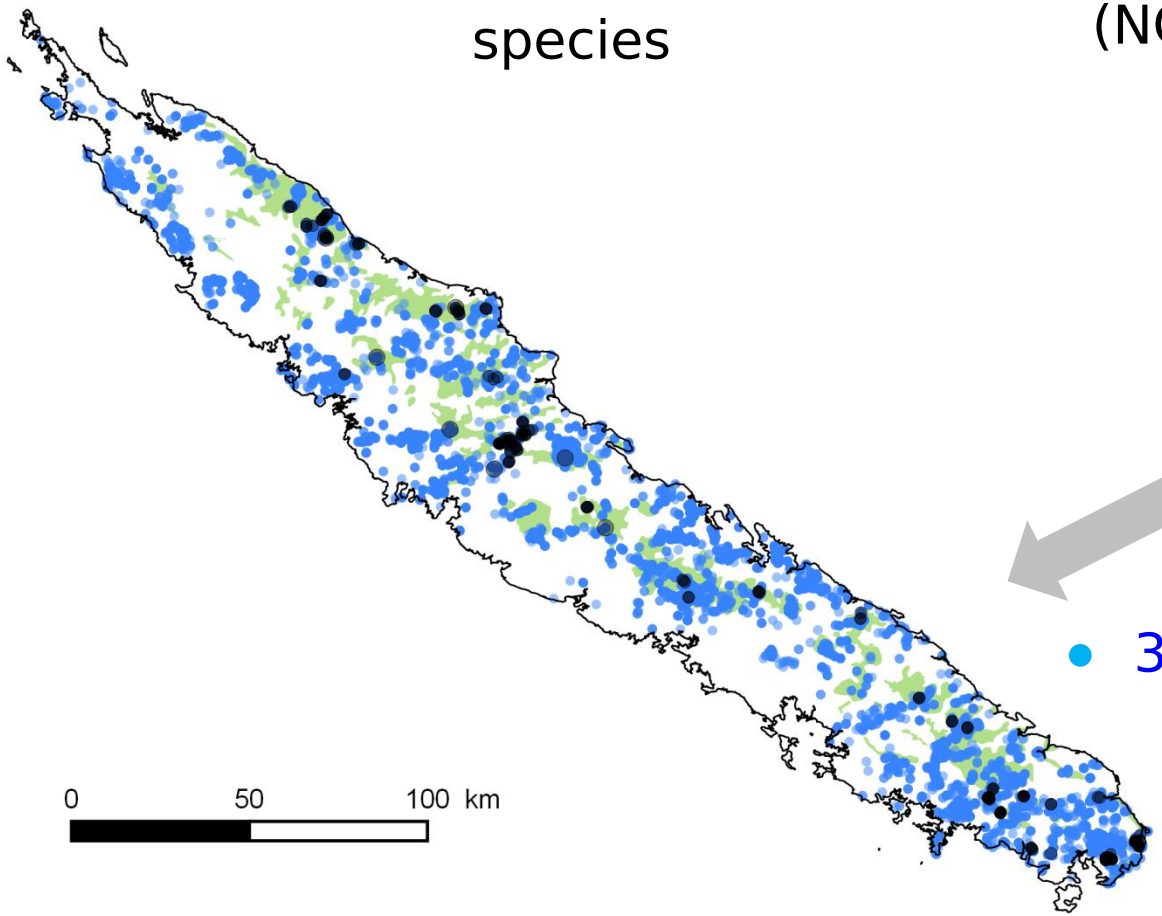
Species abundance
A usual oligarchic dominance



Plant inventory

Compilation of tree occurrence for each tree species inventoried in the plot network

