Does endemic trees flora make endemic forests?

insights from New Caledonia

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Island BIOLOGY La Réunion 8-13 JULY 2019

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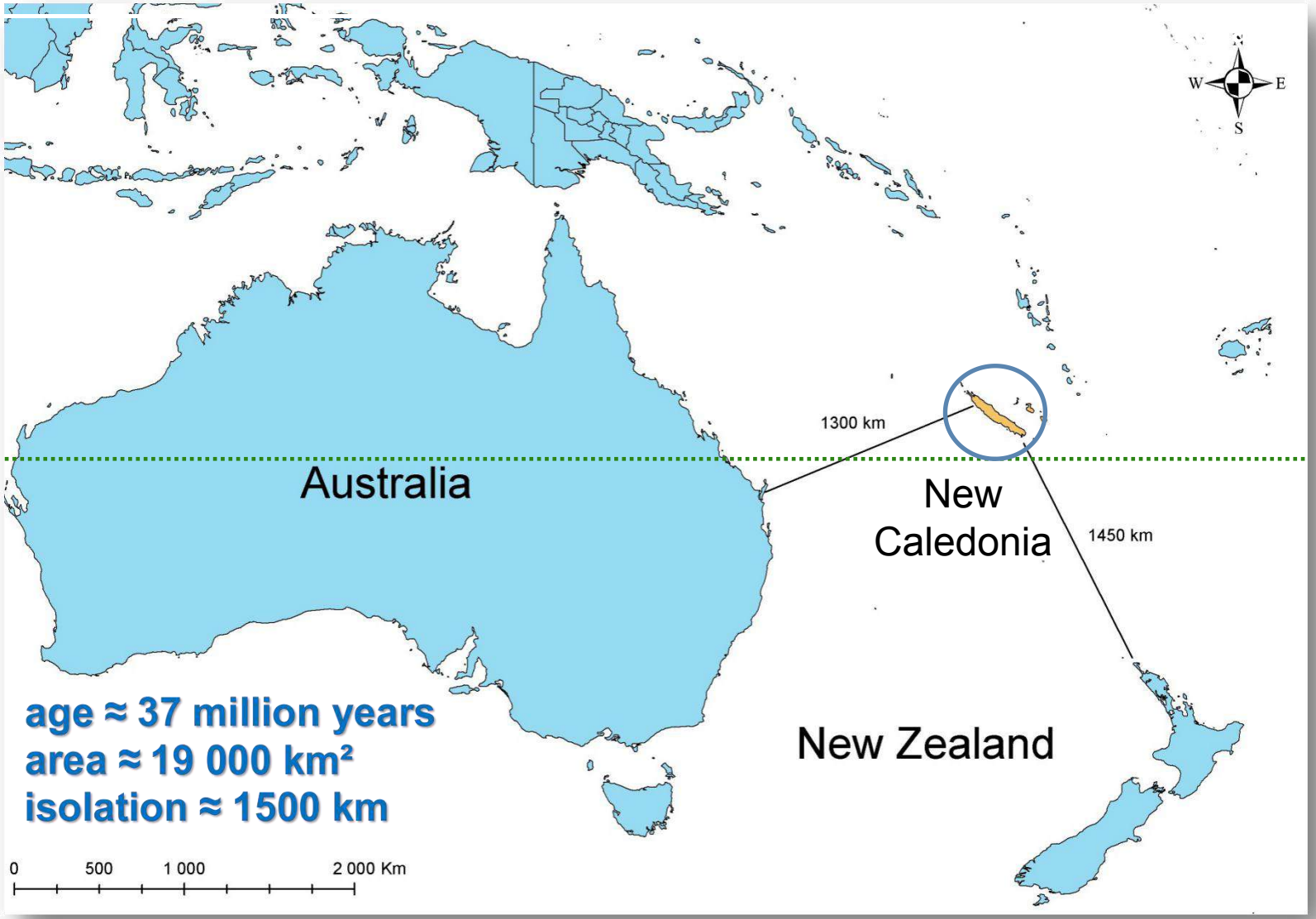
IAC Institut Agronomique néo-Calédonien

IRD Institut de Recherche pour le Développement

New Caledonia archipelago

Old, large and isolated archipelago



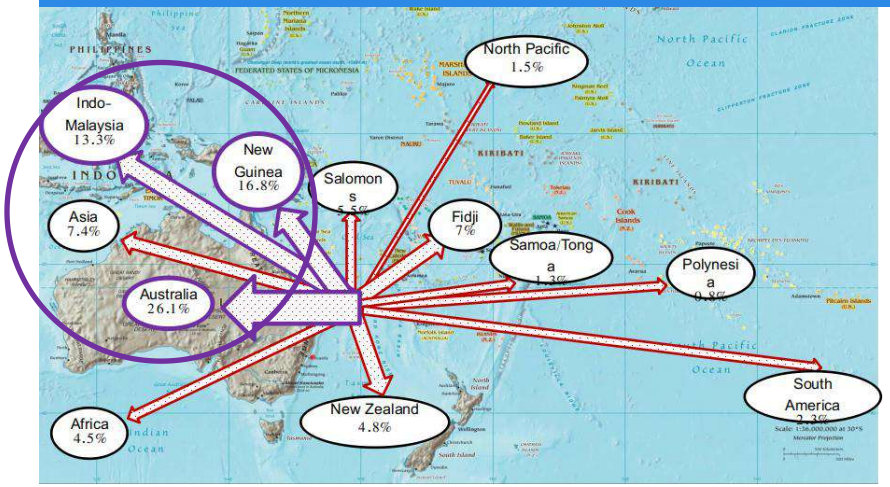
Taxonomists heaven

Floristic diversity: huge, amazing, remarkable

Botanical accounting (florical june 2019)

	Families		Genera		Species			Taxa		
	Indigenous	Endemic	Indigenous	Endemic	Indigenous	Endemic	%	Indigenous	Endemic	%
Lycophytes	2	0	9	0	24	11	45.8	24	11	45.8
Ferns	31	0	99	1	267	102	38.2	268	102	38.1
Gymnosperms	5	0	14	2	51	50	**98**	51	50	98
Basal dicots	11	1	21	4	113	103	**91.2**	127	117	92.1
Monocots	34	0	196	17	566	271	47.9	588	281	47.8
Eudicots	130	2	474	72	2388	2011	84.2	2576	2181	84.7
Angiosperms	175	3	691	93	3067	2385	77.8	3291	2579	78.4
Vascular plants	**213**	**3**	**813**	**96**	**3409**	**2548**	**74.7**	**3634**	**2742**	**75.5**

Australasian origin (Morat et al., 2012)



- Genera affinities with Australia, Malaysia & Papua New-Guinea

- 3 endemic families
- 96 endemic genera
- 75 % endemic species

Biologists heaven

Floristic diversity: curiosity, eccentricity, singularity

Taxonomic disharmony

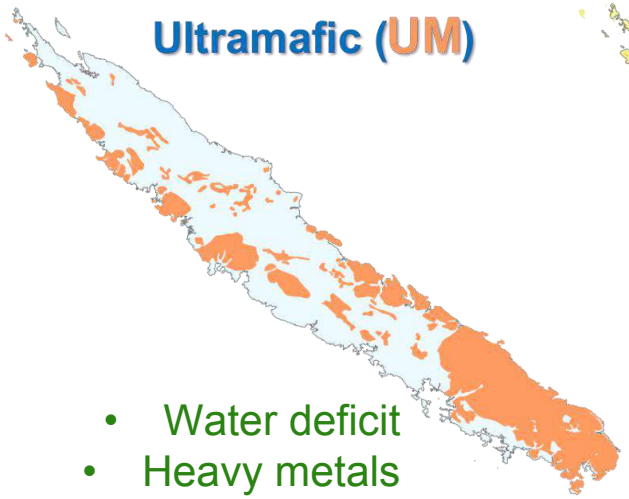
- **Taxonomic disharmony**
  - ++ Rubiaceae, Pittosporaceae, Cunoniaceae, Euphorbiaceae
  - -- Fabaceae, Lamiaceae, Malvaceae, Ericaceae
- **Gymnosperms diversification**
  - 7% of all world species
- **Basal Angiosperms diversification**
  - Lauraceae, Proteaceae, Winteraceae, Piperaceae, Annonaceae, Monimiaceae…
  - Amborellaceae
- **Interspecific parasitism in Gymnosperms (Podocarpaceae)**
  - *Parasitaxus usta* **and host** *Falcatifolium taxoides*
- **Tallest Pteridophyte (tree ferns)**
  - *Sphaeropteris intermedia* (28 m)

