

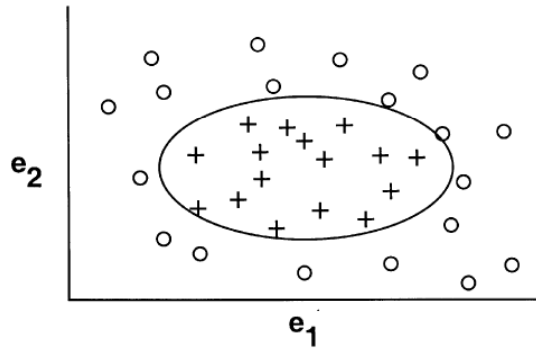


BETTER DISPERSAL MEANS WIDER REALIZED SPECIES NICHE

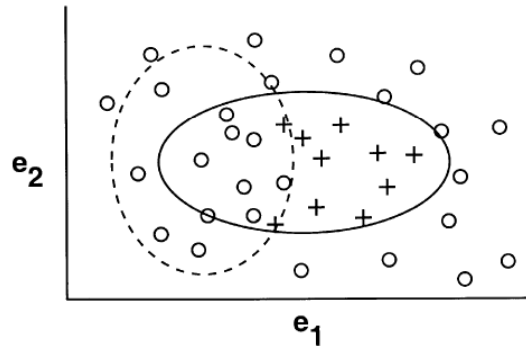
David Zelený



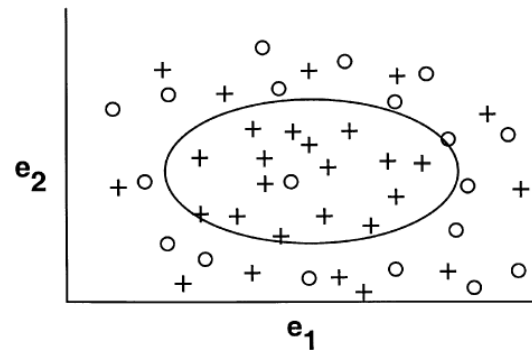
CONCEPT OF REALIZED ECOLOGICAL NICHE



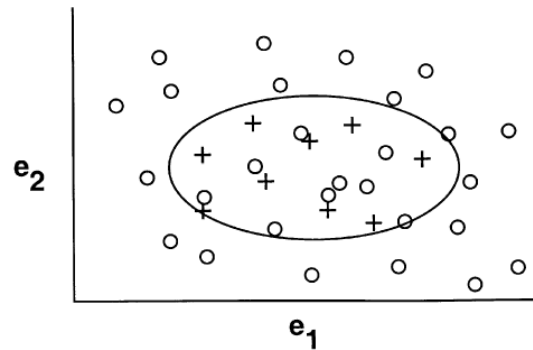
A. Grinnellian Niche



B. Hutchinsonian Realized Niche



C. Source-Sink Dynamics

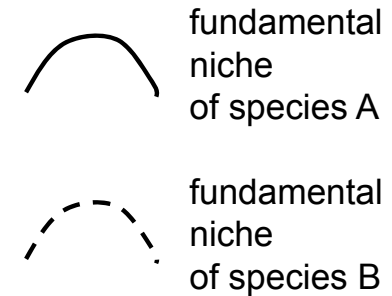


D. Dispersal Limitation

Explanation:

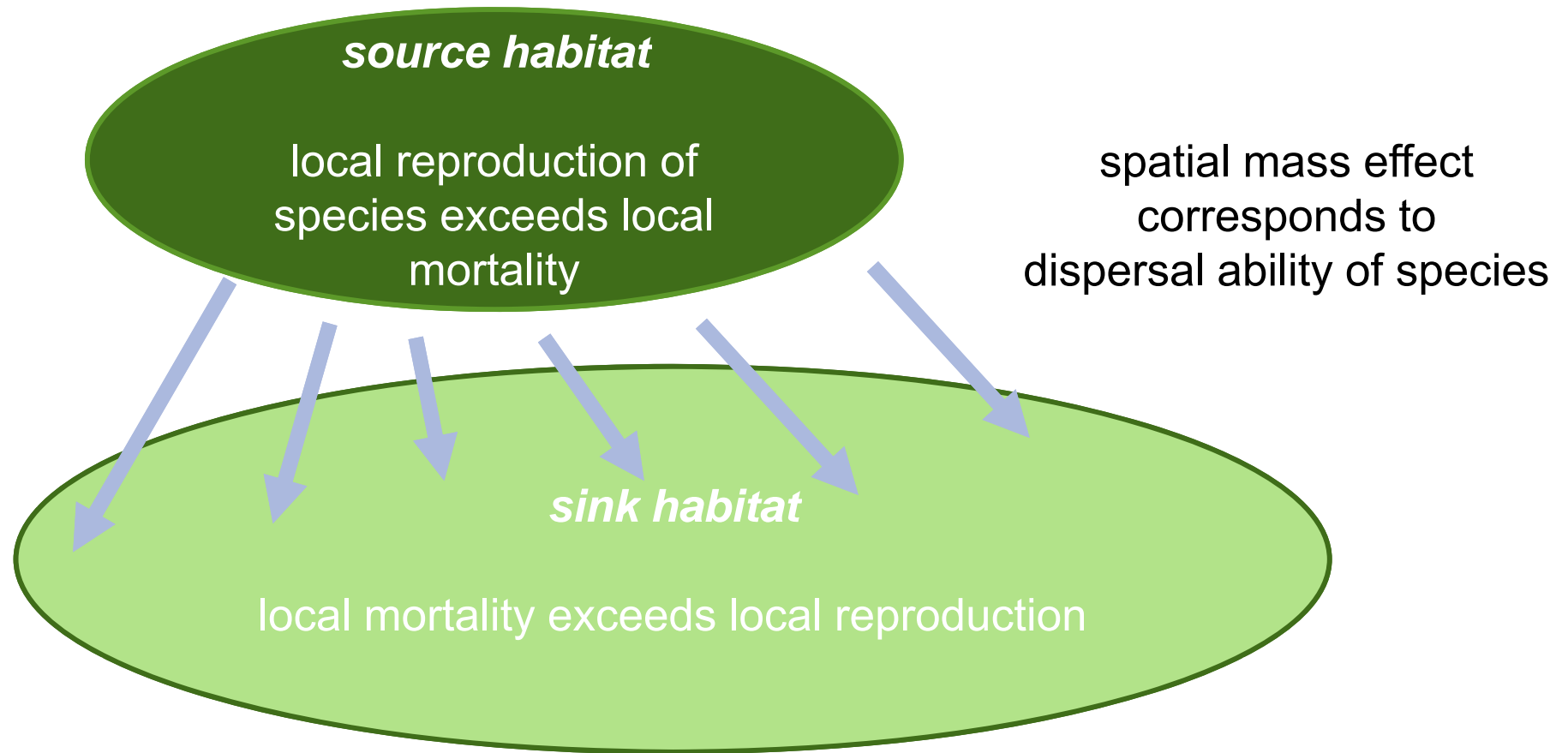
the species on the habitat is
 + present
 o absent

e_1, e_2 – ecological gradients

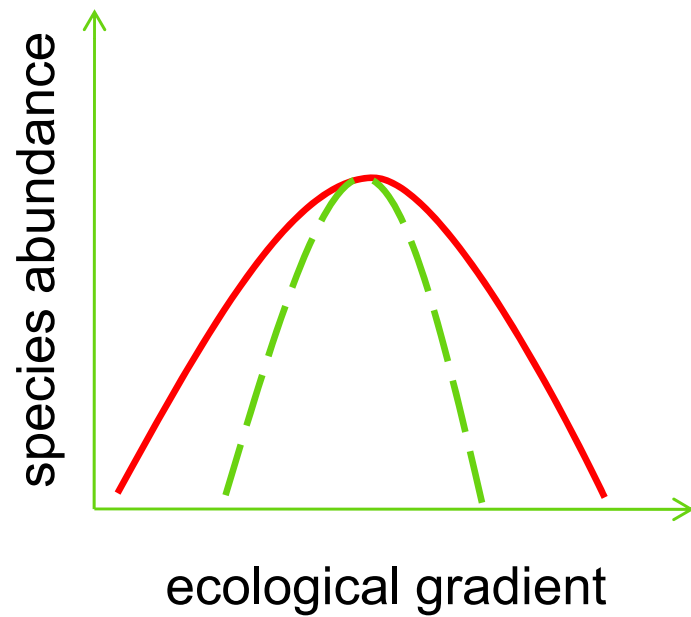


SOURCE-SINK DYNAMIC (PULLIAM 1988)