Plot network
636 tree species



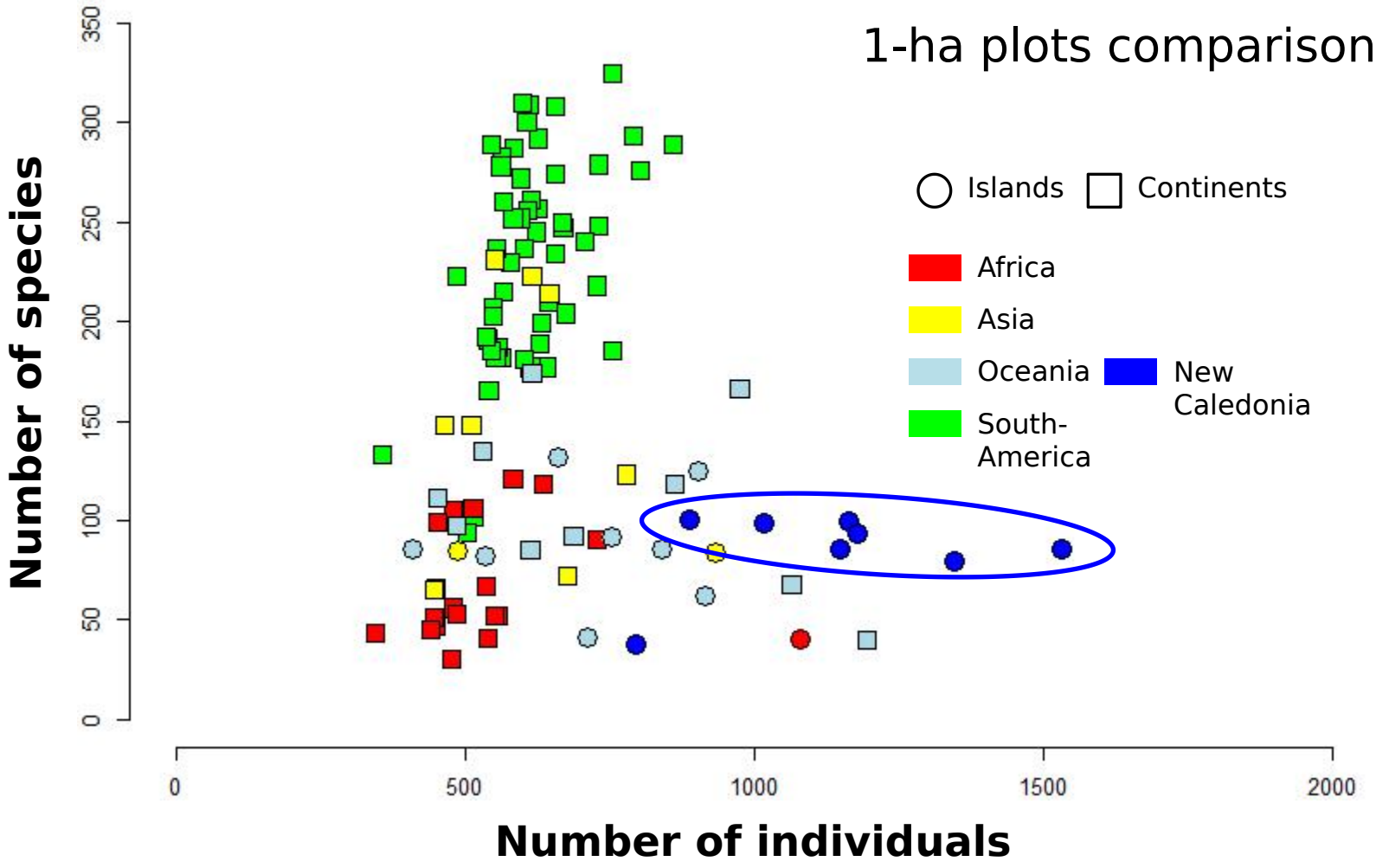
Occurrences datasets (NOUméa herbarium and others)

- 38936 tree occurences

Drivers of diversity
Alpha, beta and gamma diversity vs. Environmental heterogeneity