Contrasted habitats

Grande-Terre : Environmental heterogeneity

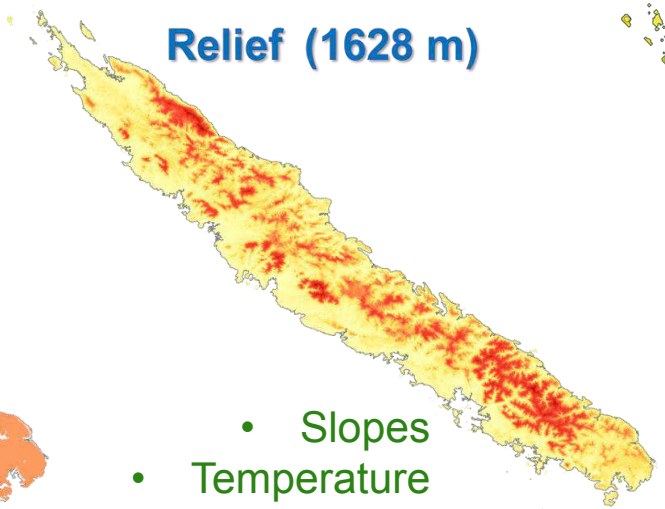
Diversity of environment

Ultramafic (UM)



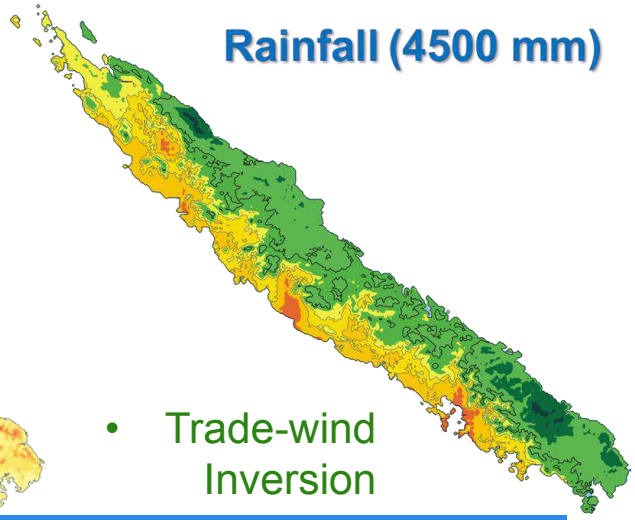
- Water deficit
- Heavy metals

Relief (1628 m)



- Slopes
- Temperature

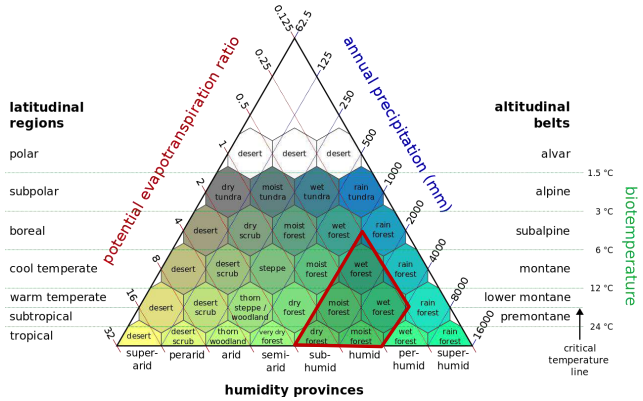
Rainfall (4500 mm)

