Are plant functional traits randomly distributed at the community level?

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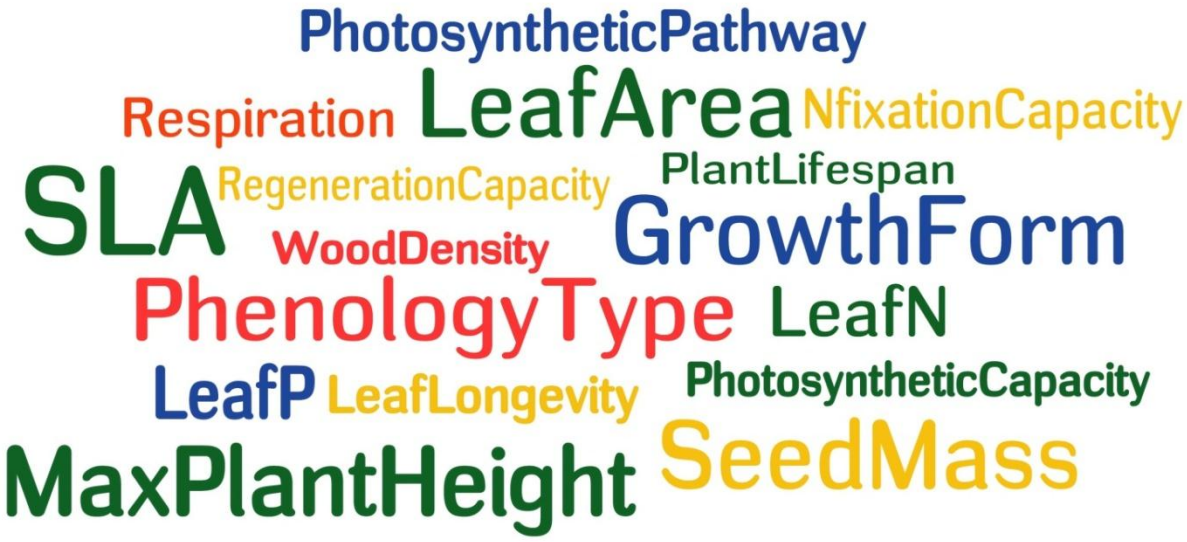
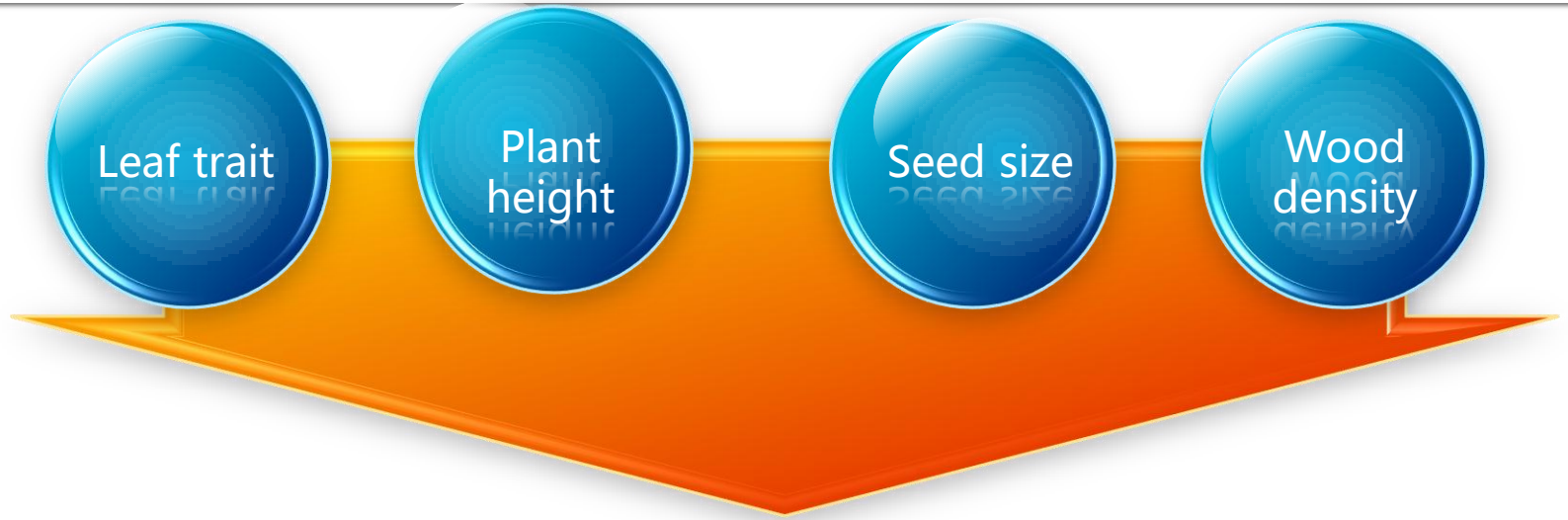
What are functional traits

Functional traits are morphological characters that strongly influence performance of organisms.