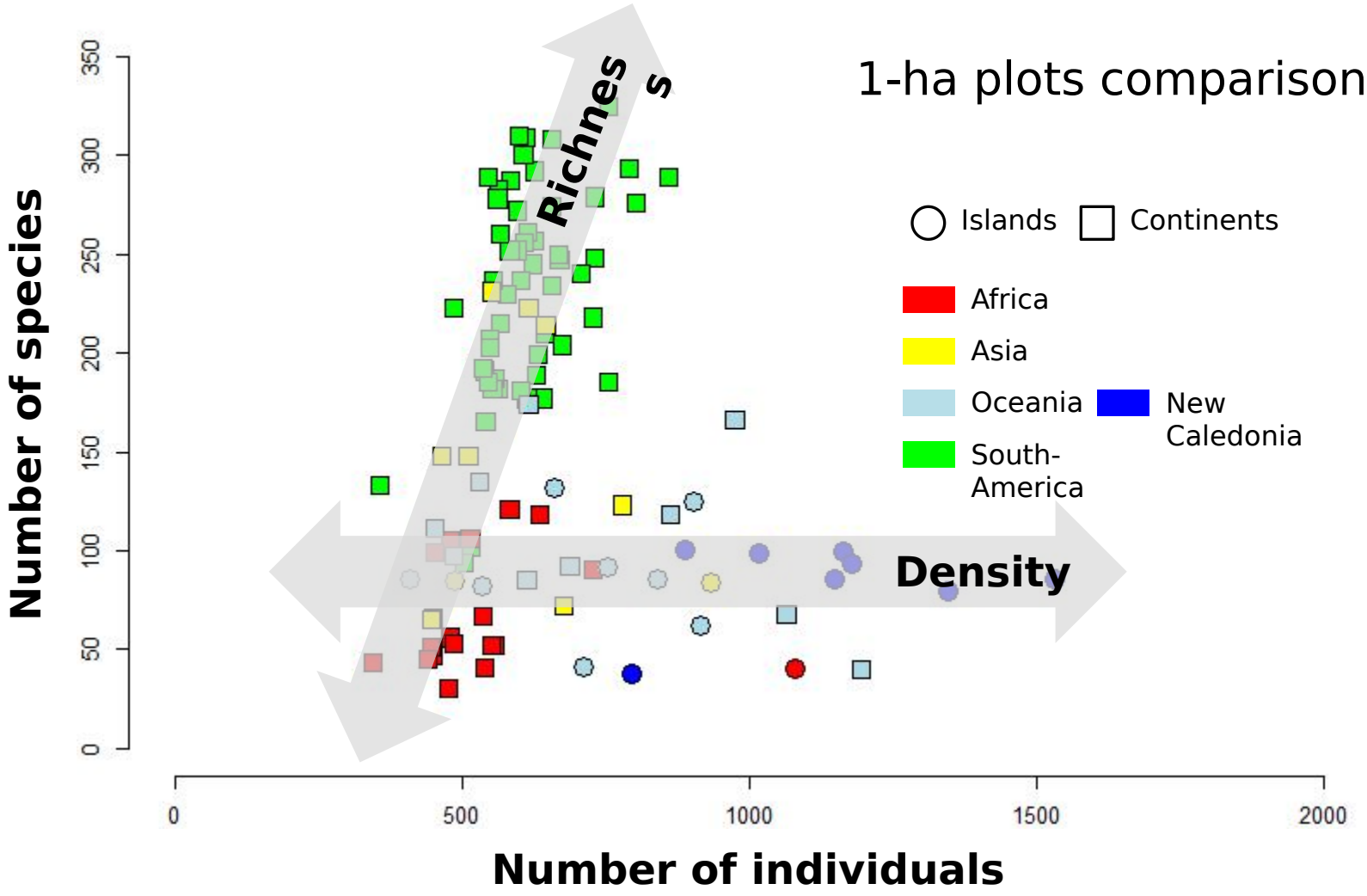
α diversity

New Caledonia vs. Tropics
An unusual tree density per hectare, a relatively low richness



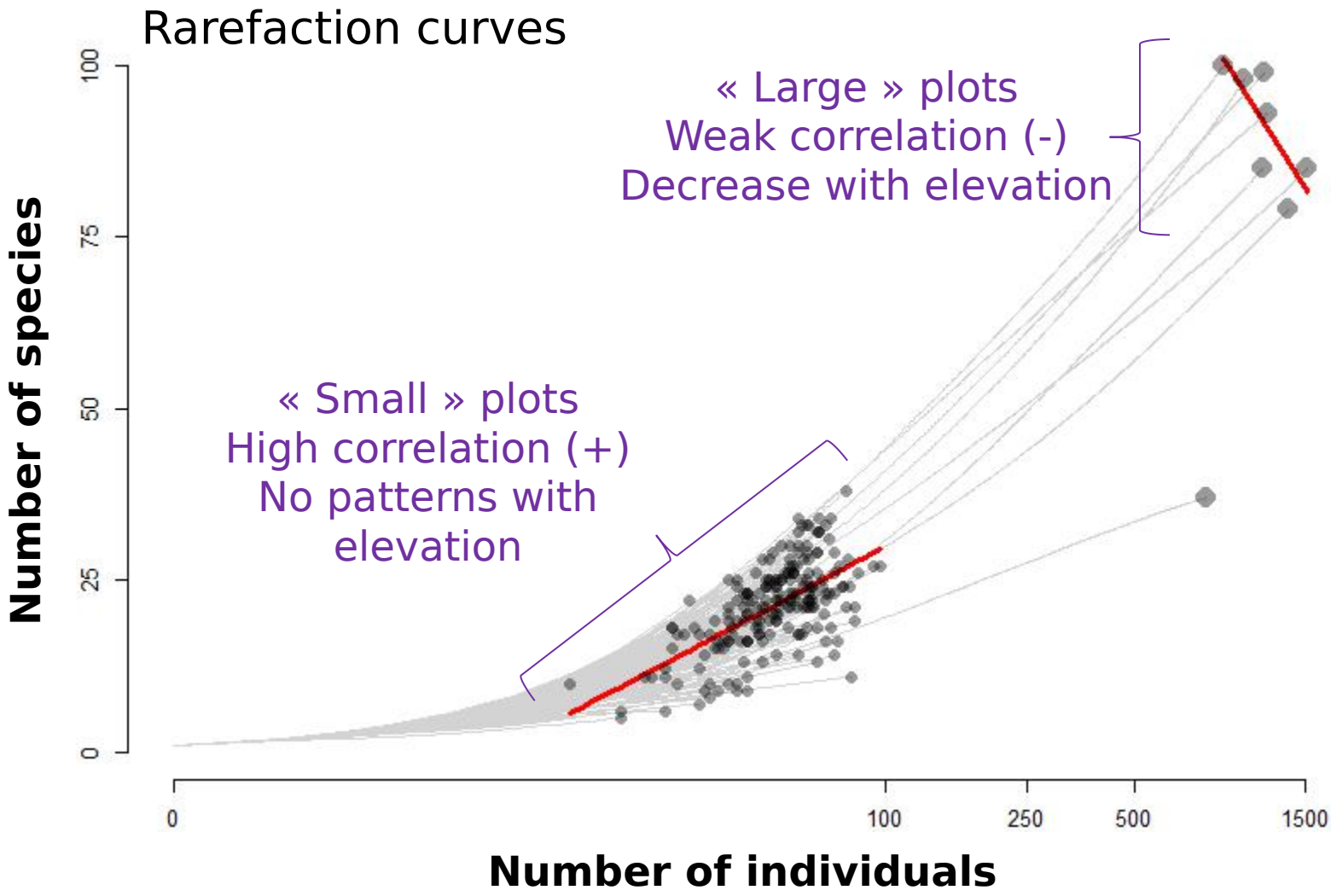
α diversity

Islands vs. continents
High density and low richness vs. low density and high richness ?