SPATIAL MASS EFFECT (SHMIDA & ELLNER 1984)

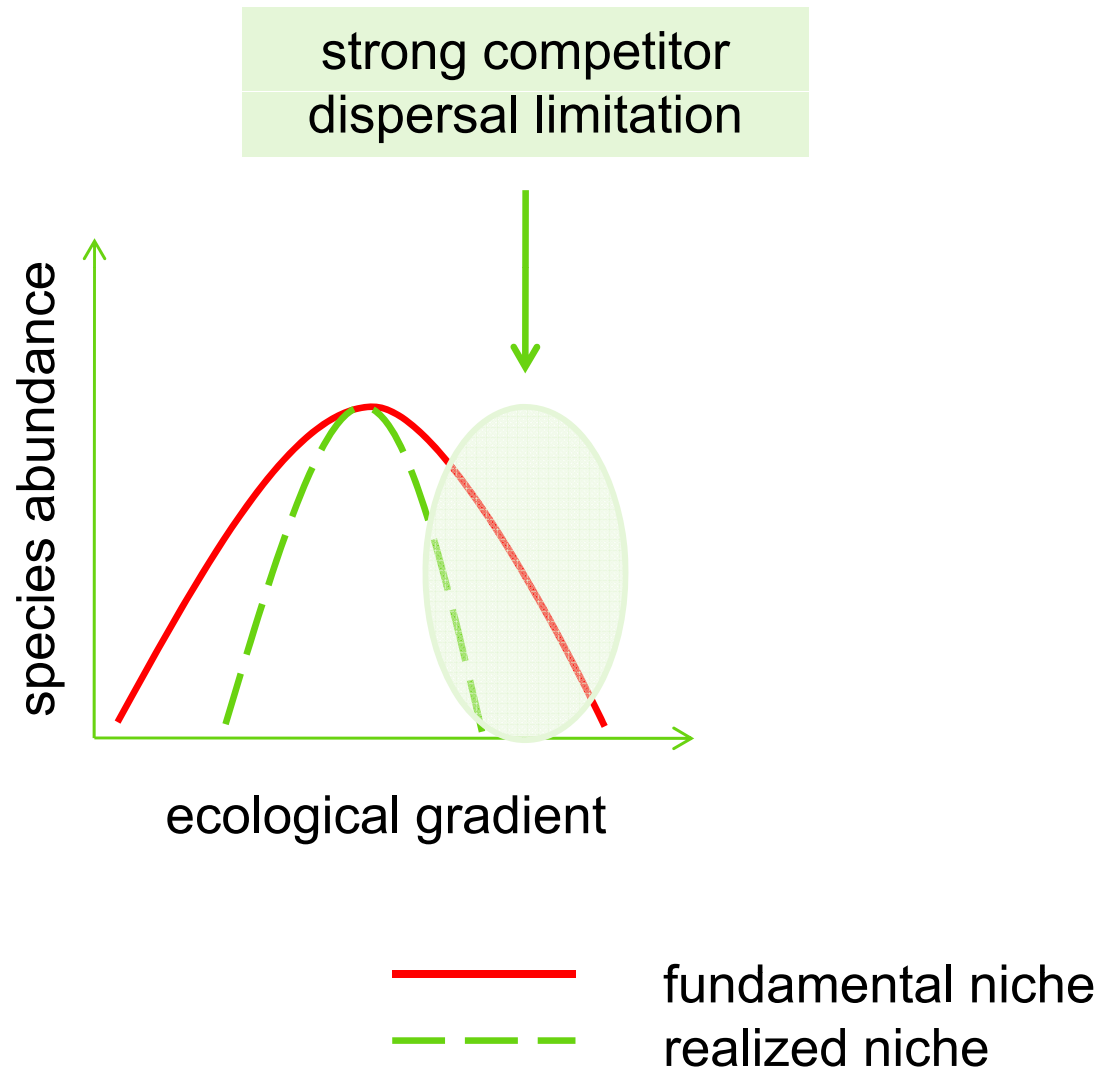


FUNDAMENTAL × REALIZED SPECIES NICHE

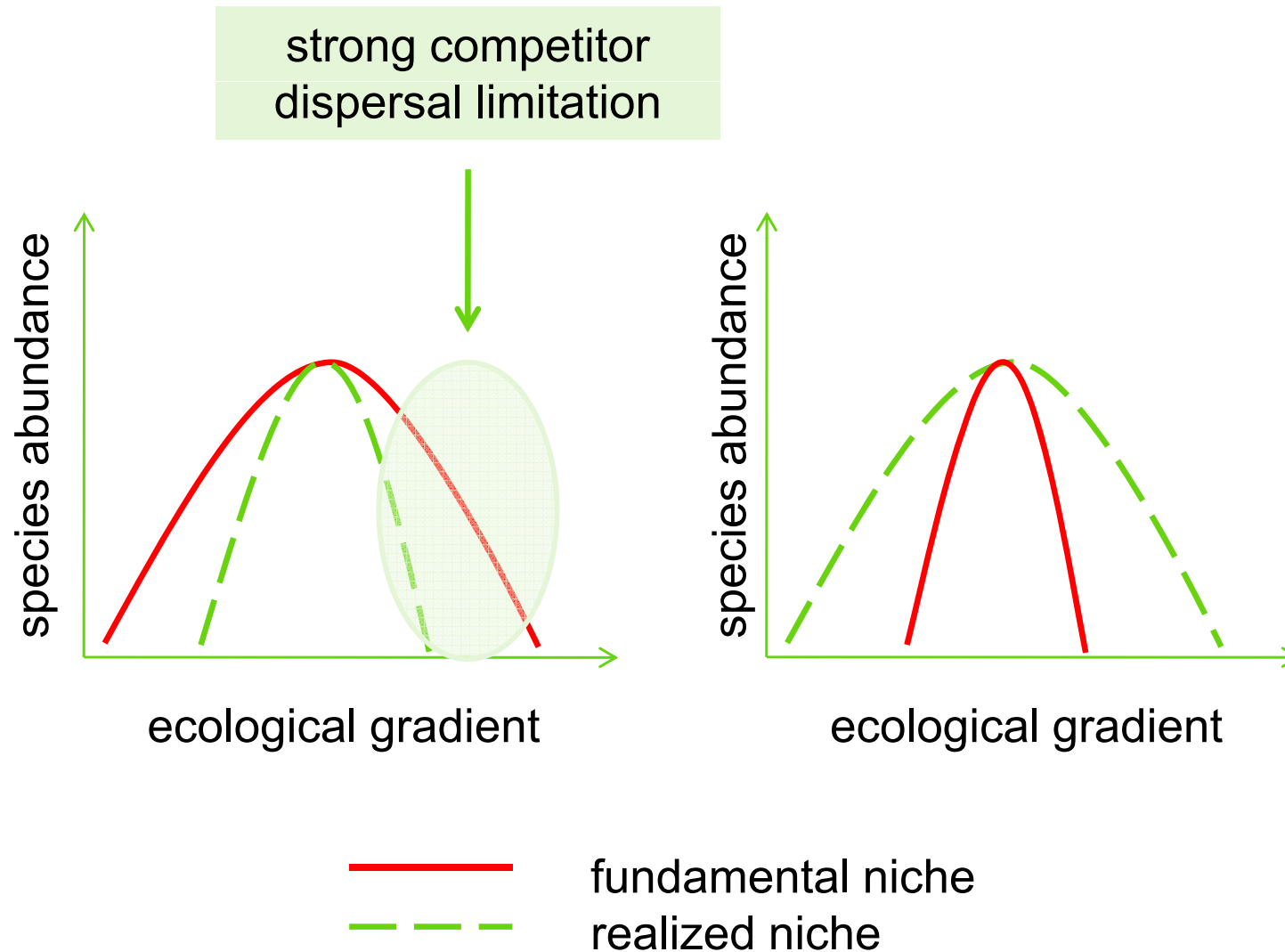


— fundamental niche
