¿Is hábitat diversity a sentinel of soil microbiota?

Implications for conservation y restauration

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Centro de Investigación sobre Desertificación (CIDE)
Ecología y cambio global

CIDE Centro de Investigaciones Sobre Desertificación

CSIC Consejo Superior de Investigaciones Científicas

Universitat de València

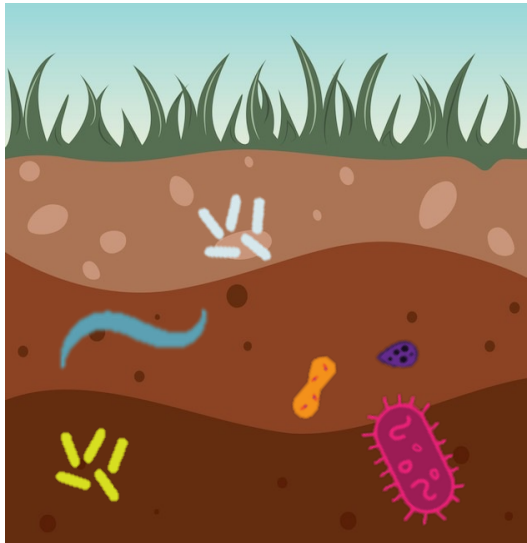
Generalitat Valenciana

BIOCLIMA

Introduction

Conserving and restoring generally implies the need to focus on habitats types or maximizing the diversity within a trophic level, e.g. vegetation

To which extent vegetation and microbiota vary in similar ways along environmental gradients?



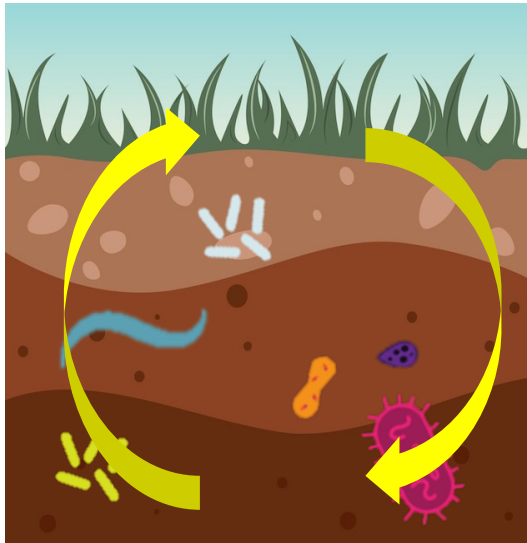
Introduction

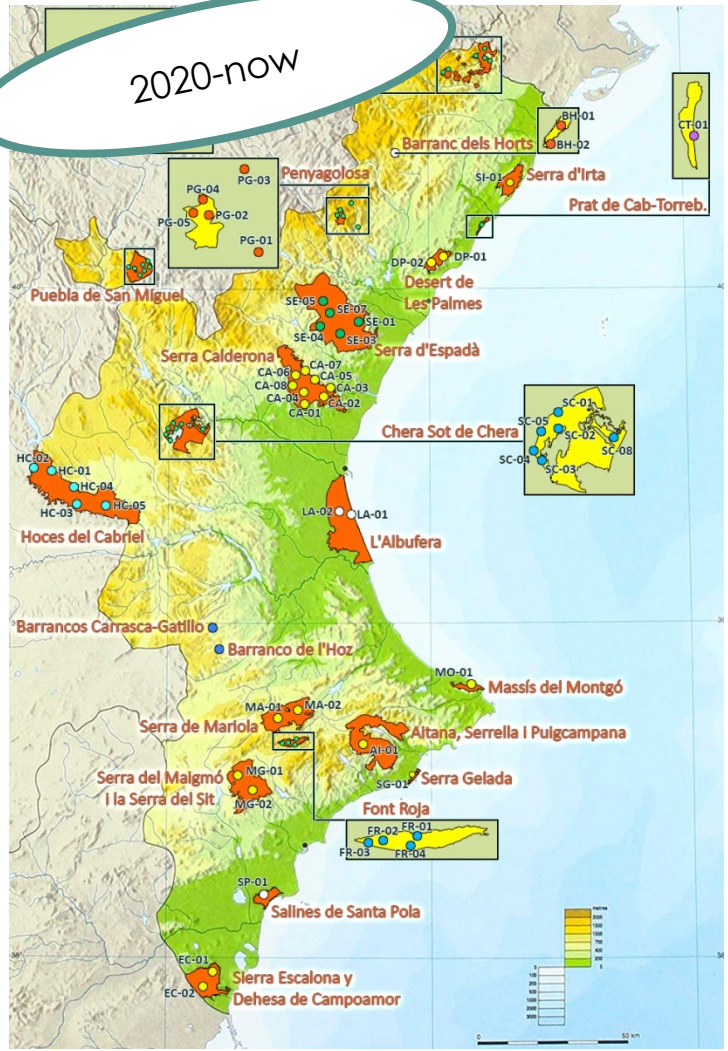
Conserving and restoring generally implies the need to focus on habitats types or maximizing the diversity within a trophic level, e.g. vegetation

To which extent vegetation and microbiota vary in similar ways along environmental gradients?

A retro-alimentation between plants and microbiota cause some spatial covariation?

To which extent this depends on functional traits?