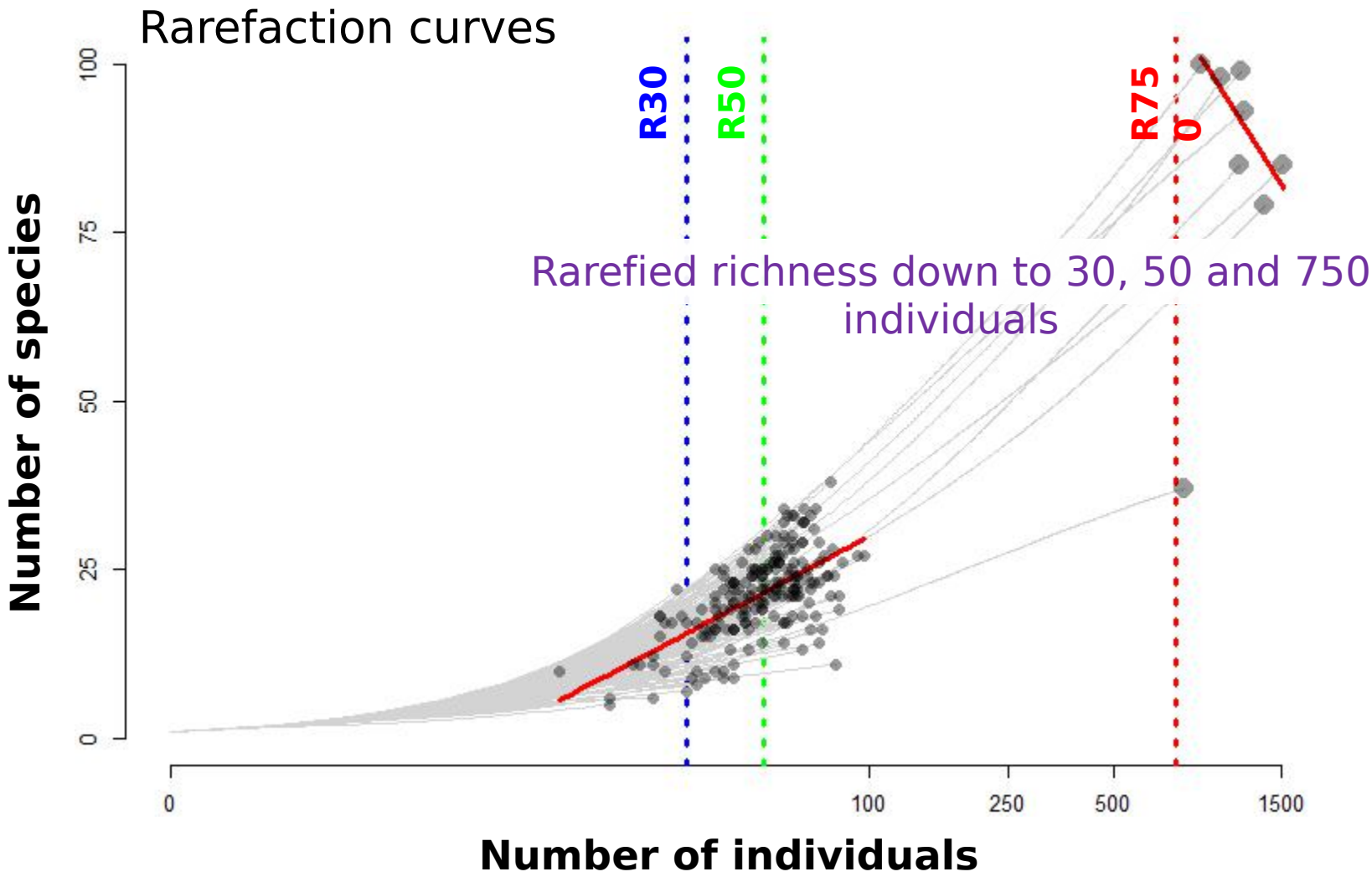
α diversity

Species richness standardization:
Plot area or number of stems?