McGill, Enquist *et al*. 2006，*ECOLOGY*

Plant traits and life history relationship

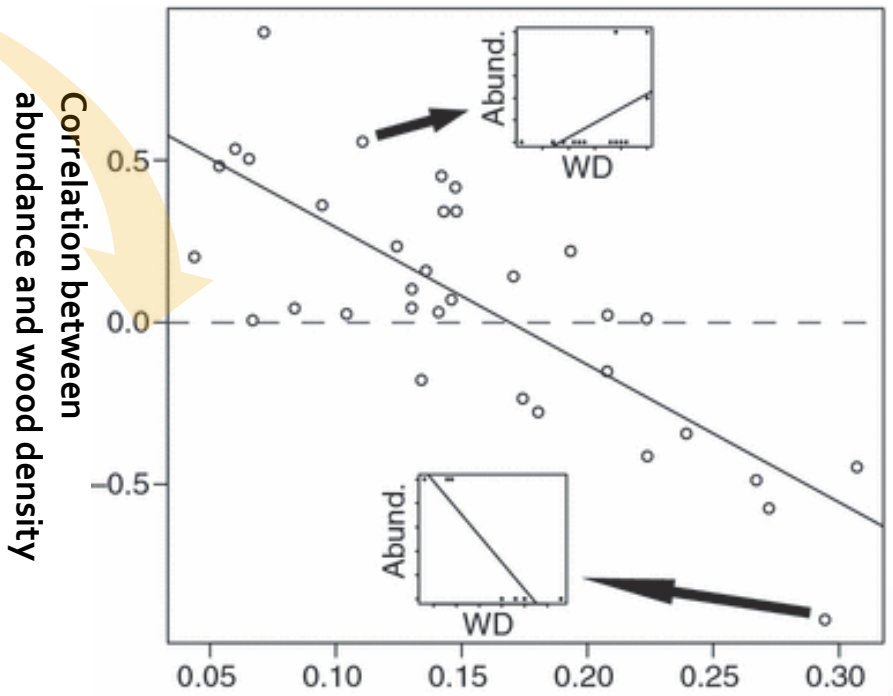


1. the photosynthesis and respiration rate
2. life span, seed mass, time to reproductive maturity
3. fecundity, dispersal and colonization
4. growth rates, mortality levels and succession strategies

Westoby, M *et al*, 2002, *Annu.Rev.Eco.Syst*

Traits determinate community structure

1. Abundance
2. Demography
3. Decompositions rate
4. Ecological interactions
5. Net primary productivity
6. Disturbance
7. Classification of trait groups
8. Succession
9. Invasion resistance
10……

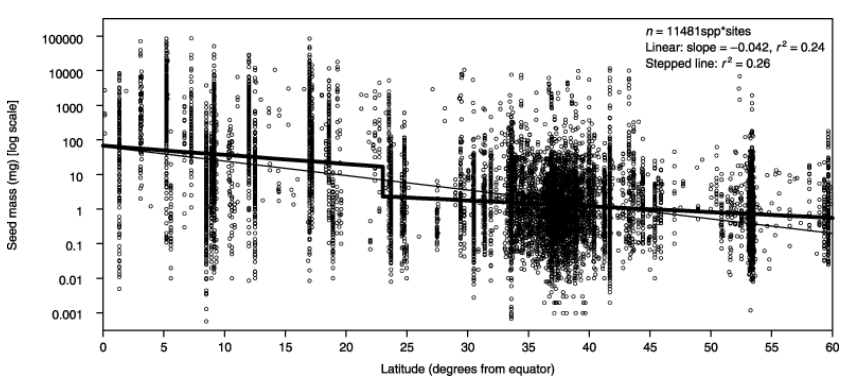


$$AGB = WD \times \exp(-1.499 + 2.148\ln(dbh) + 0.207(\ln(dbh))^2 + 0.0281(\ln(dbh))^3)$$

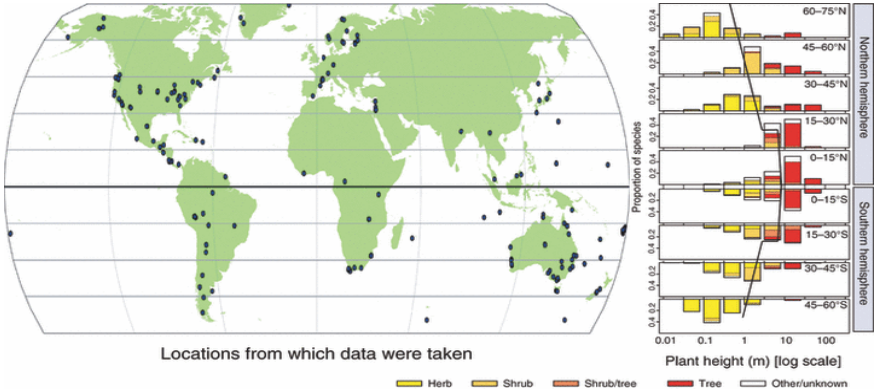
AGB = Above Ground Biomass (Mg)

William K. Cornwell,*et al*,2010,*J ECOL*

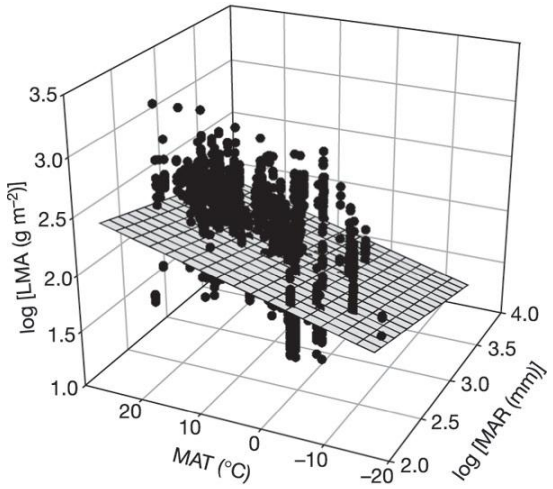
Global scale patterns of functional traits