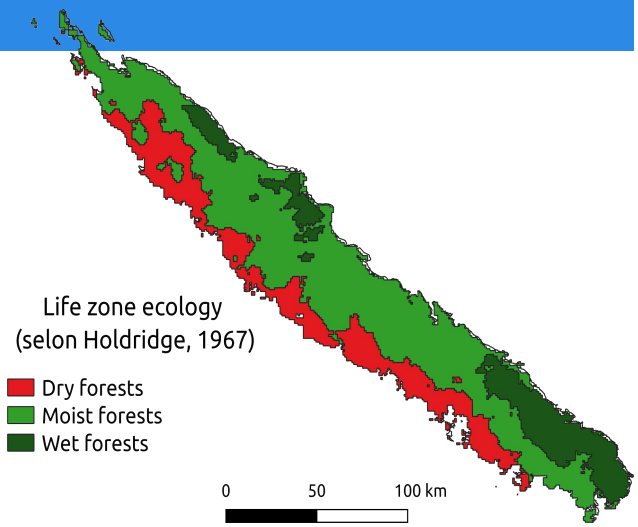


- Trade-wind Inversion

Habitats diversity

- **Three life zones according to Holdridge**

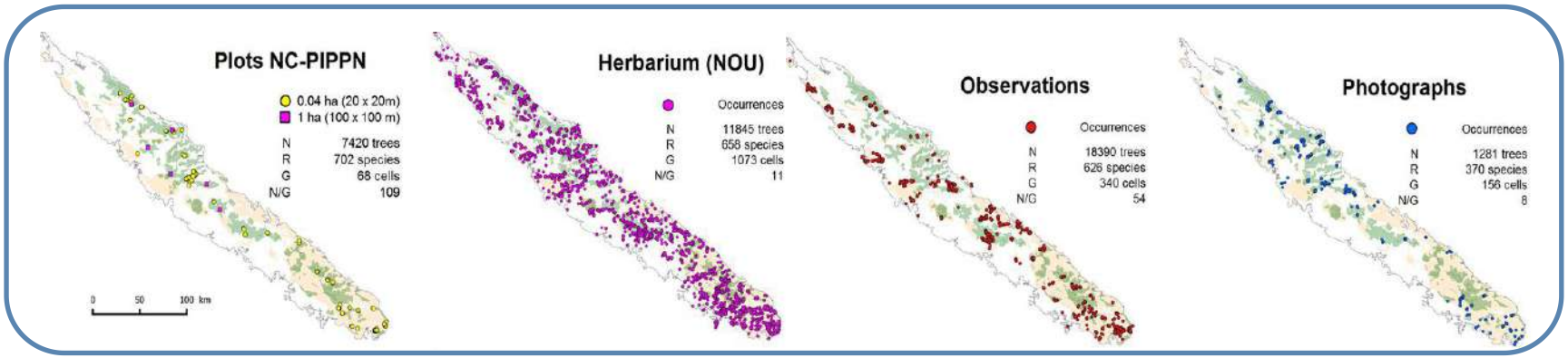




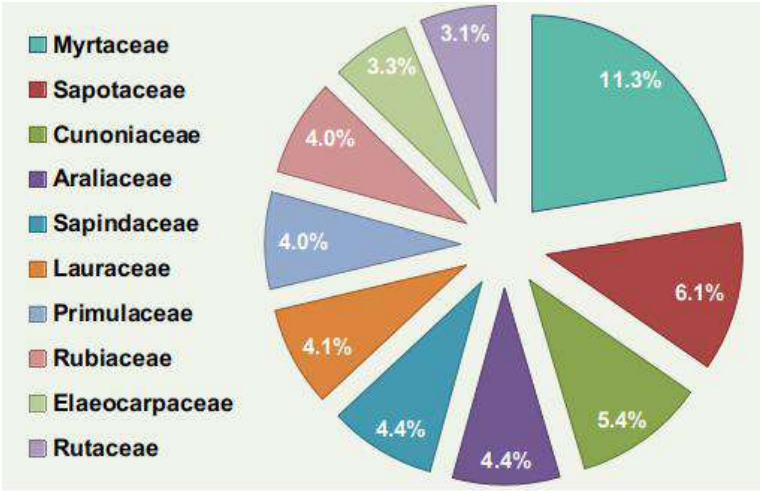
Trees flora

Geographic and environmental distribution

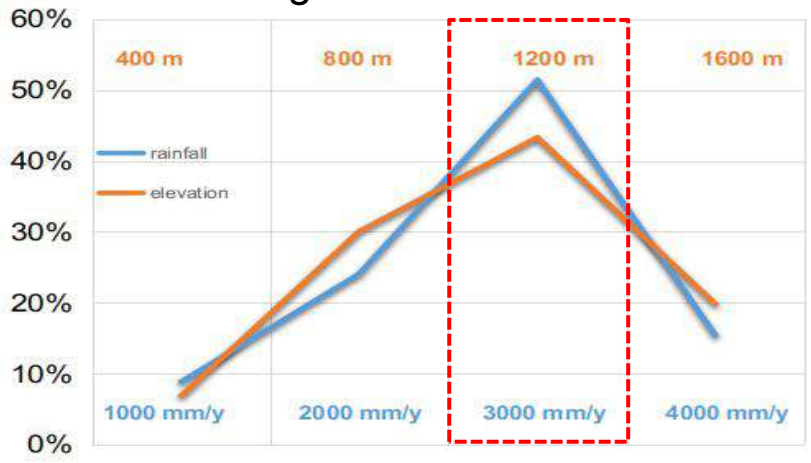
Trees database: > 70 000 occurences, 450 plots (≈ 40 ha)



Trees flora: 99 families, 951 species, 94 % endemism, high environmental tolerance



Range of trees distribution



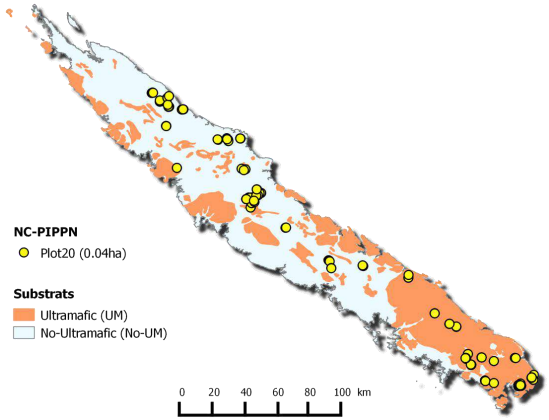
Oligarchy : 17.5 % of species = 50 % occurences

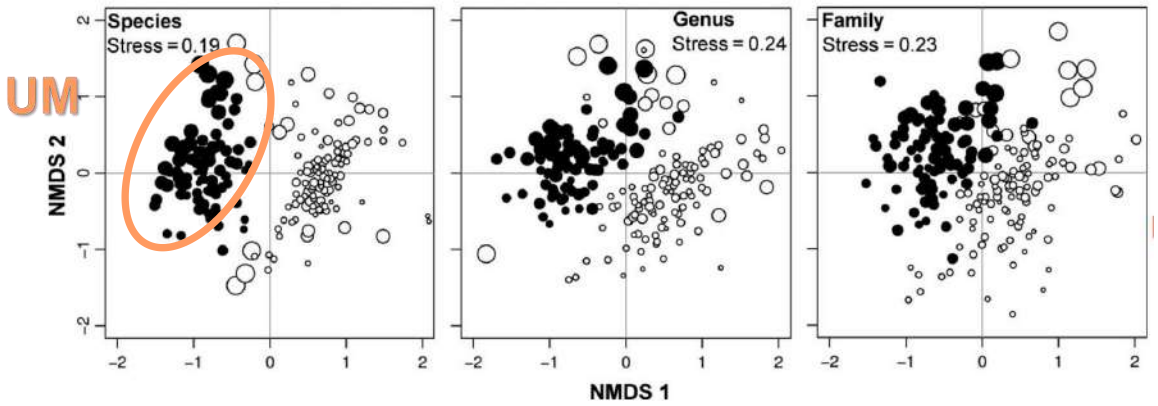
Birnbaum et al., 2015; 2016

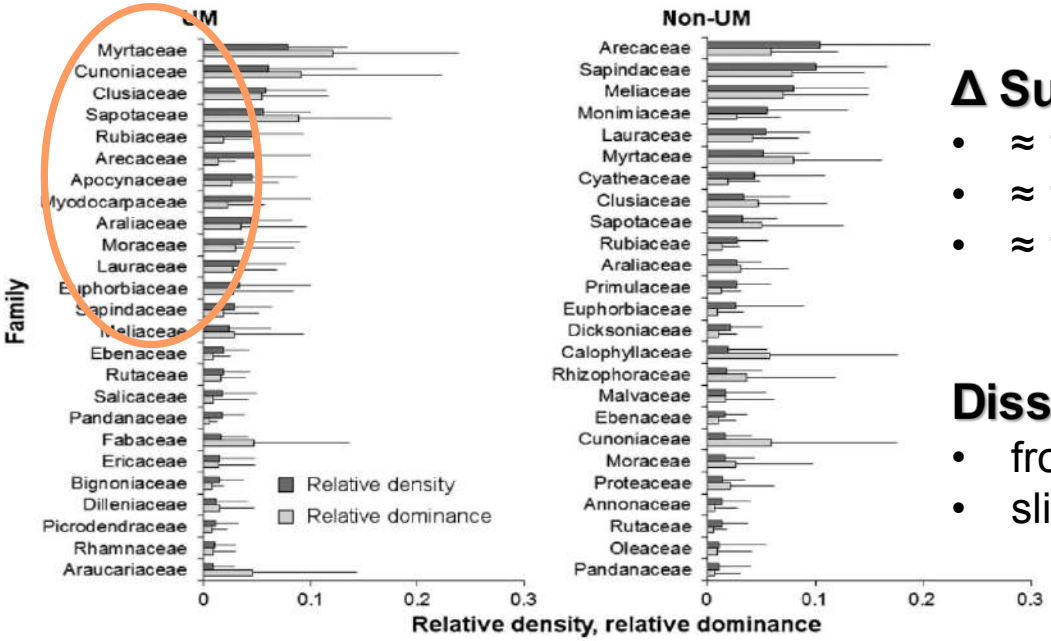
Trees floristic dissimilarities

Beta diversity: substrate effect

inter-plot dissimilarities > 70 %







Δ Substrat

- ≈ 1/3 species only on UM-substrate
- ≈ 1/3 species only non-UM-substrate
- ≈ 1/3 substrate-tolerant