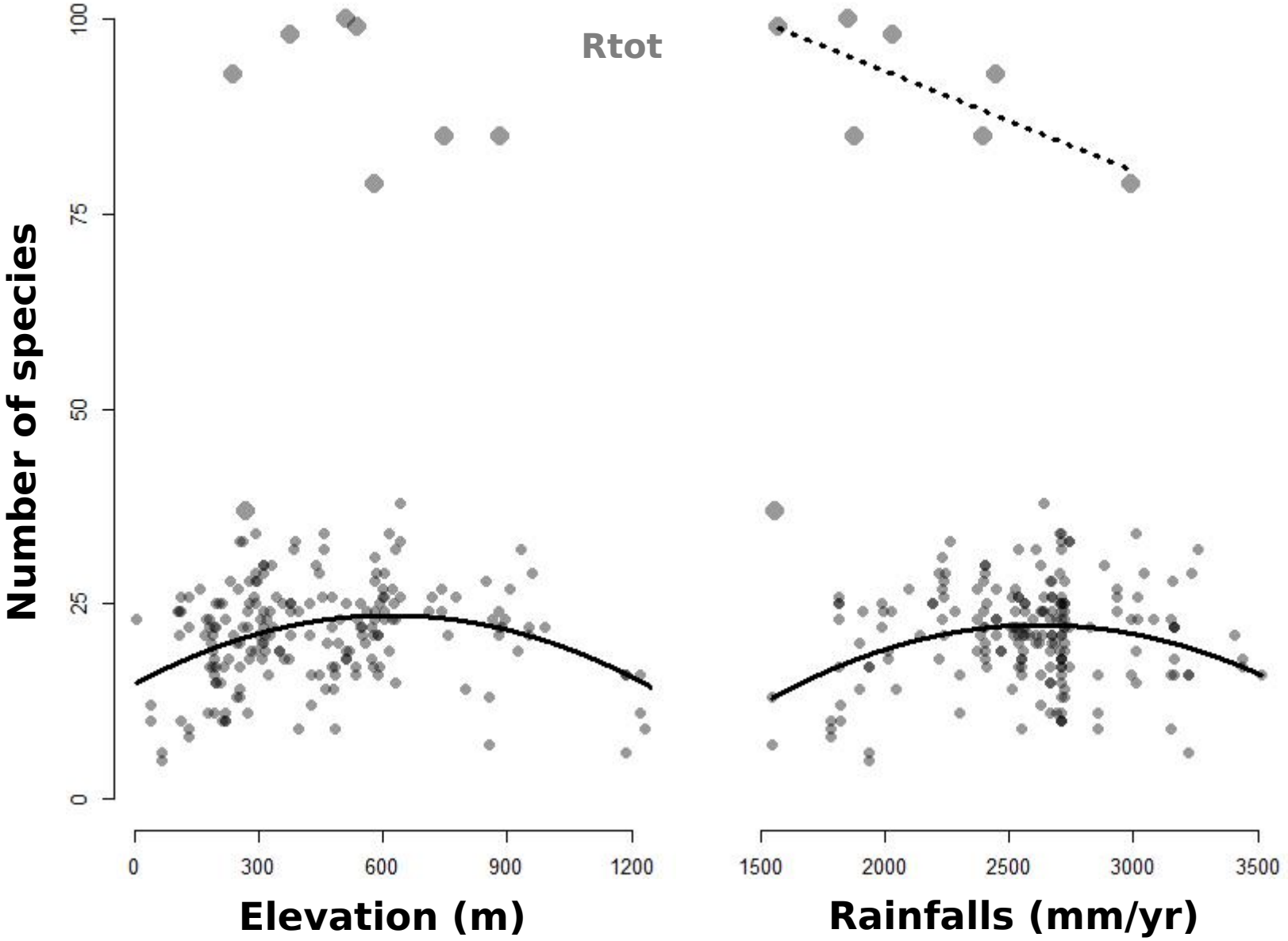
α diversity

Species richness standardization: Plot area or number of stems?