- - realized niche

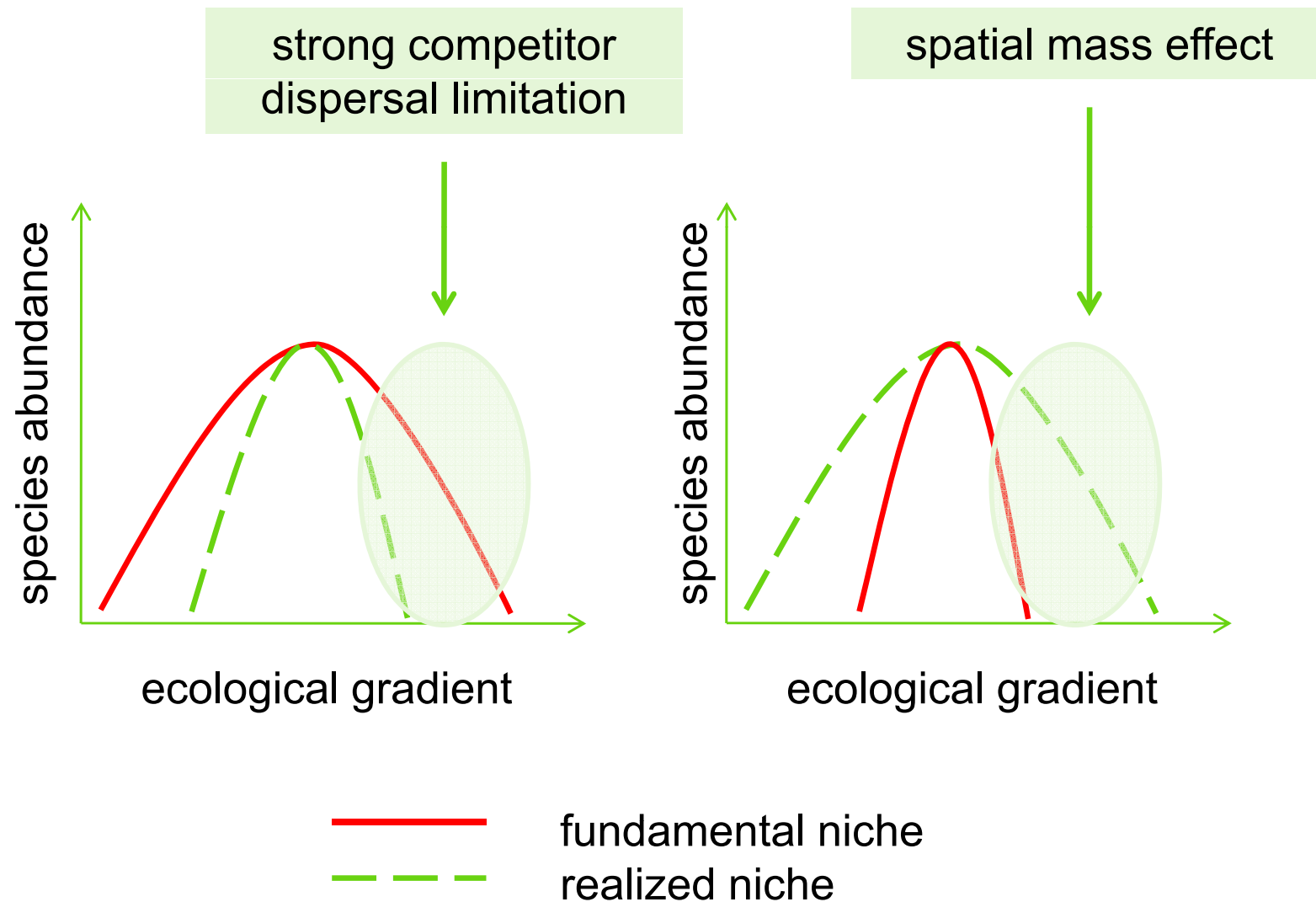
FUNDAMENTAL × REALIZED SPECIES NICHE



FUNDAMENTAL × REALIZED SPECIES NICHE



FUNDAMENTAL × REALIZED SPECIES NICHE