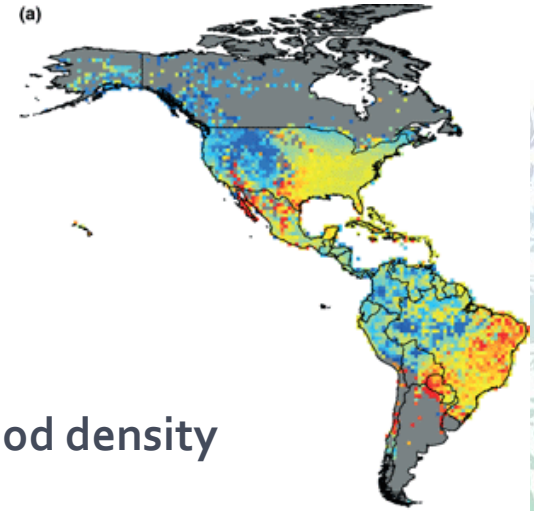
Seed size



Plant maximum height



Leaf mass per area



Wood density

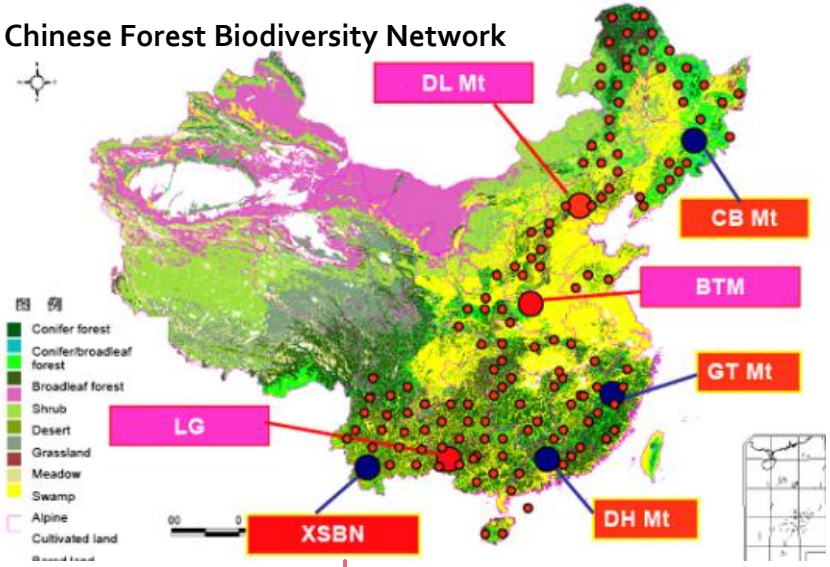
Research questions

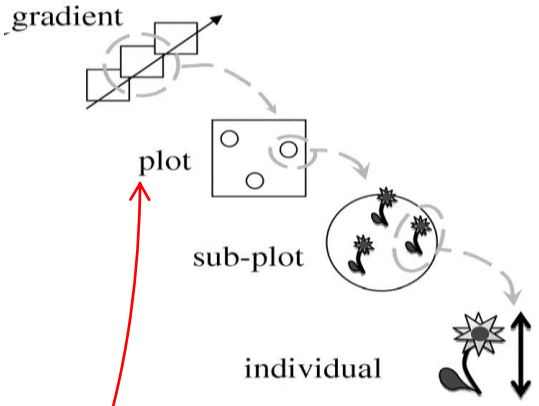
How do functional traits vary at the community level?

What determinate the distribution pattern of functional traits at the community level?

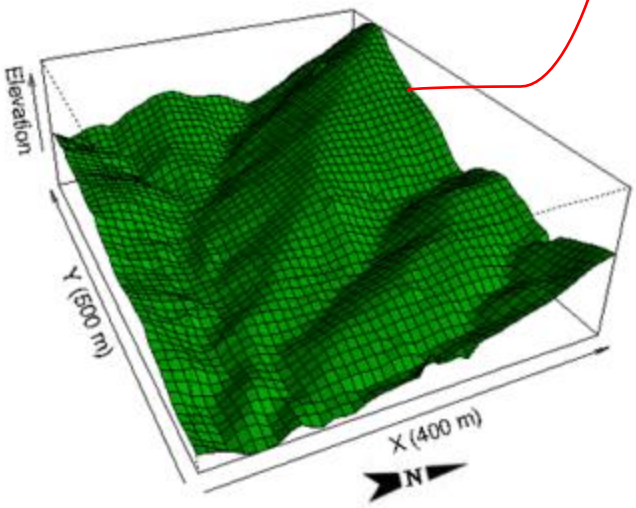
Study sites

Chinese Forest Biodiversity Network





Logged, mapped and indentified



20 ha
94,856 individuals
334 species
Elevation from 710.5m to 866.8m

Trait data collection

Leaf area

Leaf maximum length × maximum width × 0.7

Plant maximum height

Seed mass

Wood density

(Kraft, Valencia et al. 2008; Cornwell and Ackerly 2009)