RED BIOCLIMA (Bioclima network)

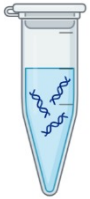
Network of permanent plots across Natural Parks in the Valencian region

https://mediambient.gva.es/es/web/cief/xarxa-bioclima-seguiment-de-la-biodiversitat

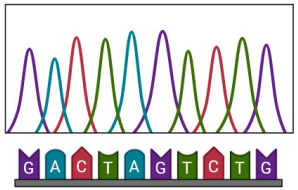
Methods

Soil samples

Processing



DNA



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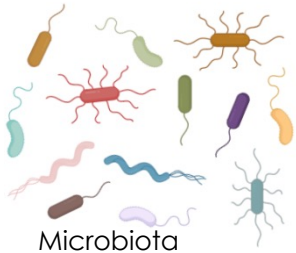
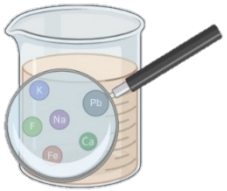


Microbiota



Chemical properties

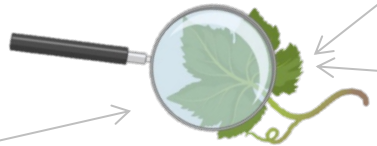
2x10 m
59 plots

Physical properties

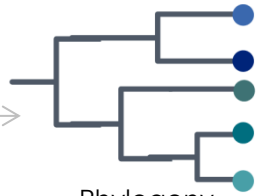
Vegetation composition

BROT2

TRY



Functional traits

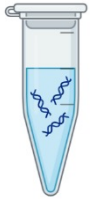


Phylogeny

Methods

Soil samples

Processing



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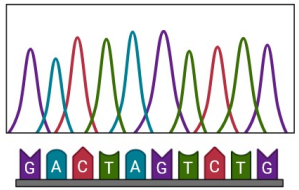

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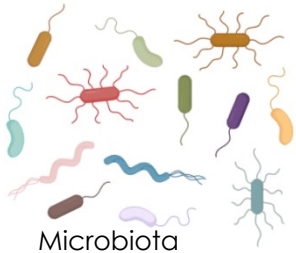
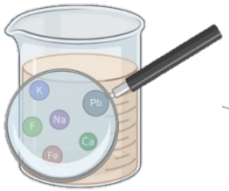


Microbiota



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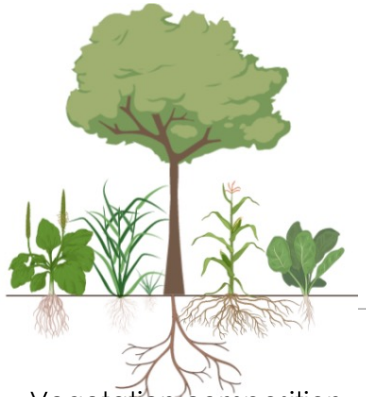
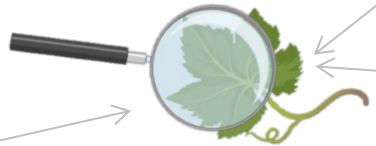


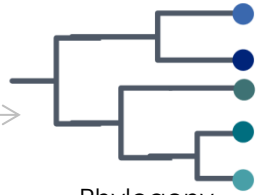
Vegetation composition

BROT2

TRY



Functional traits

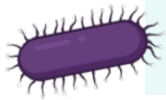


Phylogeny

Data

Vegetation

- Taxonomic
- Functional
- Phylogenetic



Bacteria

- Taxonomic
- Functional

Fungi

- Taxonomic

Data

Vegetation

- Taxonomic
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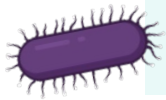

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Fungi

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Covariation

β

α

Data

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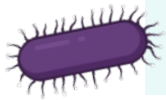

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- Taxonomic
- Functional

Fungi

- Taxonomic

Covariation

β

α

- PCA Soil + pH

- Lat.-Long. y Altitud

DIVERSIDAD BETA

DISSIMILARITY & COINERTIA

VARIABLE	METHOD	MANTEL		COINERTIA
		p-value	r	RV coef.
Bacteria-Fungi	Kulczynski	0.001	0.7373	0.9059
Bacteria-Plants	Kulczynski	0.004	0.2338	0.6505
Bacteria-FG.Bacteria	Kulczynski	0.001	0.5127	0.6911
FG.Bacteria-Plants	Kulczynski	0.009	0.1715	0.3554
FG.Bacteria-Fungi	Kulczynski	0.001	0.5286	0.6328
Fungi-Plants	Kulczynski	0.001	0.2464	0.6969