Dissimilarity UM vs non-UM

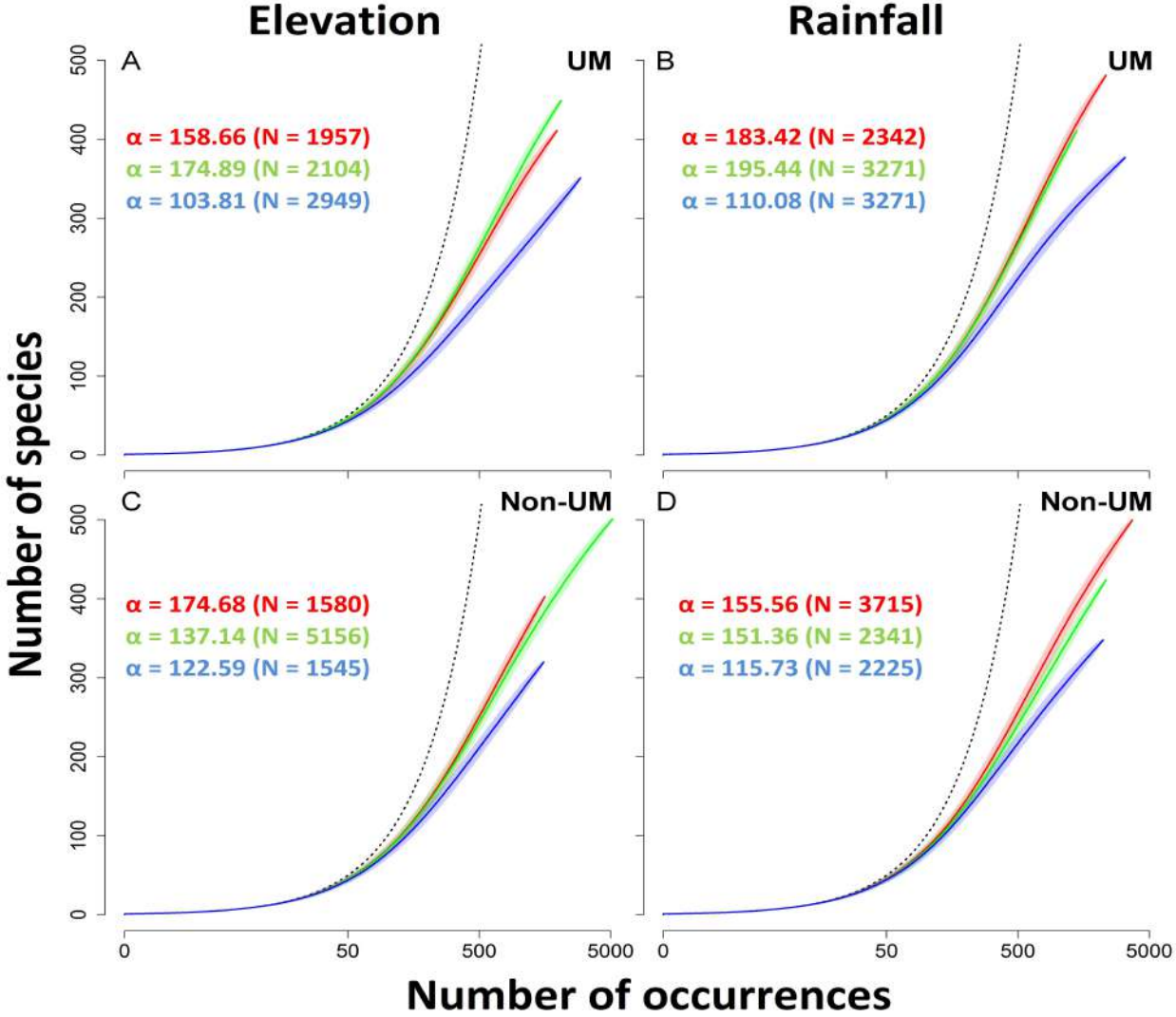
- from families to species
- slightly decreases with elevation

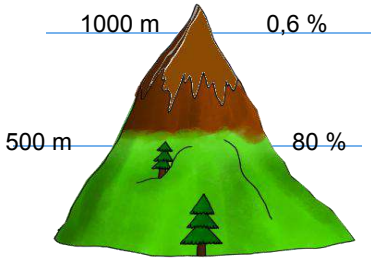
Ibanez et al., 2014; Isnard et al., 2016