World Agroforestry Centre www.worldagroforestrycentre.org/

The TRY Database http://www.try-db.org/

Global Wood Density Database

Kew **Seed information database**

XTBG **XTBG seed bank**

KIB seed bank

Environmental and trait data for each 10*10m plot

Trait

Leaf area

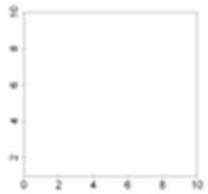
Plant maximum height

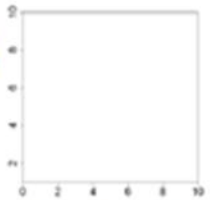
Wood density

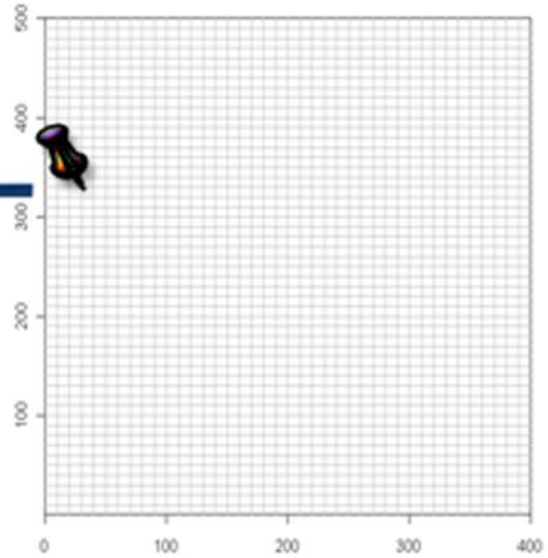
Seed mass

Individual

subplot







Environmental data for each plot

1、Slope

2、Elevation

3、Convexity

4、Aspect

5、Distance to valley

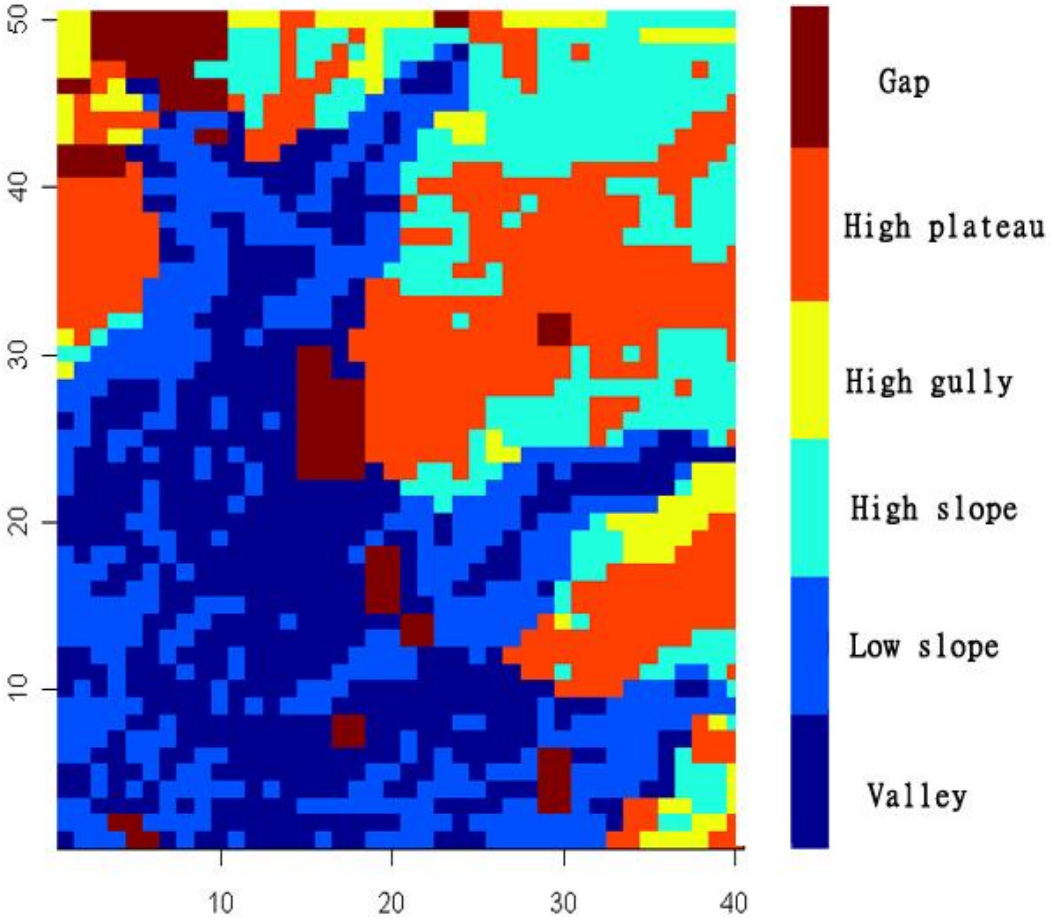
6、Distance to ridge

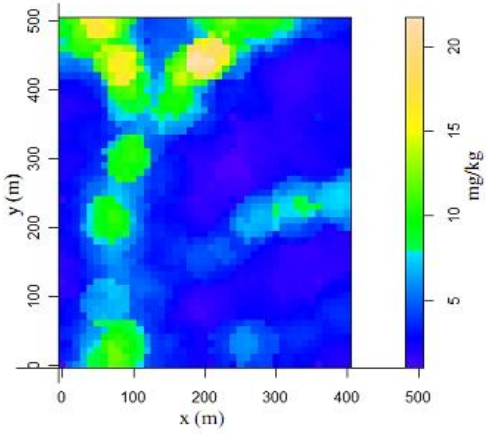
Trait data for each plot

e.g.mean wood density in this plot

Functional diversity in each plot

Define the habitat types





From academic dissertation of Hu Yuehua,2010

Valley

(slope< S_{mean}， Elevation<E_{mean})

Low slope

(slope≥S_{mean}， Elevation<E_{mean})

High slope

(slope≥Smean， Elevation≥E_{mean}， concavity>0)；

High gully

(slope≥S_{mean}， Elevation≥E_{mean}， concavity<0)