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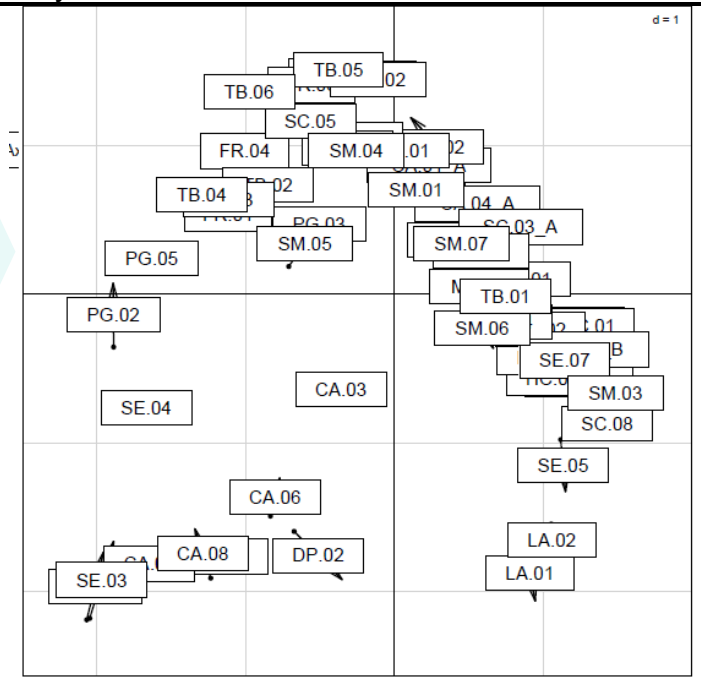
COINERTIA: Bacteria-Fungi