Trees species distribution

Gamma diversity: elevation/rainfall effect

Lower at higher elevation / rainfalls





Elevation > 800 m

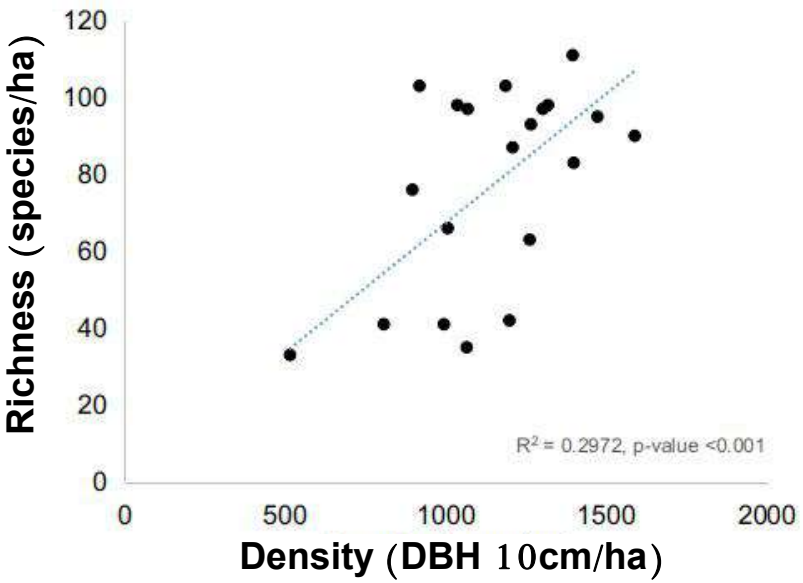
Rainfall > 3 m / year

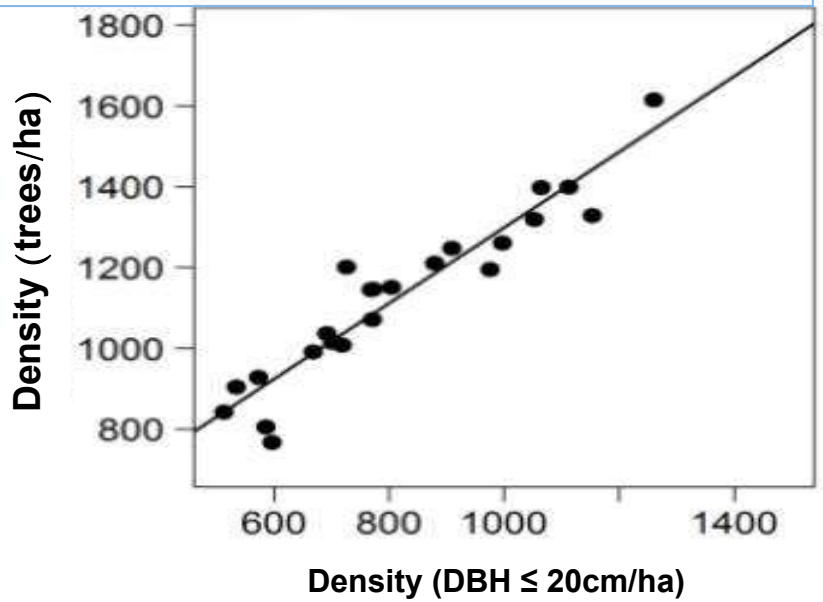
Birnbaum et al., 2015

Alpha diversity: density effect

Density explains 30 % of alpha diversity

1000 trees DBH ≥ 10cm /ha **but** 80 % of trees < 20 cm of DBH

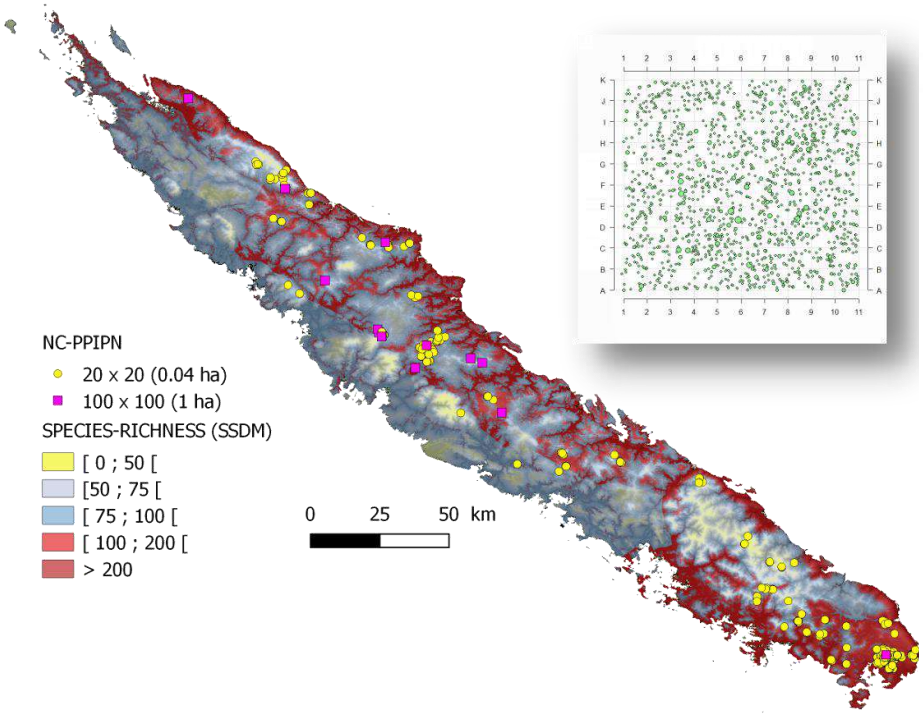


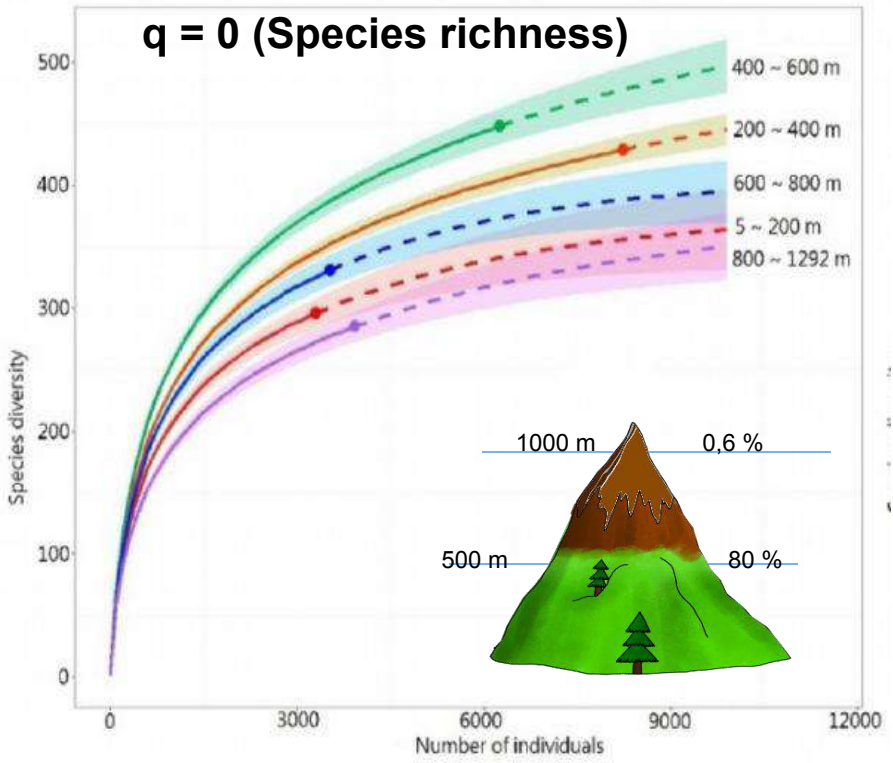


Trees communities

Alpha diversity : elevation effect

A mid-domain effect - α-diversity (Hill number))