ASSUMPTION

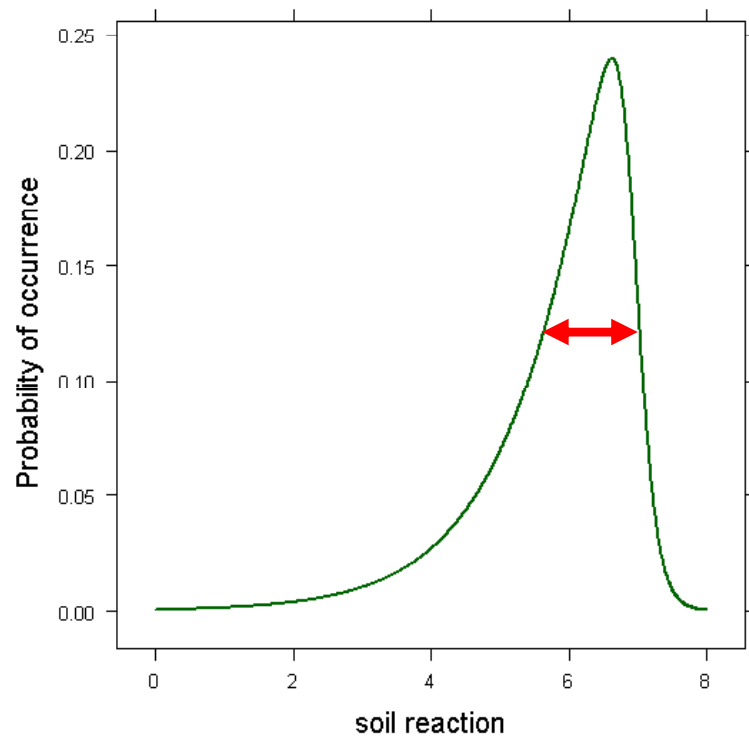
- Realized niche is partly dependent on dispersal ability of species (dispersal limitation and spatial mass effect)

QUESTION