Different microbial groups are well associated spatially

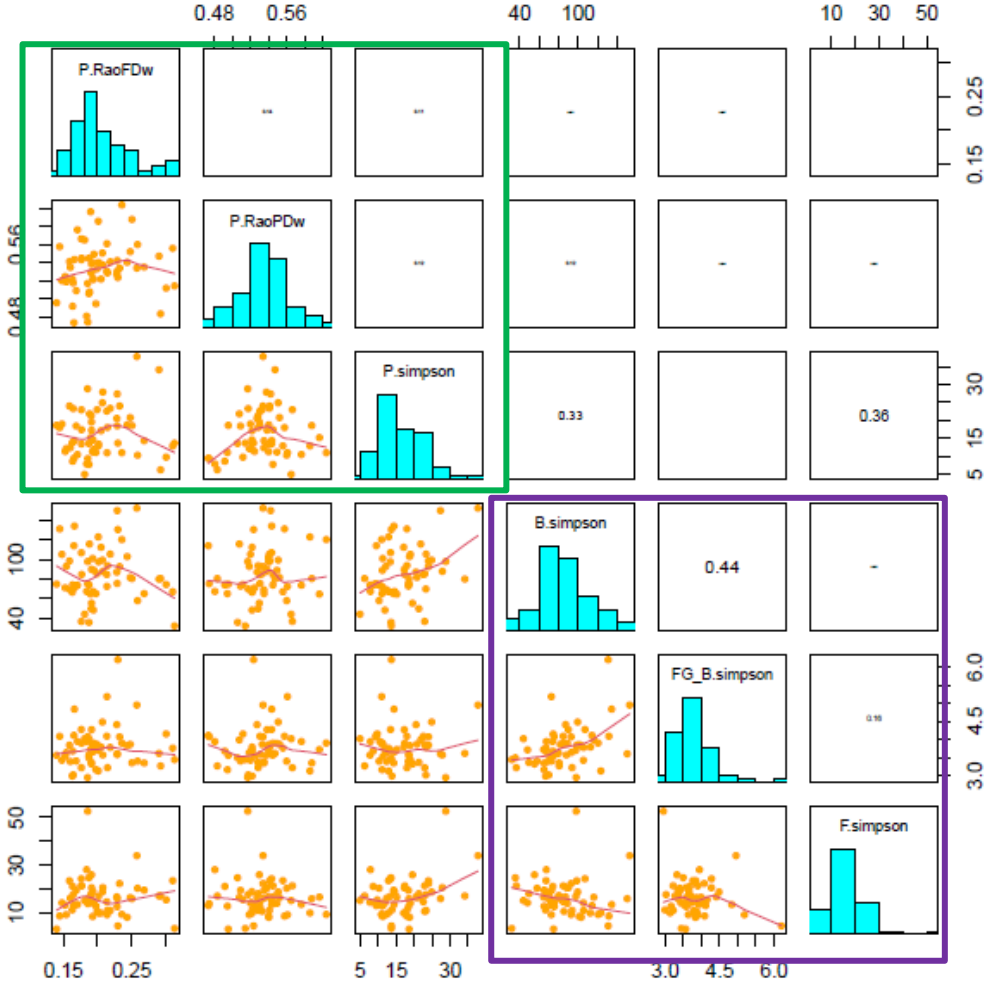
Alpha diversity

Correlations

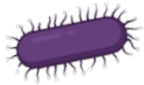
FD

PD

TD