Richness
- max. Richness = 400-600 m
- min. Richness < 200m and >800m

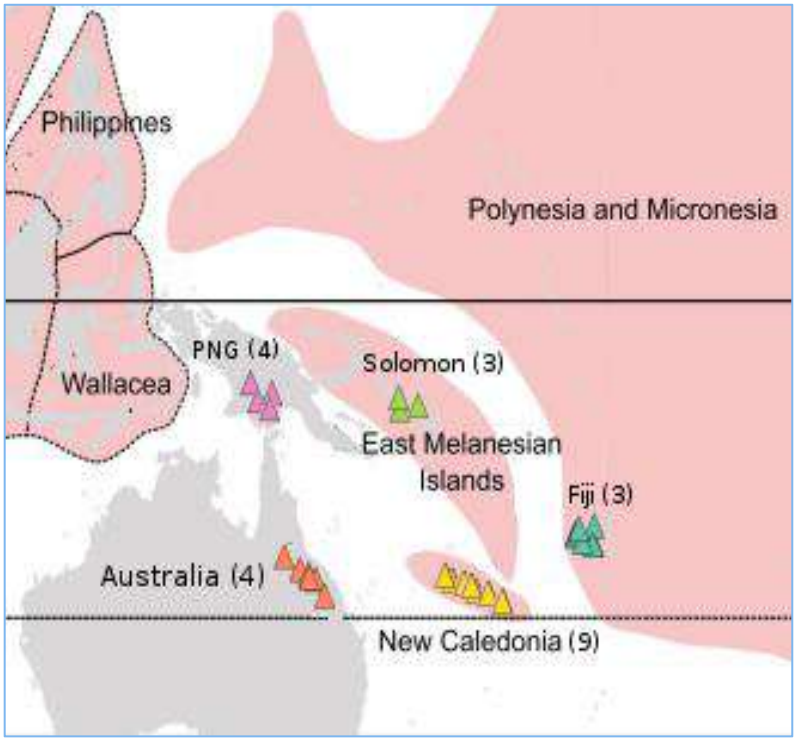
Elevation effect

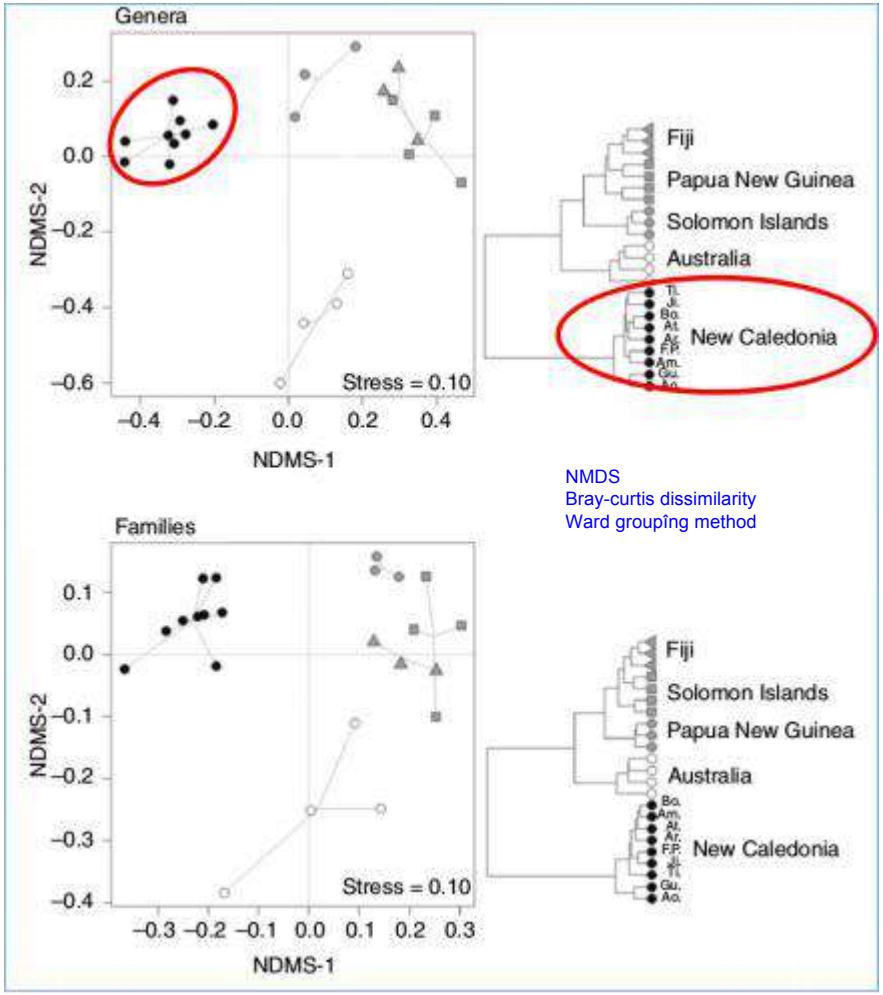
Pouteau et al., 2015; Chao et al., 2016

Regional floristic dissimilarities

Beta diversity: regional taxonomic dissimilarities

A singular tree flora - β-diversity (Bray-Curtis) - 23 plots of 1ha





Floristic dissimilarity

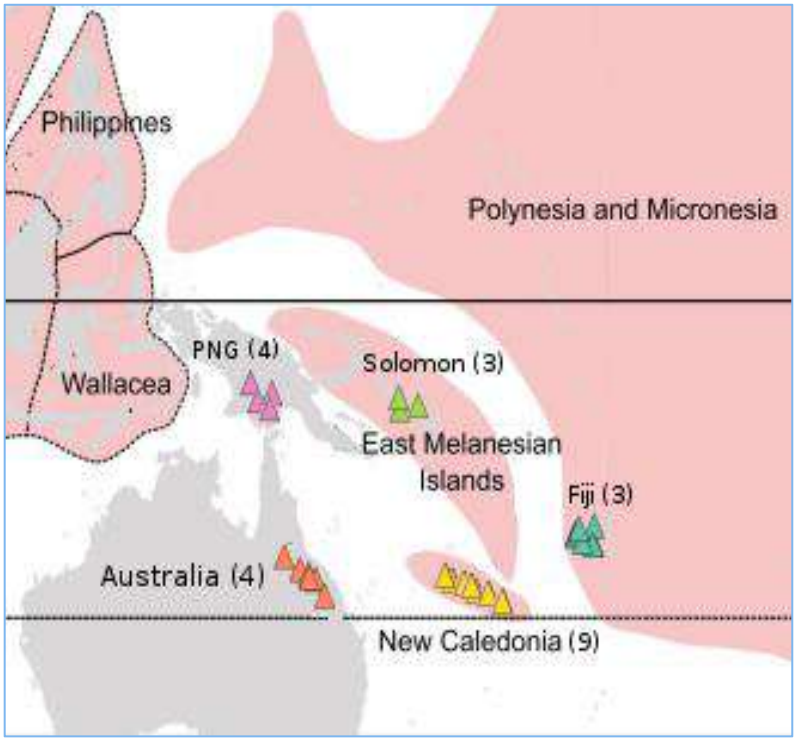
- Gymnosperms
- Basal Angiosperms
- Pteridophytes

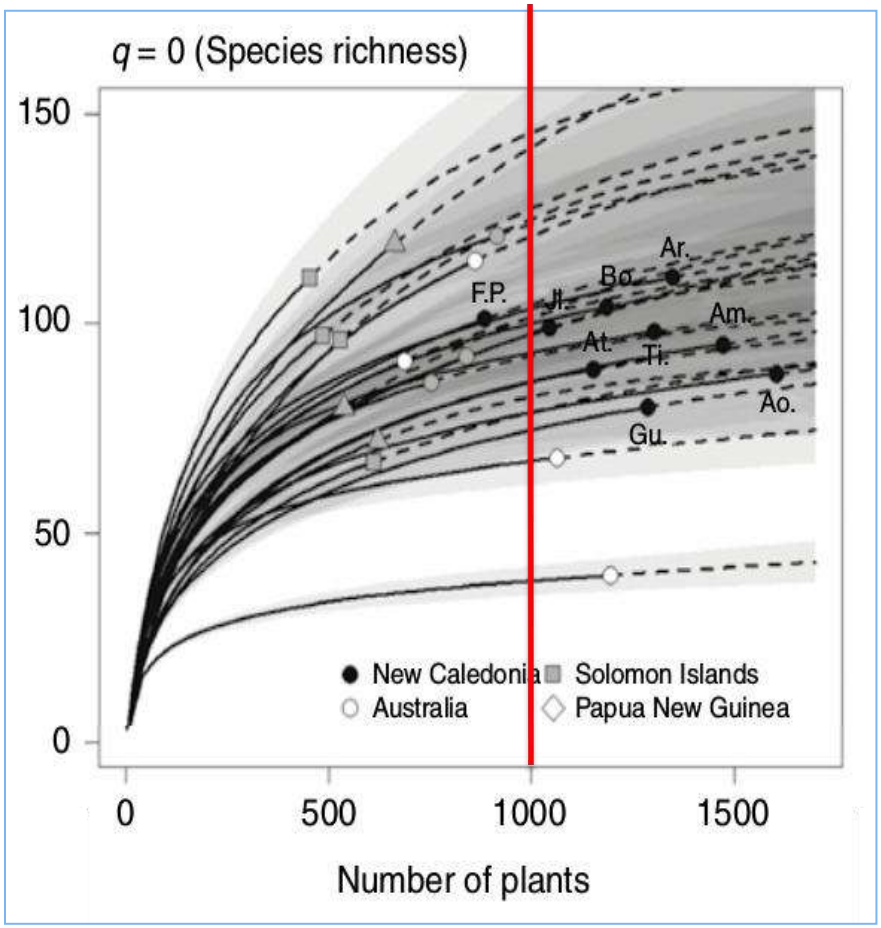
Ibanez et al., 2017

Regional Trees communities

Alpha diversity : 1-ha plots comparison

A standard richness - α-diversity (Hill number))