- Can be the relationship between realized niche width and dispersal ability of species found in real vegetation?

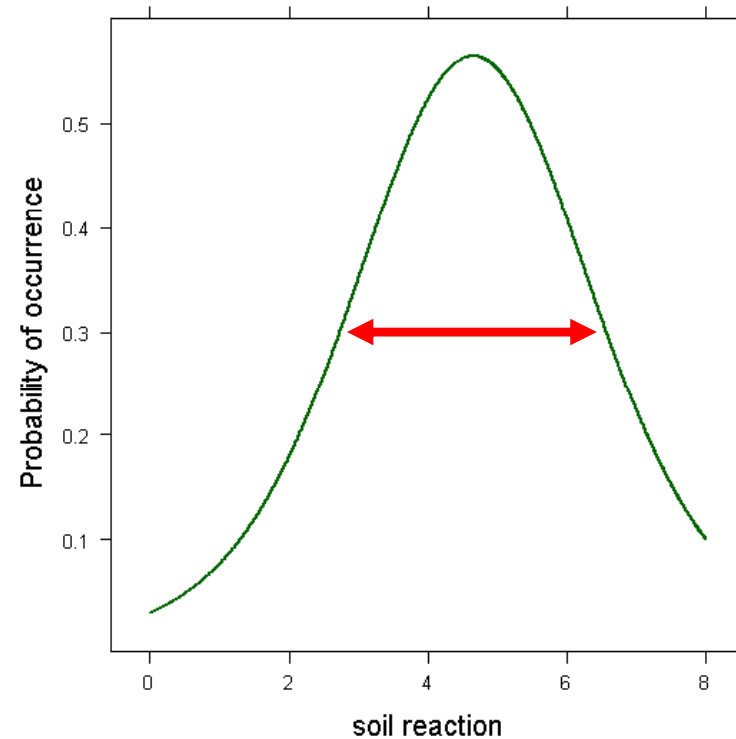
HOW TO MEASURE REALIZED SPECIES NICHE?