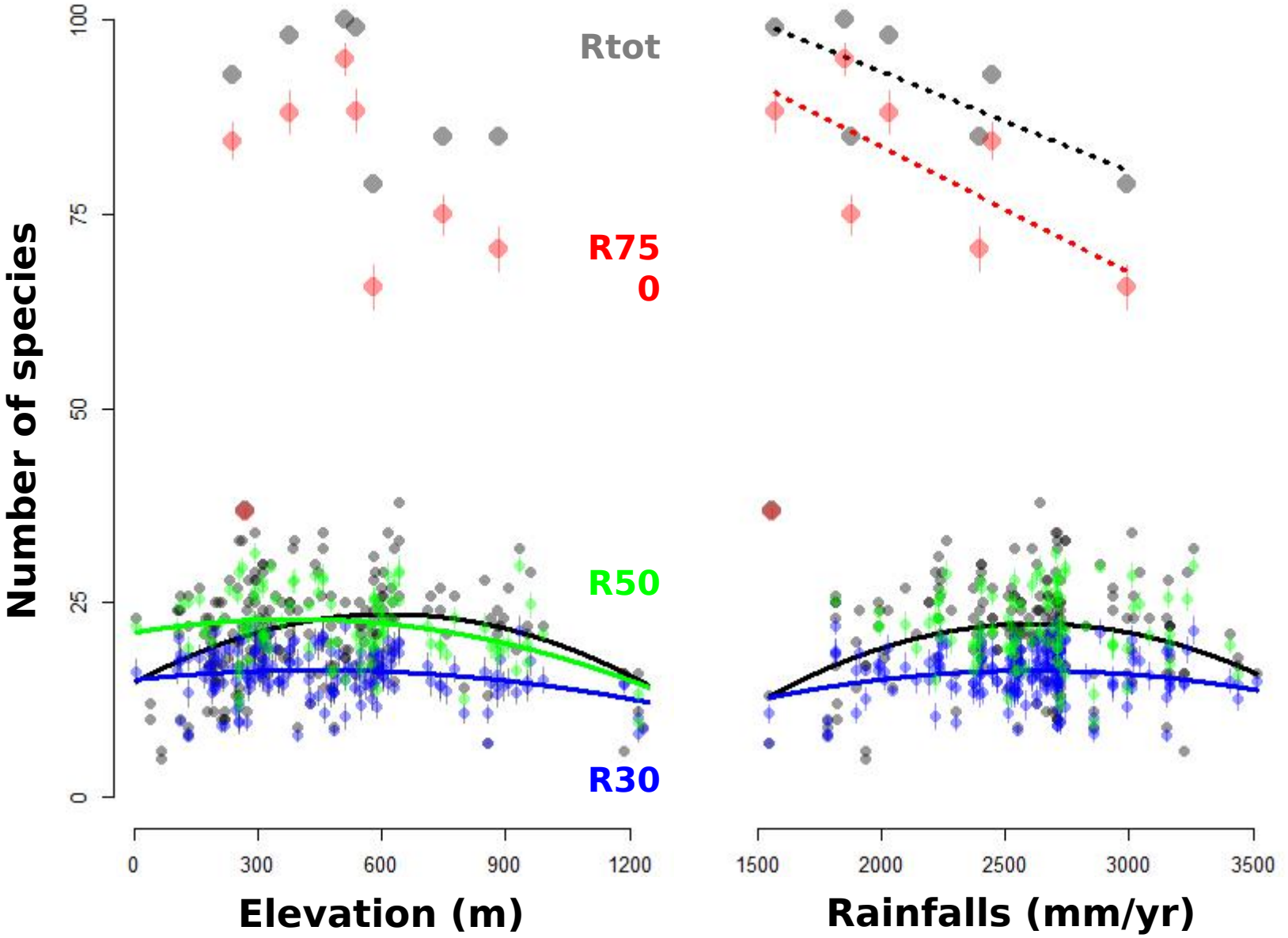
α diversity

Standardized by area



α diversity

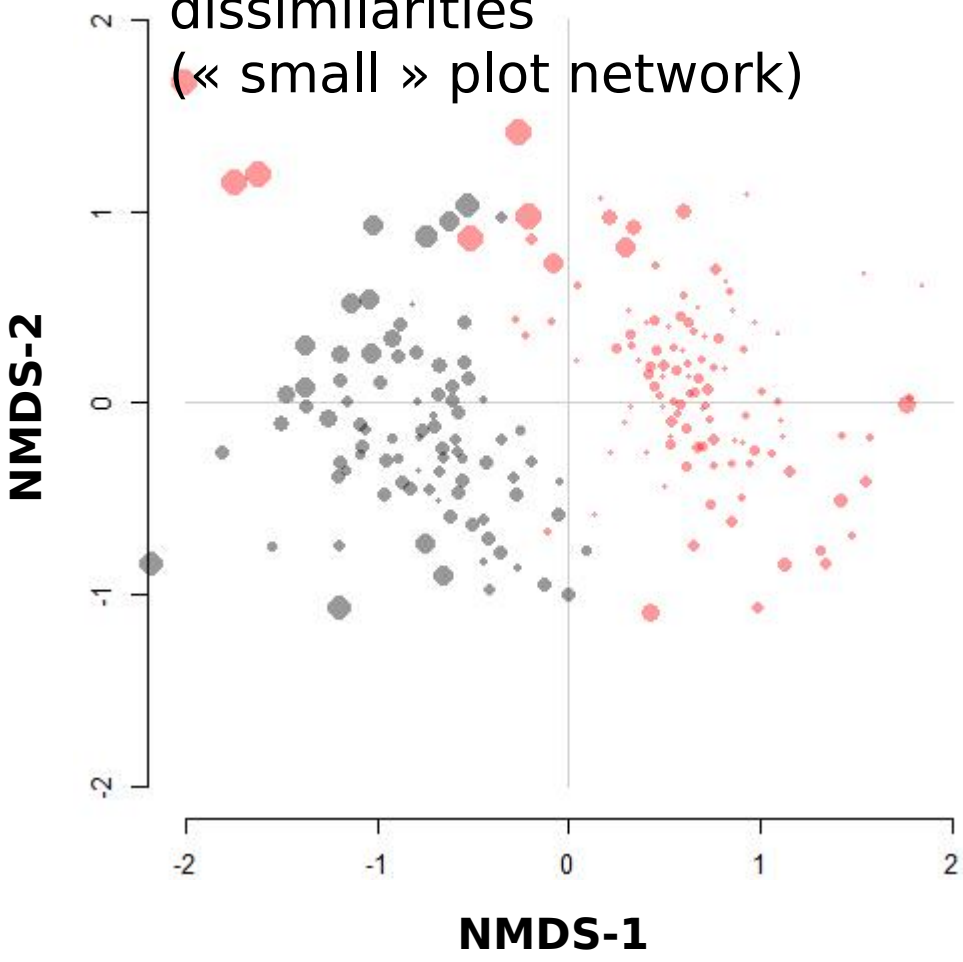
Standardized by area vs. by the number of individuals