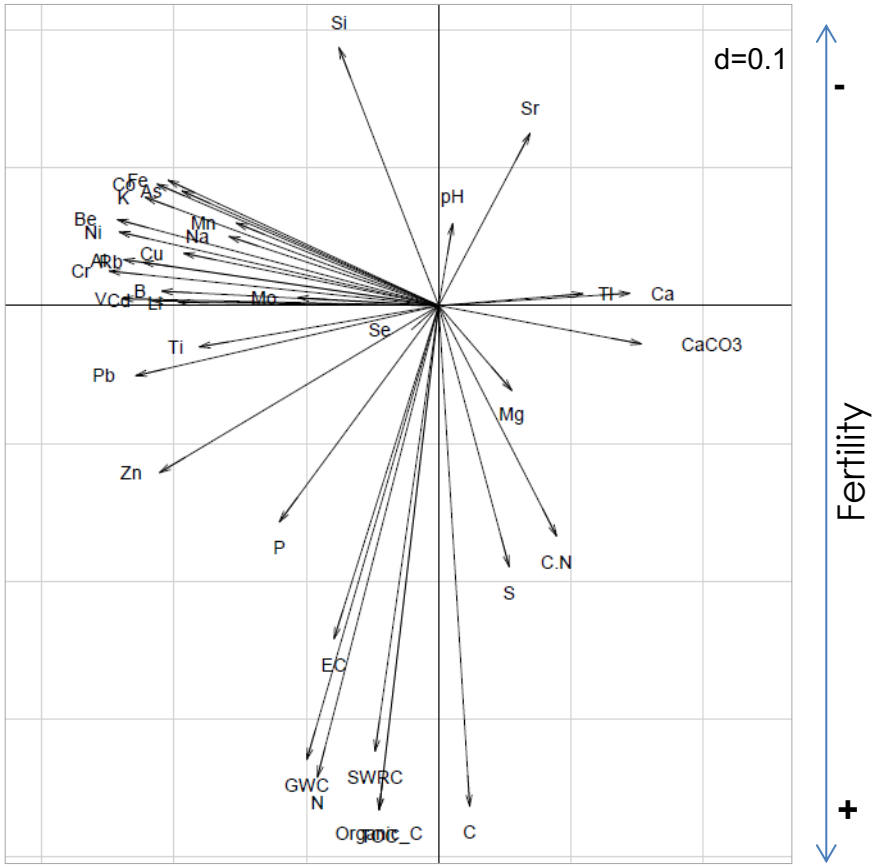
TD



FD

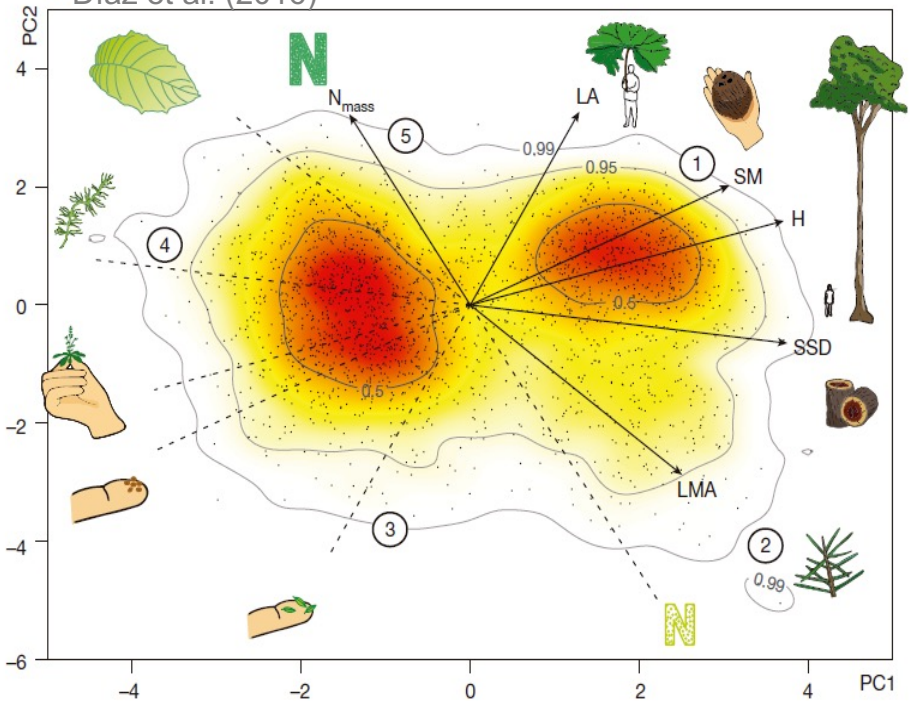
TD

PCA: Soil properties

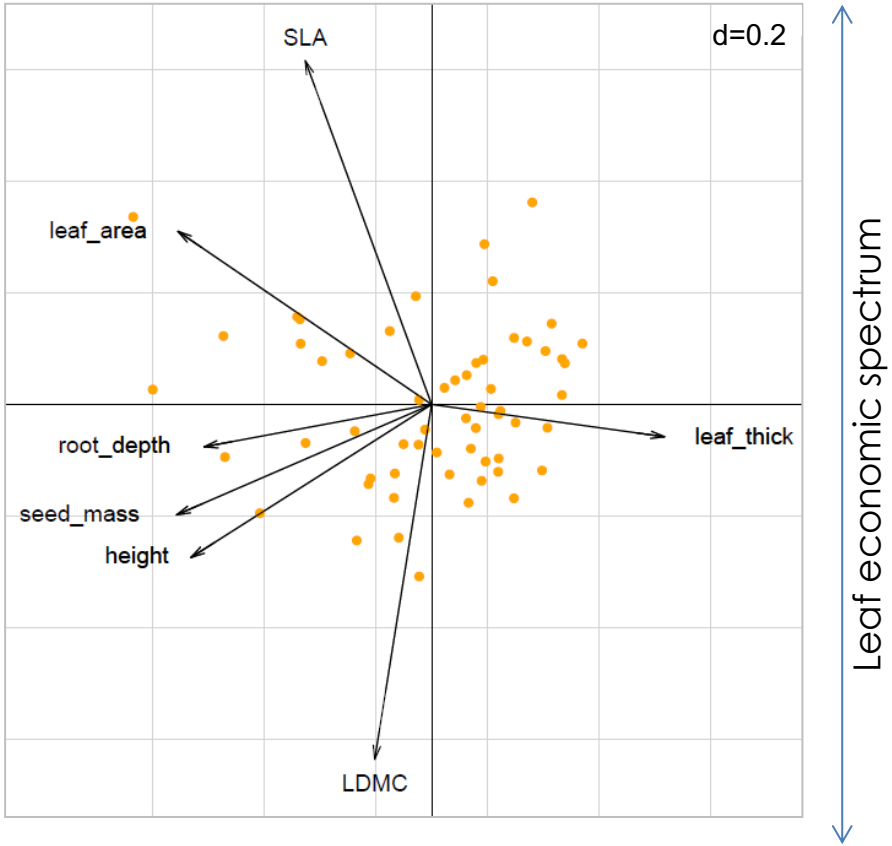


PCA: Plant traits

Díaz et al. (2016)