High plateau

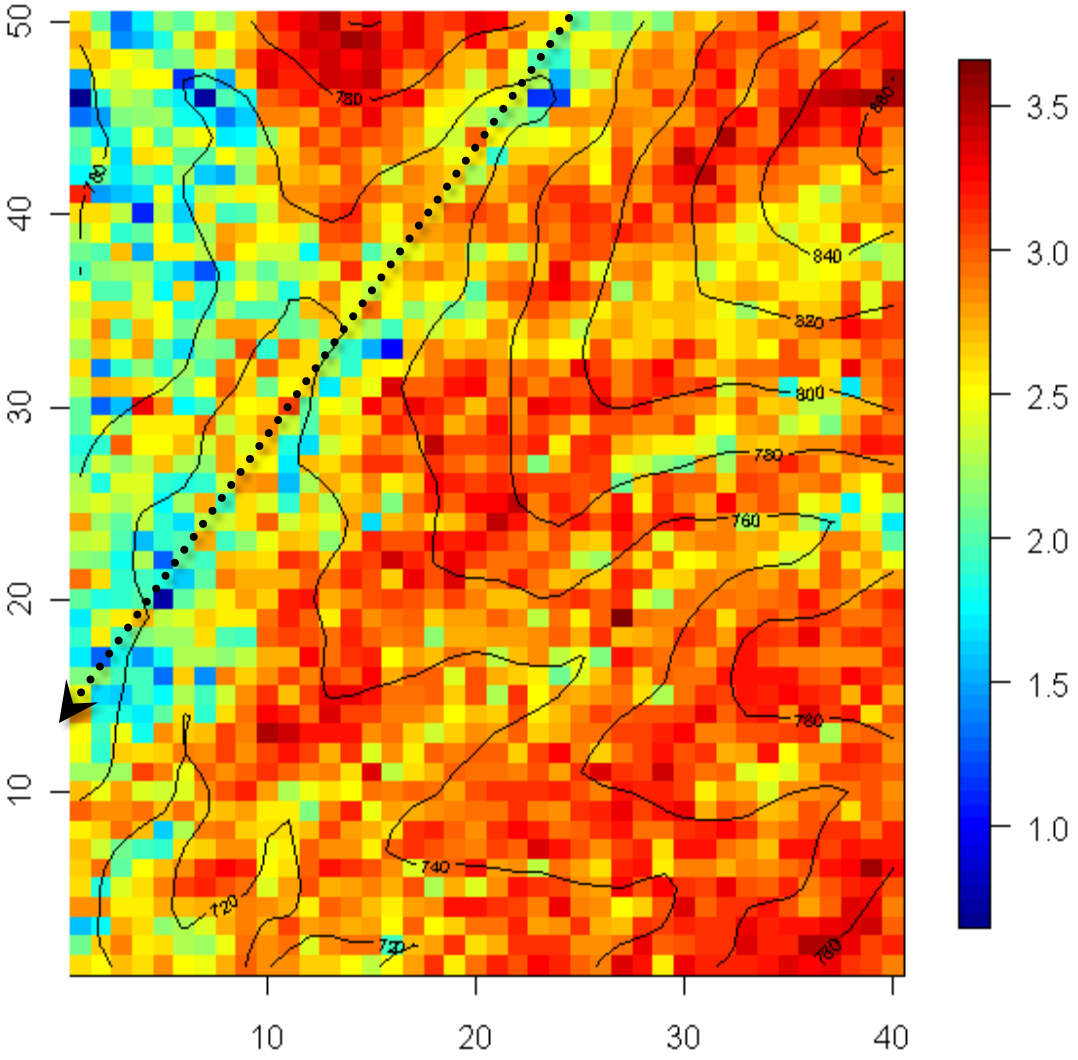
(slope≤S_{mean}, Elevation≥E_{mean}， concavity>0)

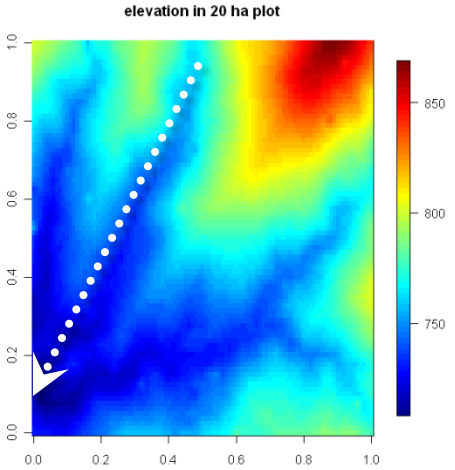
Gap

(Canopy cover less than 50%).

(Harms, Condit *et al*. 2001, *J ECOL*).

Distribution pattern of Seed mass(mean value)