Forest singularity

- High stem densities
- Endemism
- Abundance of tree ferns

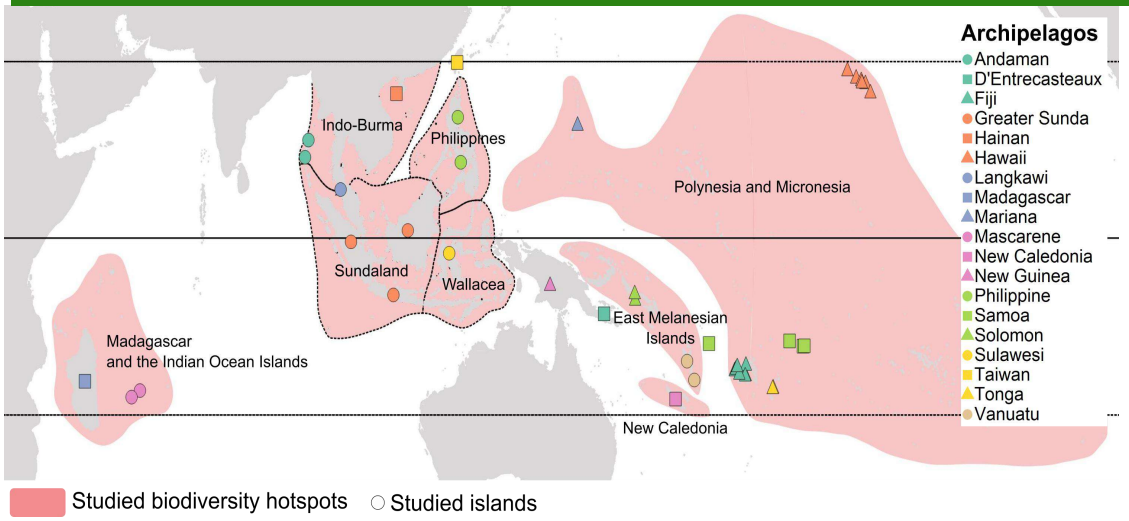
not significant difference for 1000 individuals
(Wilcoxon rank sum test, P > 0.05)

Ibanez et al., 2017

Richness as a geographical feature

Alpha diversity in tropical islands

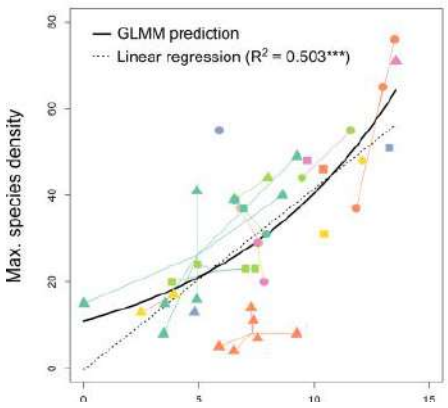
A predicted richness



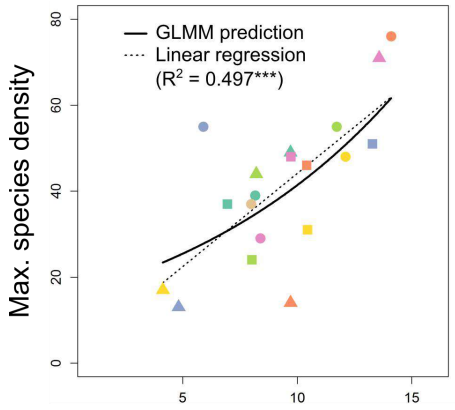
- **41 Indo-Pacific islands**
- **19 archipelagos**
- **113 plots (1ha)**

Richness variance

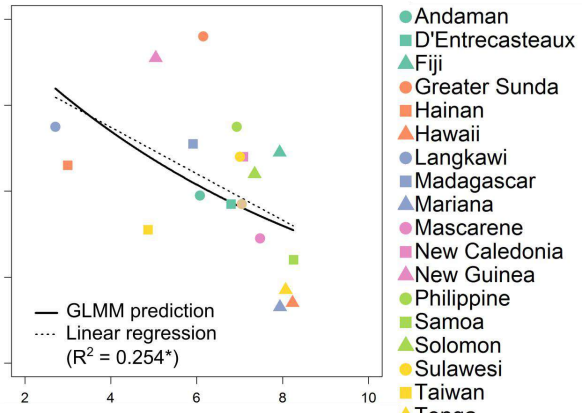
- 73 % Geography
  - area & isolation
- 21 % Climat
  - rainfall & temperature