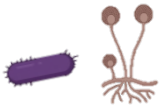
Diaz et al. 2016



Alpha diversity

PLANTS

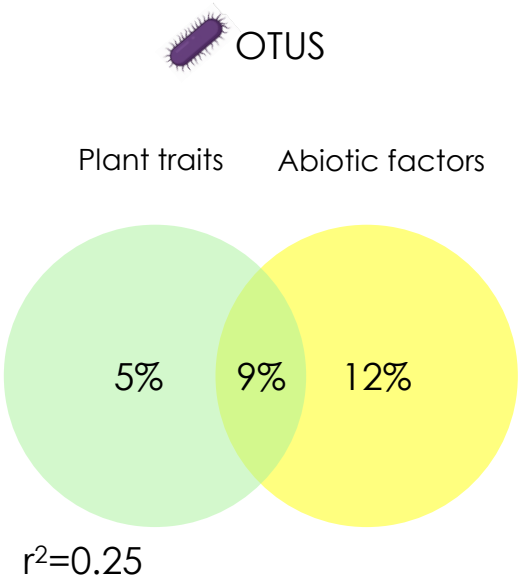
VARIABLE	MODEL	p-value	Adj. r^2	AIC
SLA	Latitude*, Altitude*, pH·	>0.001	0.3598	-212.51
Height	S.Axis1*, S.Axis2·, Latitude, pH*	>0.001	0.3782	-91.09
Richess	S.Axis1·, Altitude*, pH*	>0.001	0.2341	266.22
Simpson	S.Axis1·, Longitude, Altitude*, pH*	>0.001	0.1973	217.38
Rao_FDw	S.Axis2*, Altitude·	0.001	0.1859	-383.44
Rao_PDw	Latitude, Altitude·	0.009	0.1230	-427.57
Rao_FD	S.Axis2*	0.037	0.0573	-373.96
Rao_PD	S.Axis1, Latitude, Longitude	0.150	0.0416	-412.00



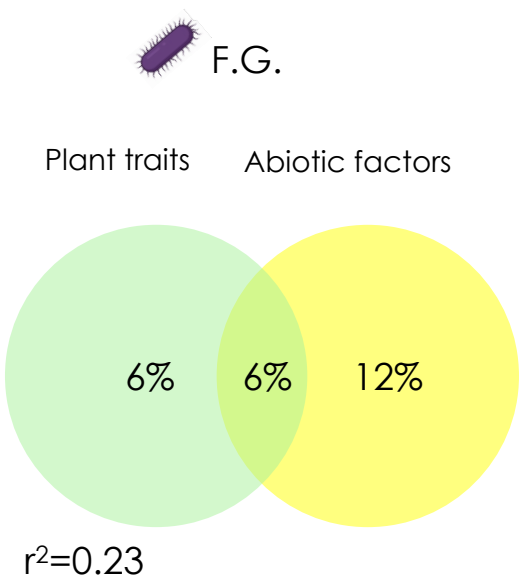
MICROBIOTA

VARIABLE	MODEL	p-value	Adj. r^2	AIC
Bacteria Richess	Latitude*, Altitude*, pH*	0.006	0.1569	483.37
Bacteria Simpson	S.Axis1*, Latitude*, Longitude·, Altitude*, pH*	>0.001	0.2534	376.28
FG Bacteria Richess	S.Axis2·, Latitude*, pH*	0.001	0.1935	153.85
FG Bacteria Simpson	S.Axis1*, S.Axis2*, pH*	>0.001	0.2151	-80.11
Fungus Richess	Longitude*	0.003	0.1289	394.78
Fungus Simpson	S.Axis1·	0.094	0.0316	239.85

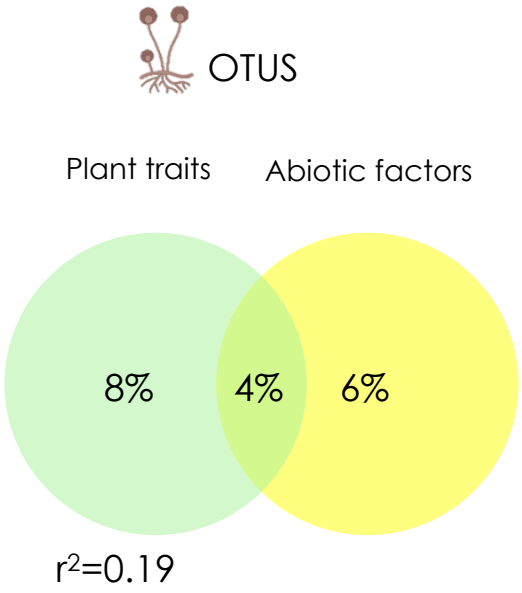
db-RDA y variance partitioning on microbial composition