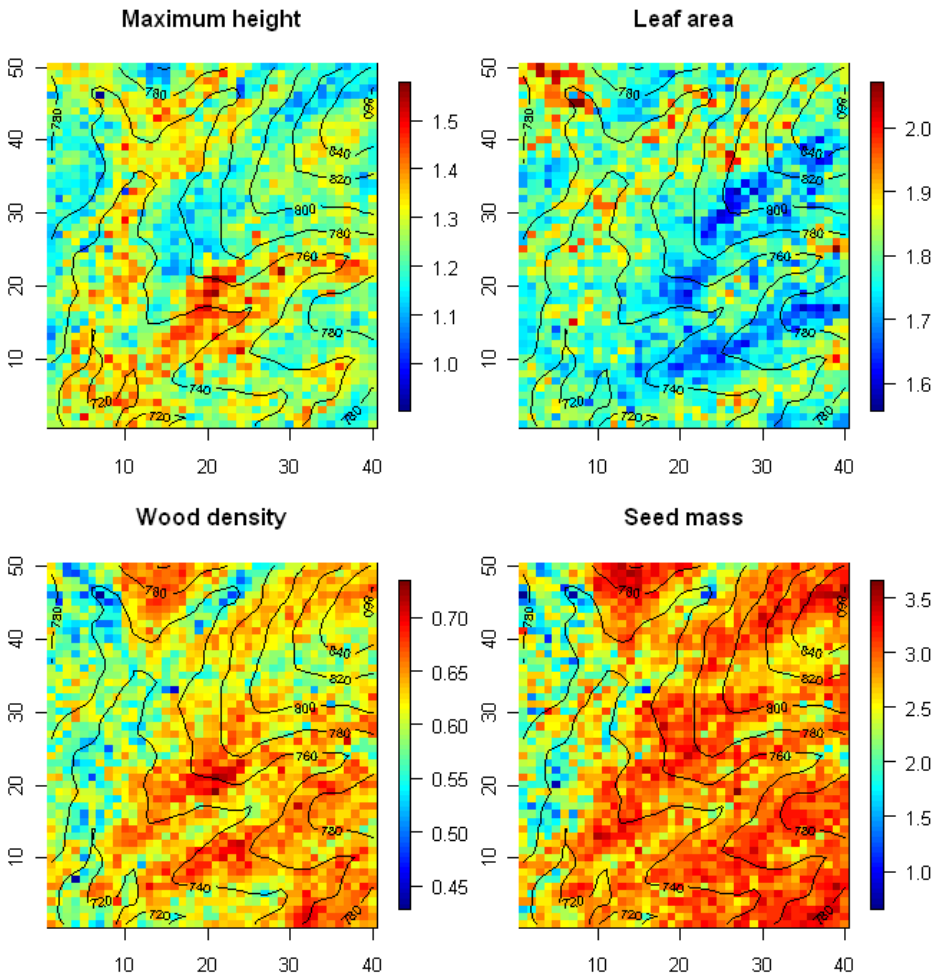


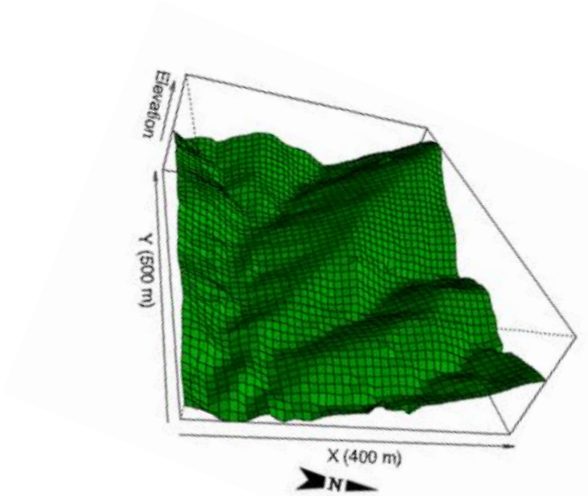


Pearson's correlation coefficients

	Seed mass
Distance to ridge	-0.2***
Distance to valley	0.19***
Elevation	0.21***
Density of stems	0.31***
Convex	0.21***
Aspect	0.37***