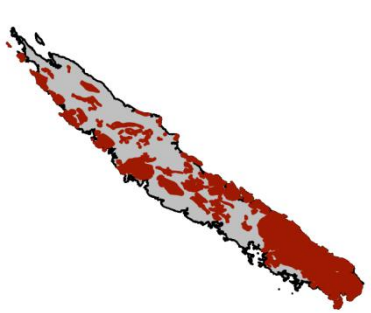


β diversity

High species turnover between ultramafic and non-ultramafic
Species turnover decreases with elevation

Ordination – SØrensen dissimilarities
(« small » plot network)



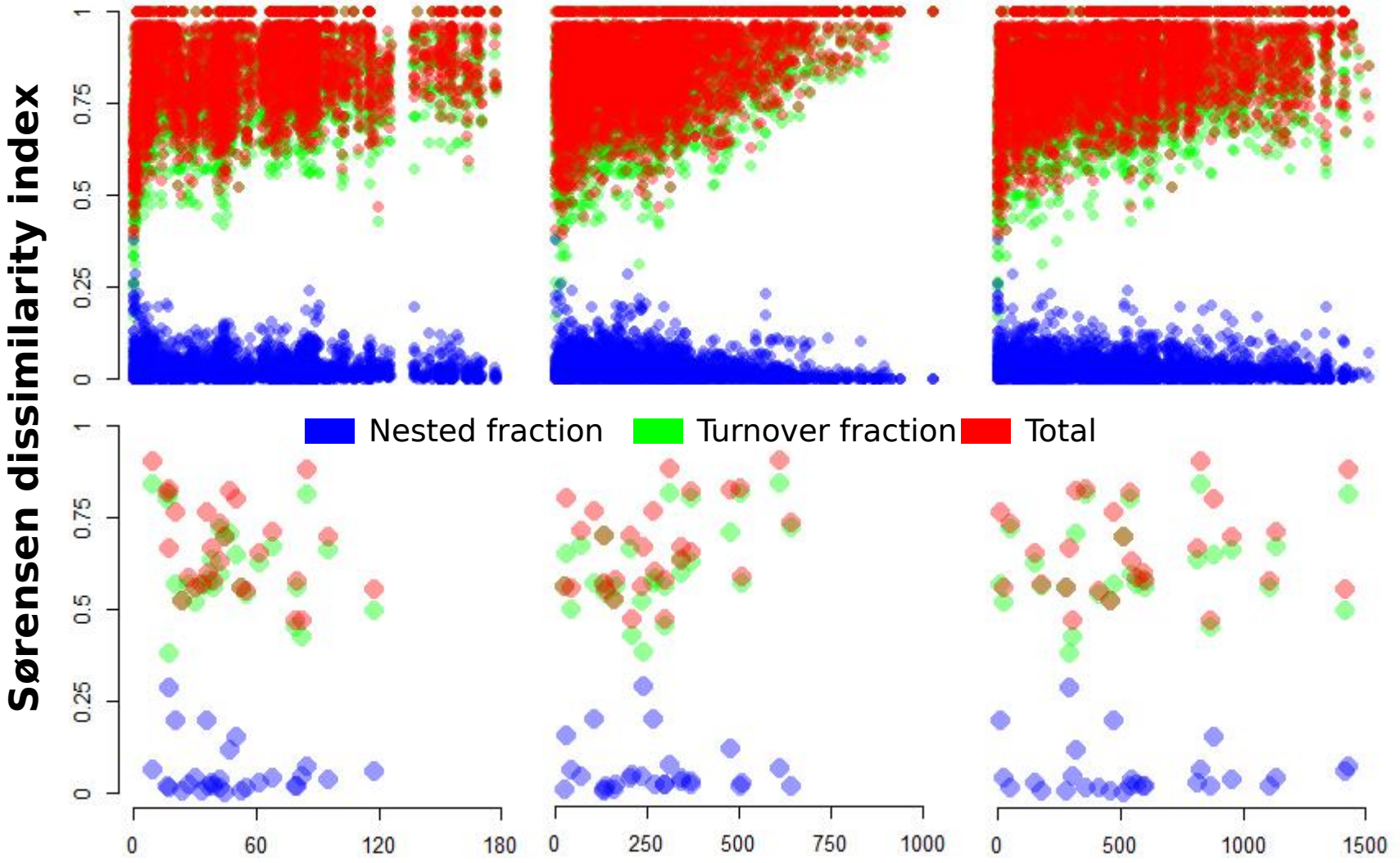


Ultramafic
Non-ultramafic

Elevation

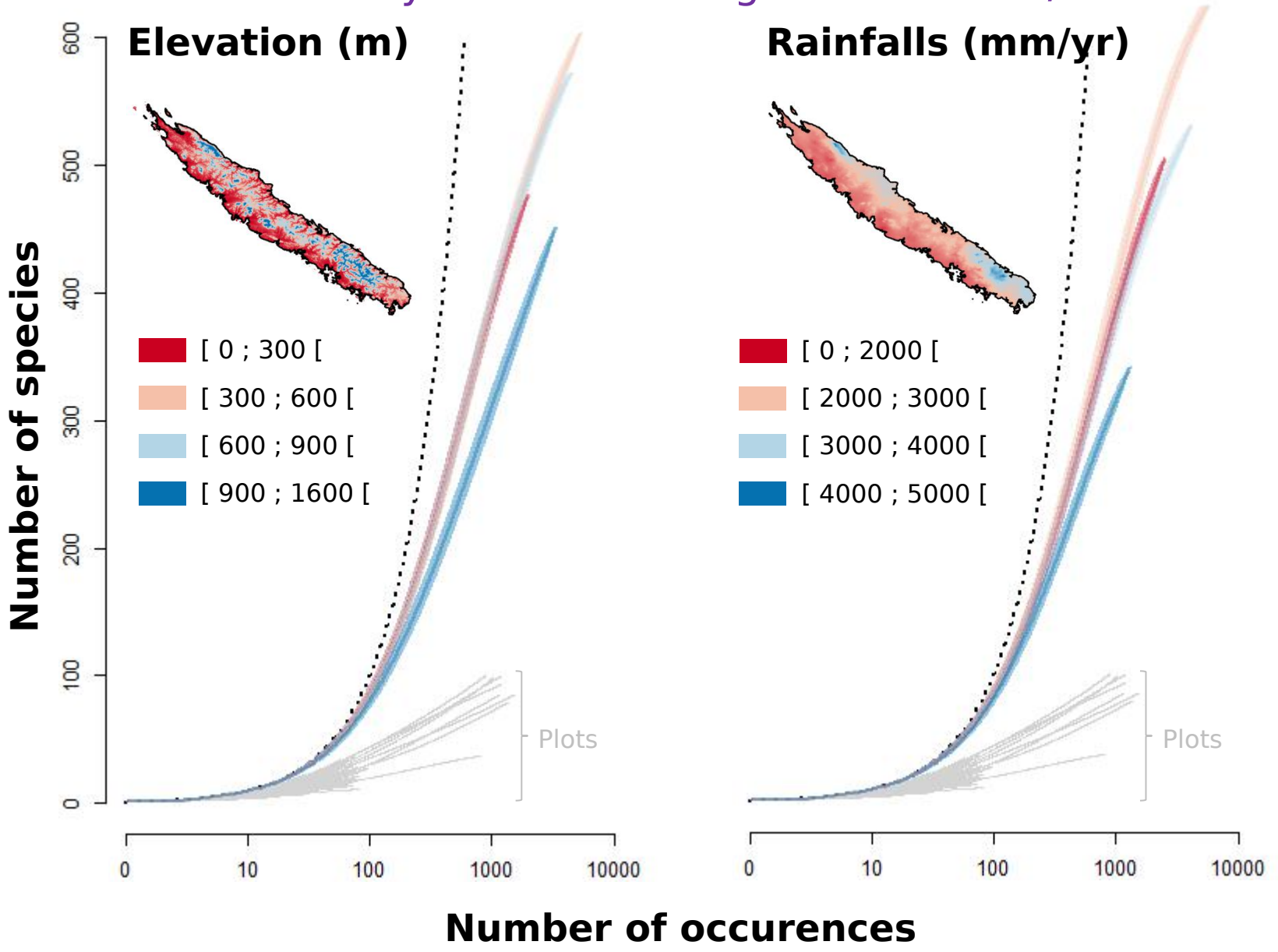
β diversity

High beta diversity (> 70 % dissimilarity)
Weak geographical and environmental effects



γ diversity

Gamma diversity decrease at higher elevation / rainfalls

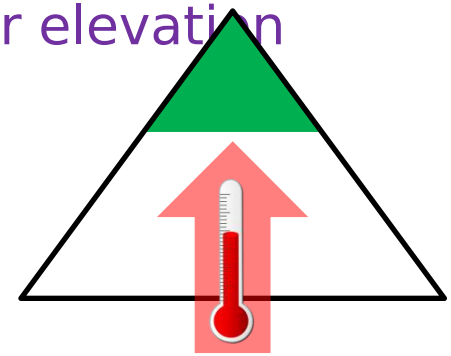


Drivers of tree species diversity
Synthesis and perspectives

Alpha diversity relatively low despite an unusual tree density
(<100 species for about 1000 individuals)

High beta-diversity
(inter-plot dissimilarities > 70 %)

Alpha and gamma diversity decrease at higher elevation
But beta diversity increase
à Less rich but specific high elevation flora
à Response of communities to warming ?



Alternative hypothesis
Spacial constrainst, not climatic constraints drive diversity patterns ?

Alternative hypothesis

Spatial constraints correlated to elevation
Forest area, connectivity, fragmentation, habitat loss


Oléti (Thank you)