r^2=0.25



r^2=0.23



r^2=0.19

Conclusions

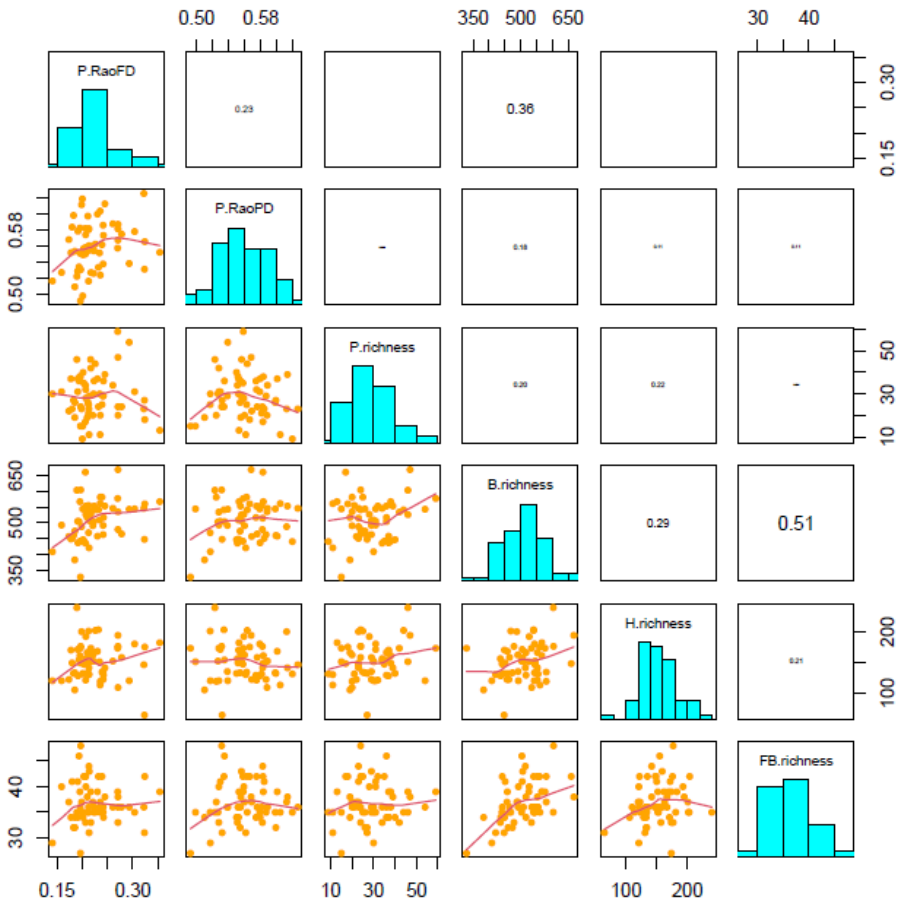
1. While the "**quantity**" of diversity vary rather independently across groups, the composition ("**quality**") is well coordinated: so habitat"
2. Microbiota respond to different **abiotic factors and** to the **plant traits** of the vegetations, particularly those associated to the global axes of plant variations

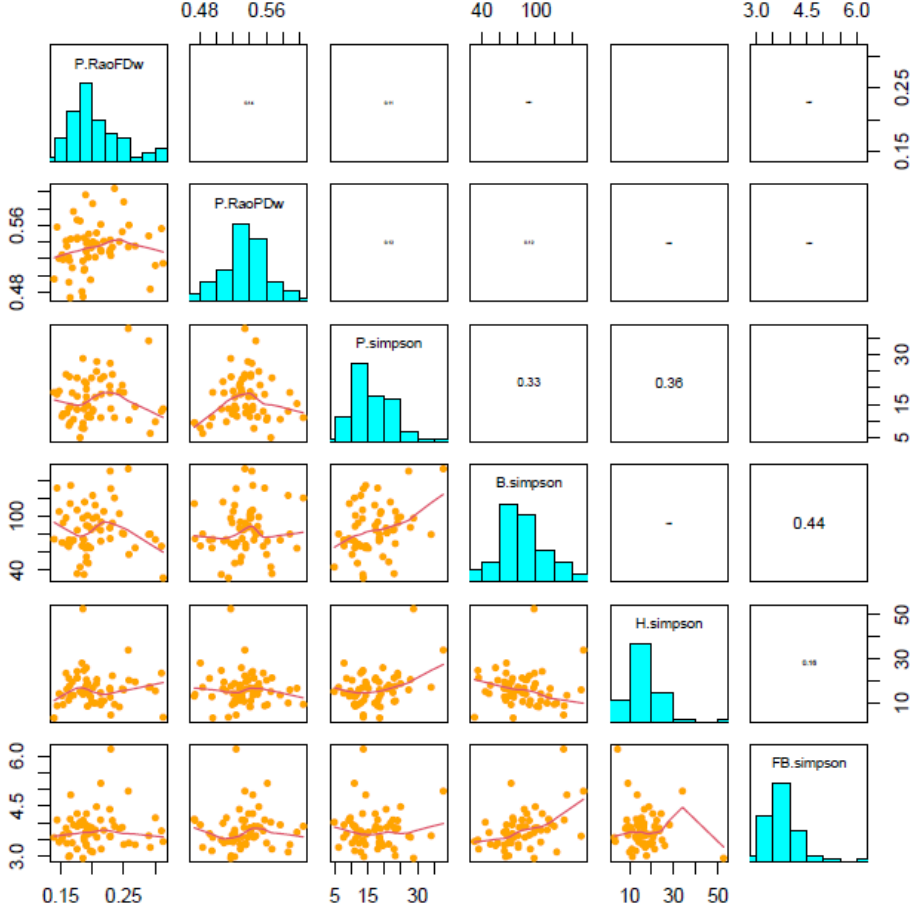
Implications:

3. On one hand a the conservation/restauration of **vegetation habitats** should imply similar results to the microbiota. However the local and regional diversity cannot be maintained only by maximizing plant diversity only
4. For microbial diversity **not "everything is everywhere"** and a diversity of communities should be maintained.

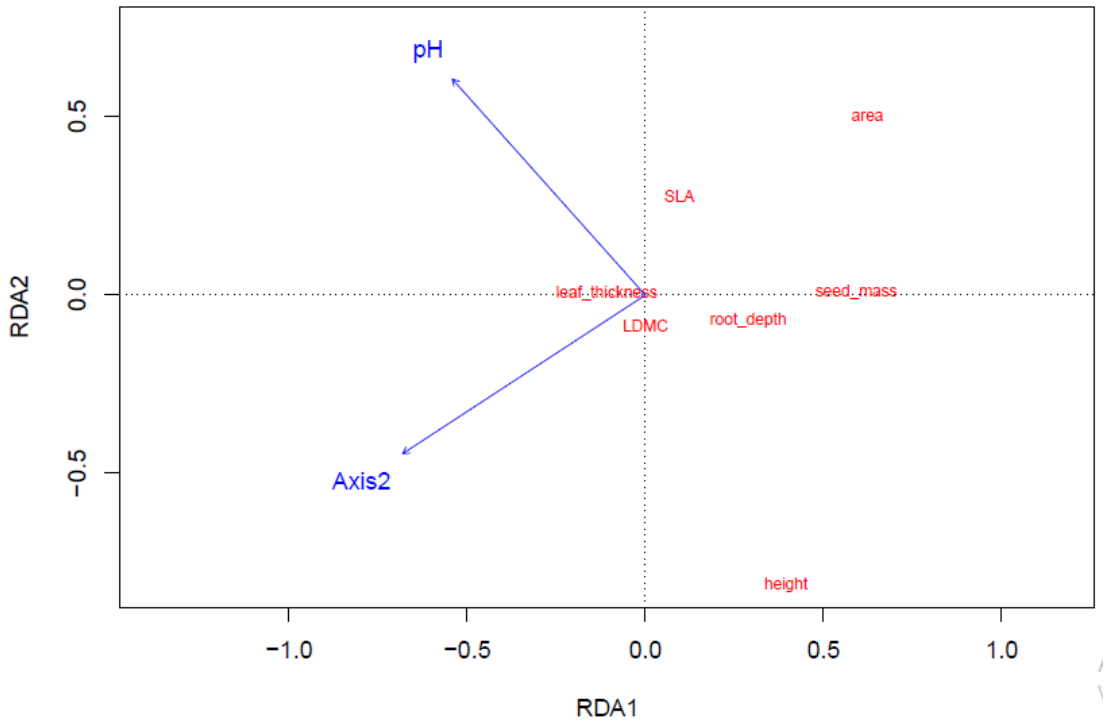
Questions material

CORRELACIÓN: Plantas-Microbiota

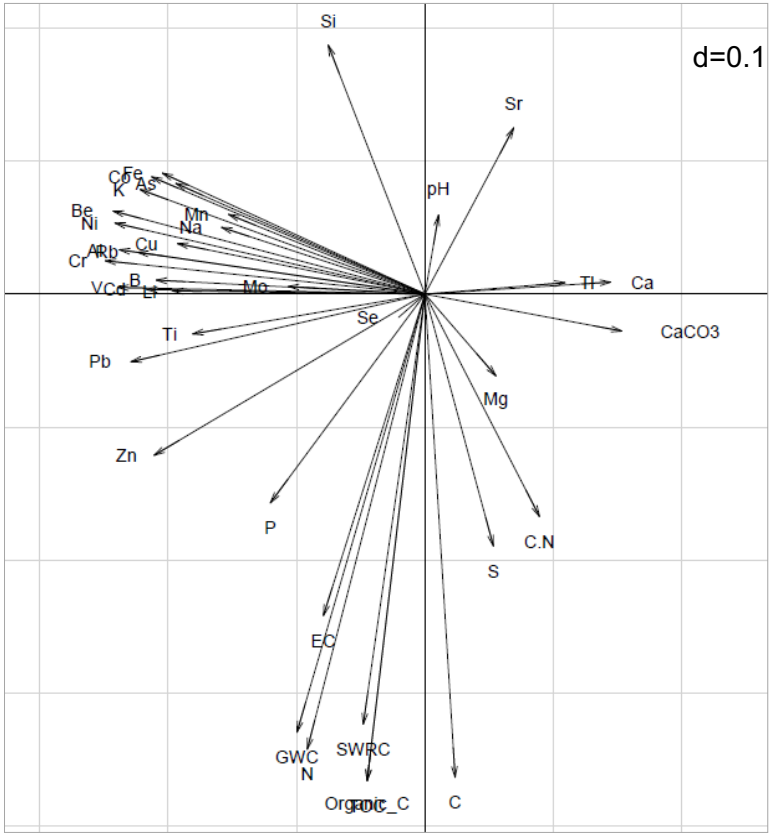




RDA: RASGOS FUNCIONALES DE PLANTAS



PCA: PROPIEDADES DEL SUELO



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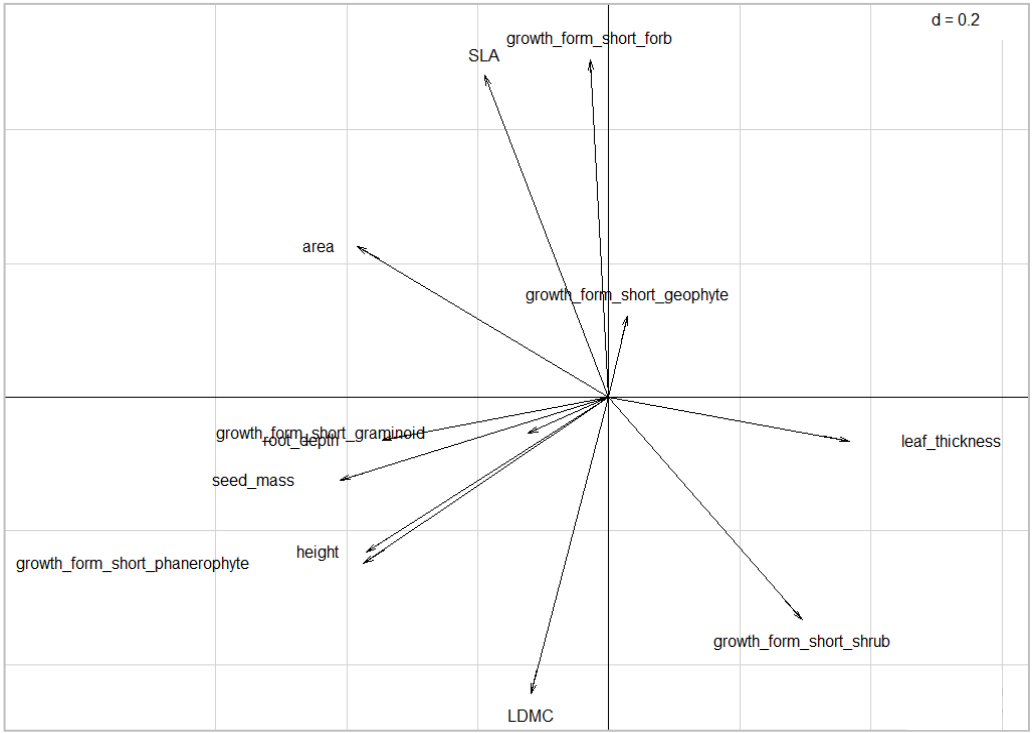

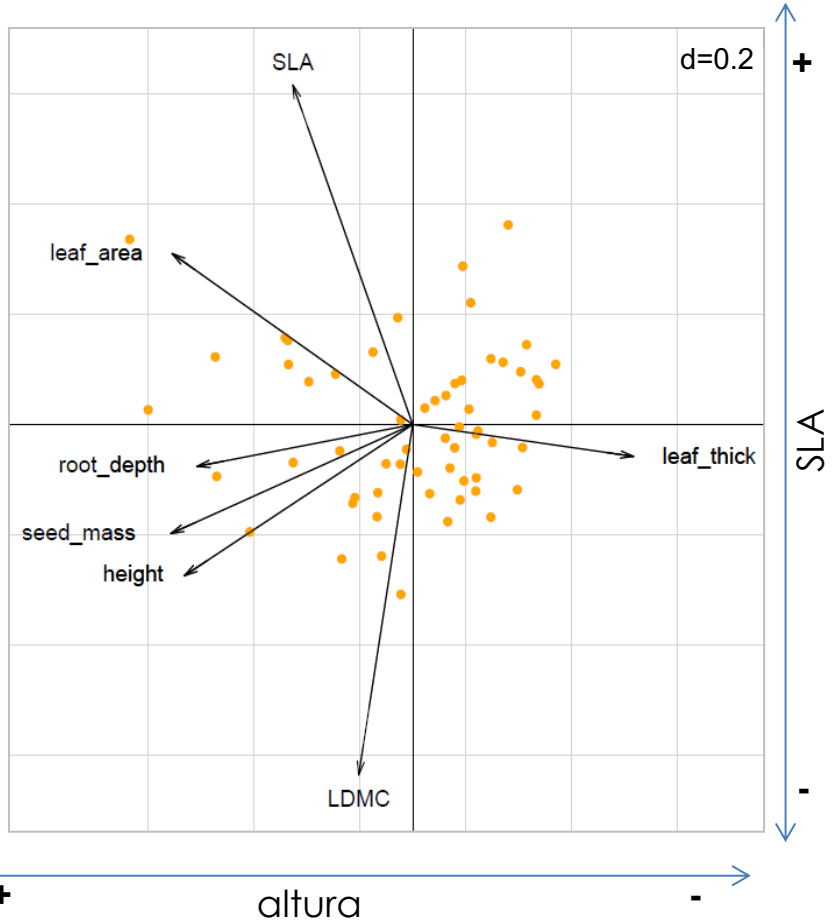

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