Distribution pattern of functional traits



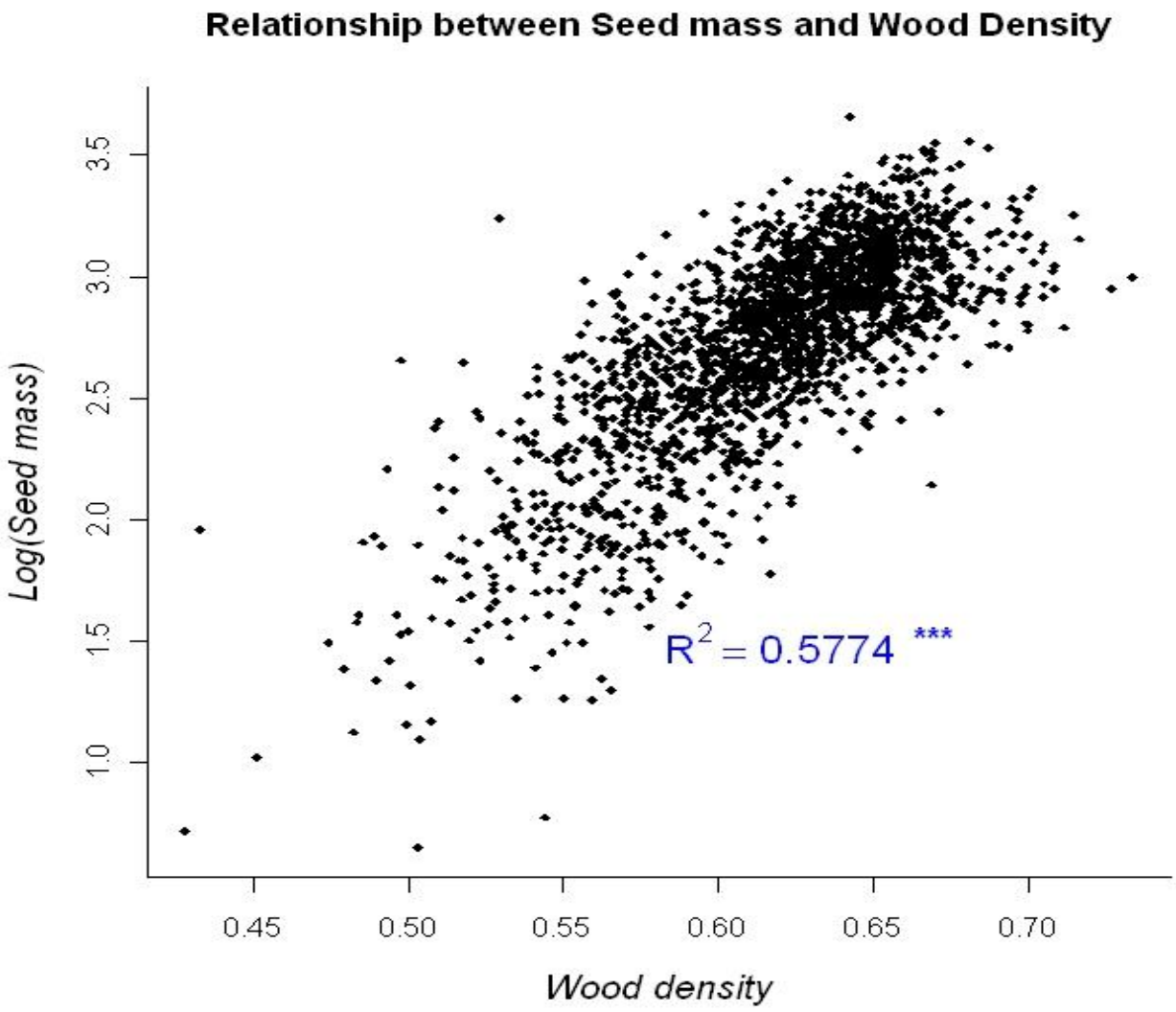


Relationship between mean trait values and environmental gradients

The Pearson's correlation coefficients for mean subplot traits value and environmental variables

	Distance to ridge	Distance to valley	Elevation	Density of stems	Convex	Aspect
Max. plant height	NS	-0.34	-0.32	NS	-0.26	NS
Leaf area	0.32	-0.21	-0.09	-0.2	-0.31	NS
Seed mass	-0.2	0.19	0.21	0.31	0.21	0.37
Wood density	-0.27	0.12	0.12	0.4	0.31	0.29

Plots with a higher value of WD will have a larger SM



Mechanisms

Environmental condictions

More water
High nutrient

Good habitat

Trees invest more energy on fast growing

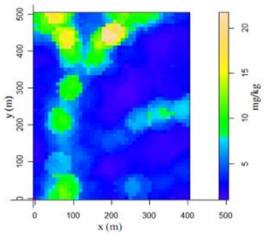
Bigger leaf area
Higher max. height

Subplot in the valley

Less water
Low nutrient

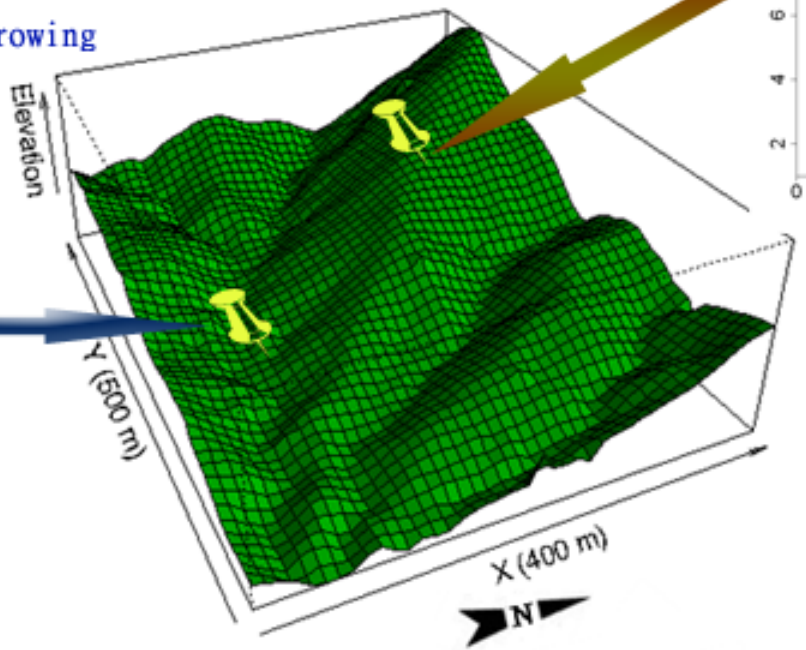
Hard Habitat

Trees invest more energy on survival



Bigger wood density
Bigger seed mass

Subplot in the ridge

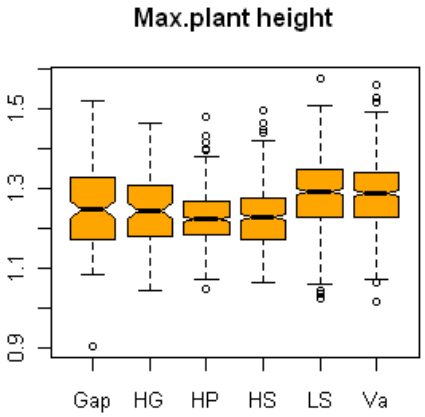


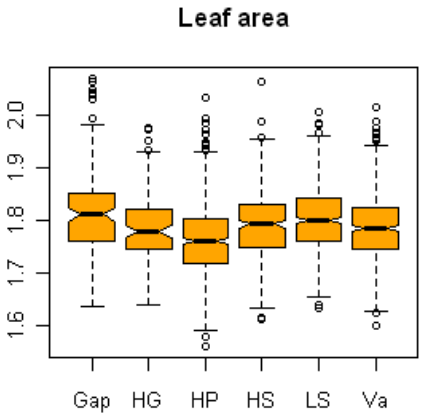
Trait distribution patterns in different habitat types