island area



archipelago area

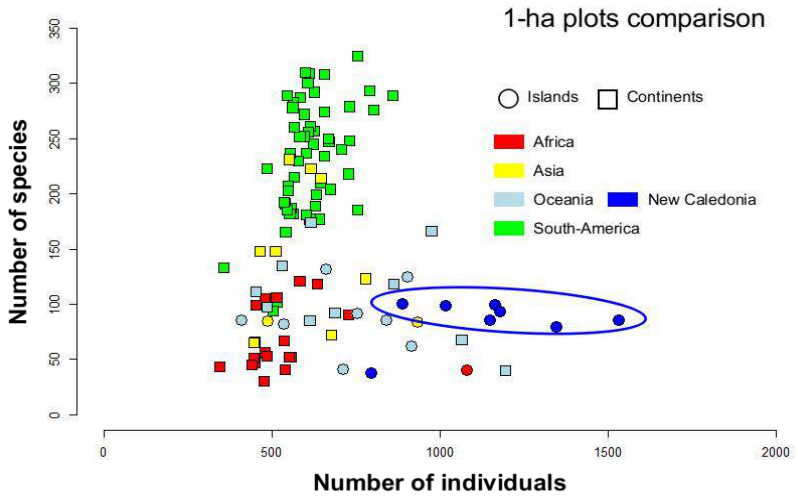


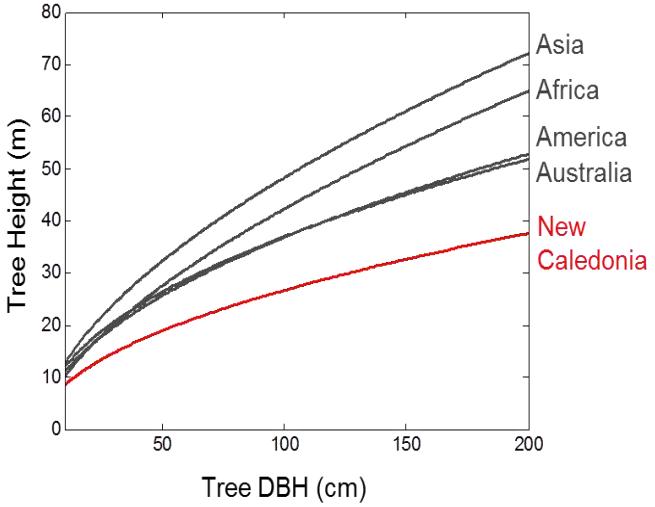
isolation

Ibanez et al, 2018

New Caledonian forest vs. other tropics forests

High tree density & low canopy height

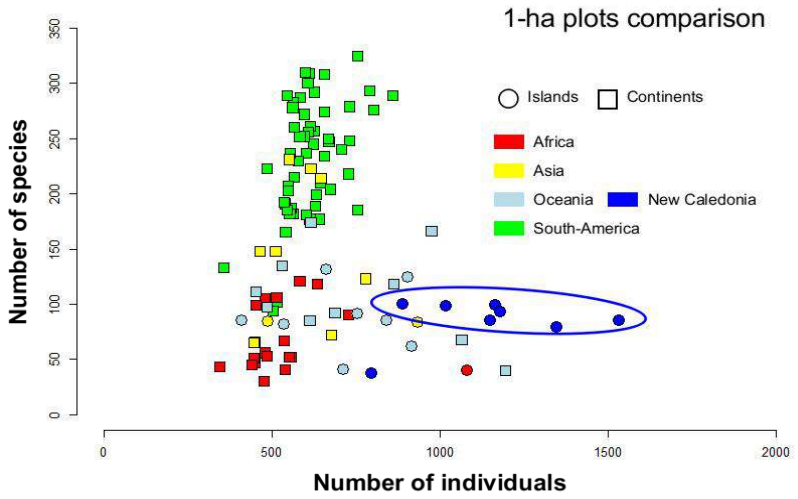


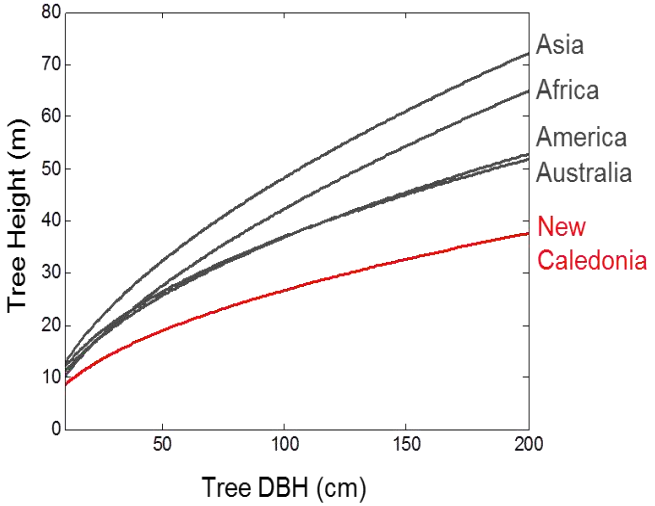


Structural singularity

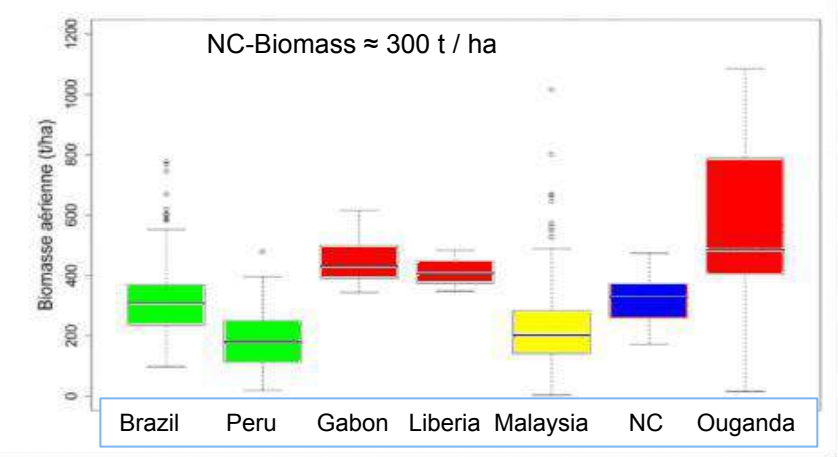
New Caledonian forest vs. other tropics forests

High tree density & low canopy height



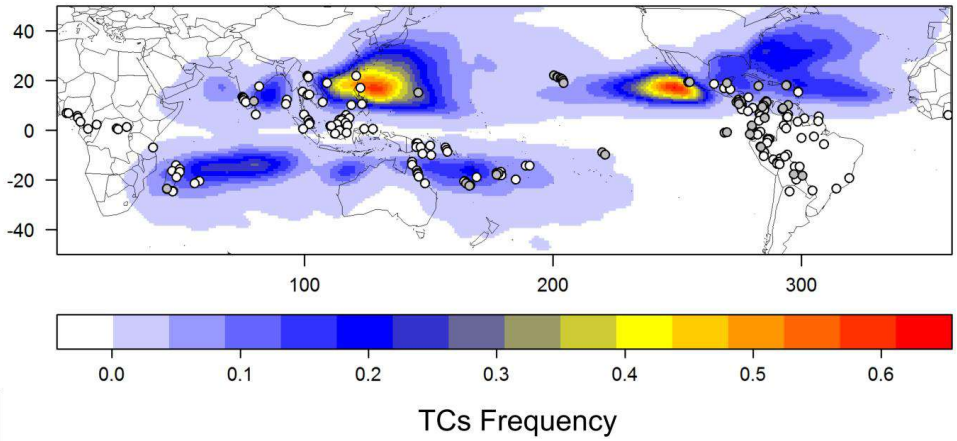


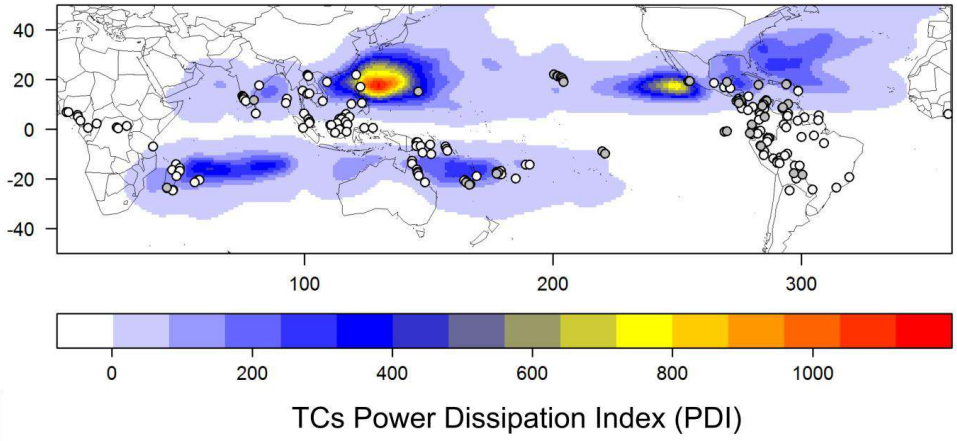
Standard biomass

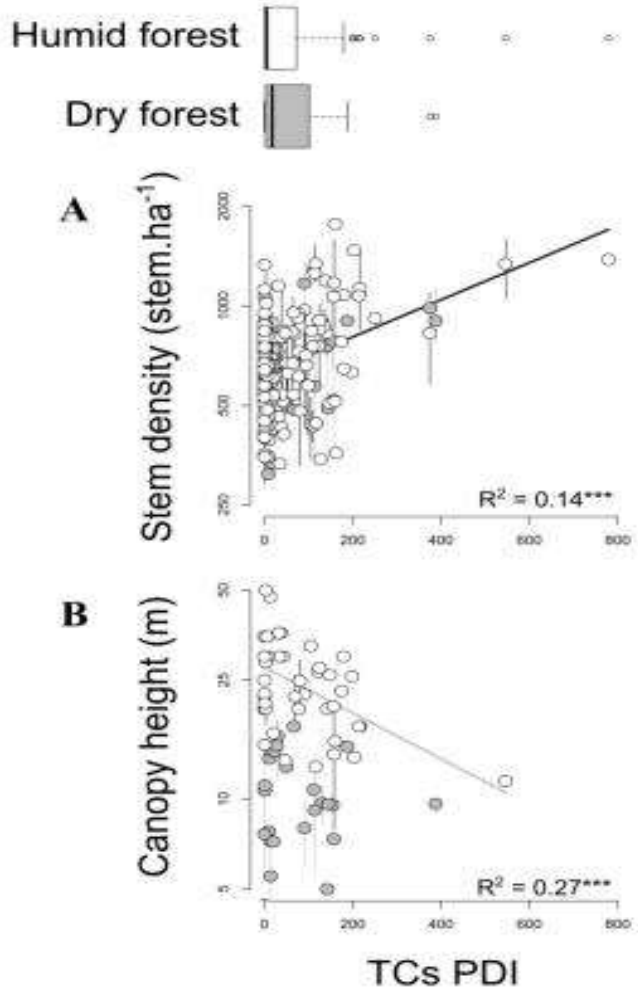


Cyclones increase density and decrease canopy height

A predicted densitiy and canopy height







Ibanez et al, 2018

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