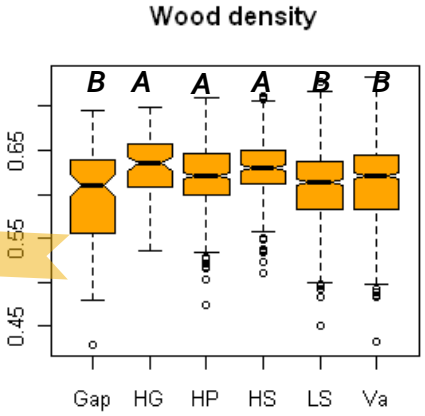
Habitat associations

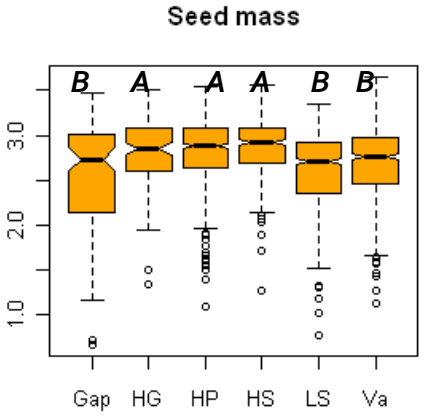
Kruskal-Wallis chi-squared = 84.1964, df = 5, p-value < 2.2e-16

Duncan	Mean value	N	Habitat type
A	0.6625	91	High slope
A	0.6495	90	High plateau
A	0.6464	57	High gully
B	0.6208	140	Valley
B	0.6159	31	Gap
B	0.6188	91	Low slope

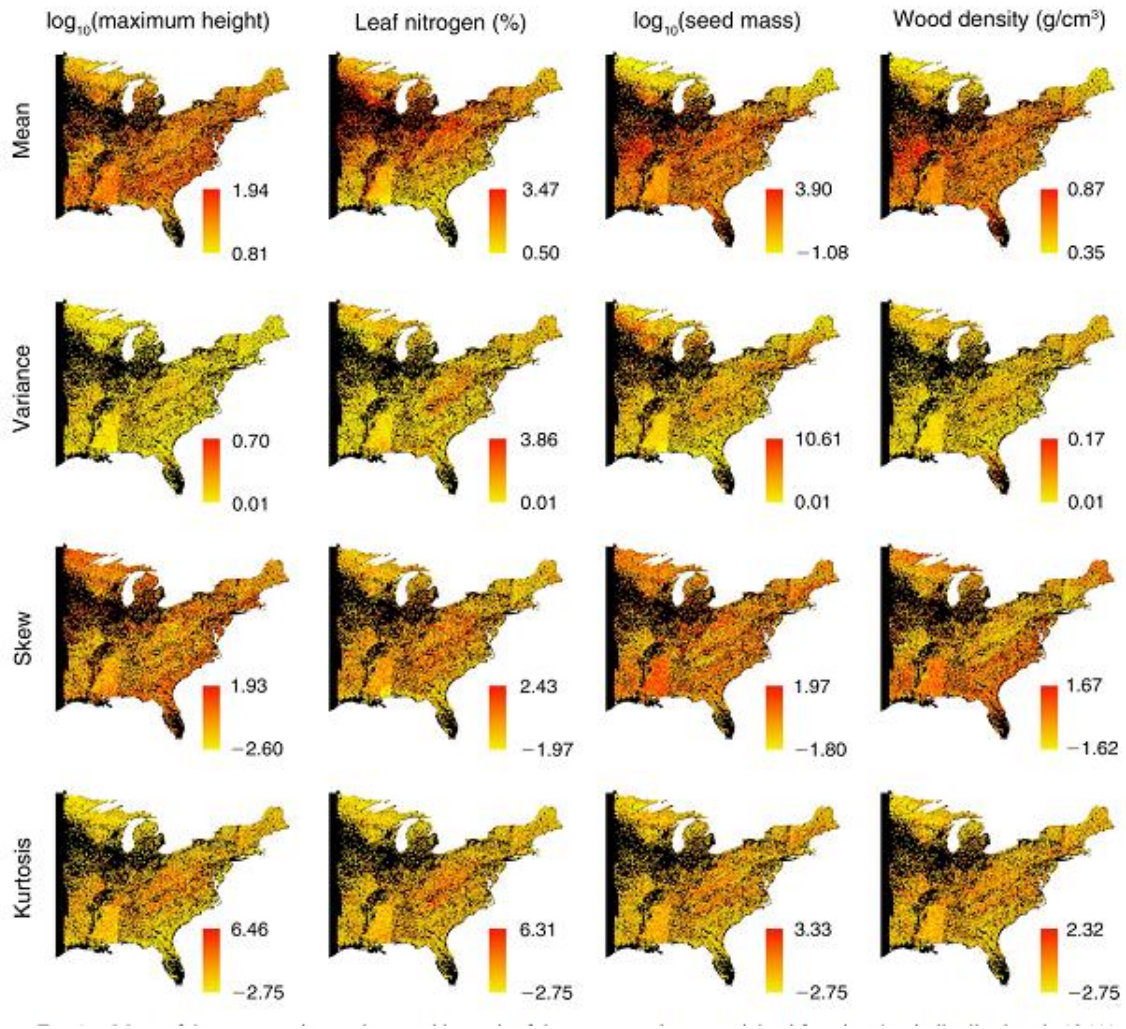








Evidence at the regional scale



NG Swenson, *et al*, 2010, *ECOLOGY*

Conclusions

Functional traits are not randomly distributed at the community level but the result of environmental filtering.

Habitats have a better resources availability tend to favor traits are fast growing while in "poor" habitats they are more tolerant!

Implications:

Functional trait can be used to explain species coexistence mechanisms and conservation.

Acknowledgements

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中国森林生物多样性监测网络
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