Alnus glutinosa



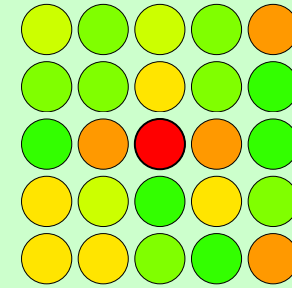
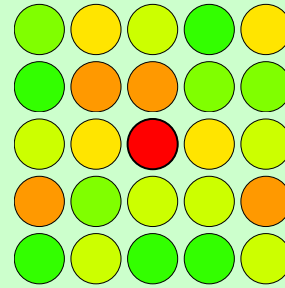
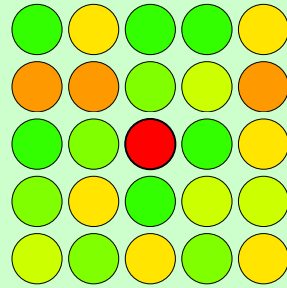
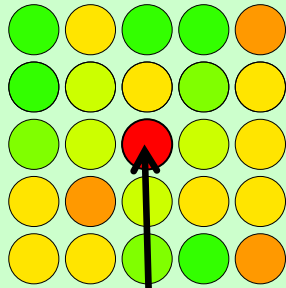
specialist
species with
narrow niche

Fagus sylvatica

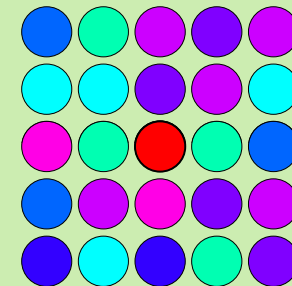
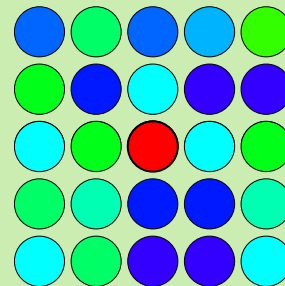
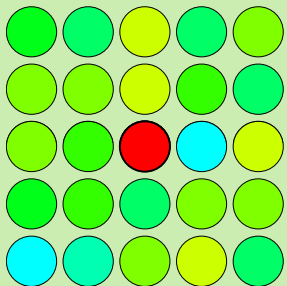
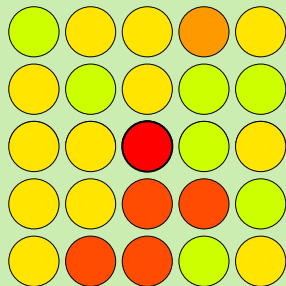


generalist
species with
wide niche

HOW TO MEASURE REALIZED SPECIES NICHE?



specialist – occurs on **similar** habitats with **similar** species composition

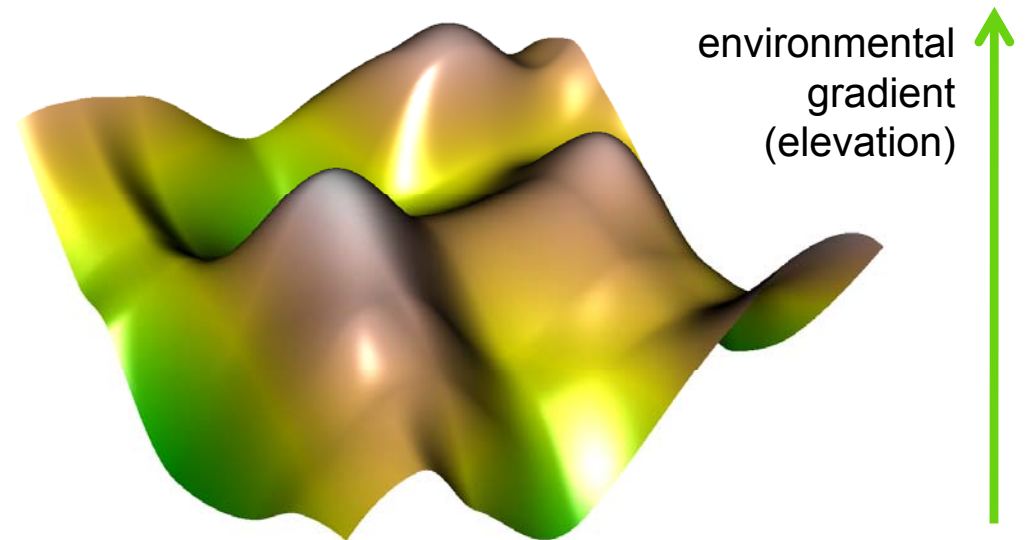
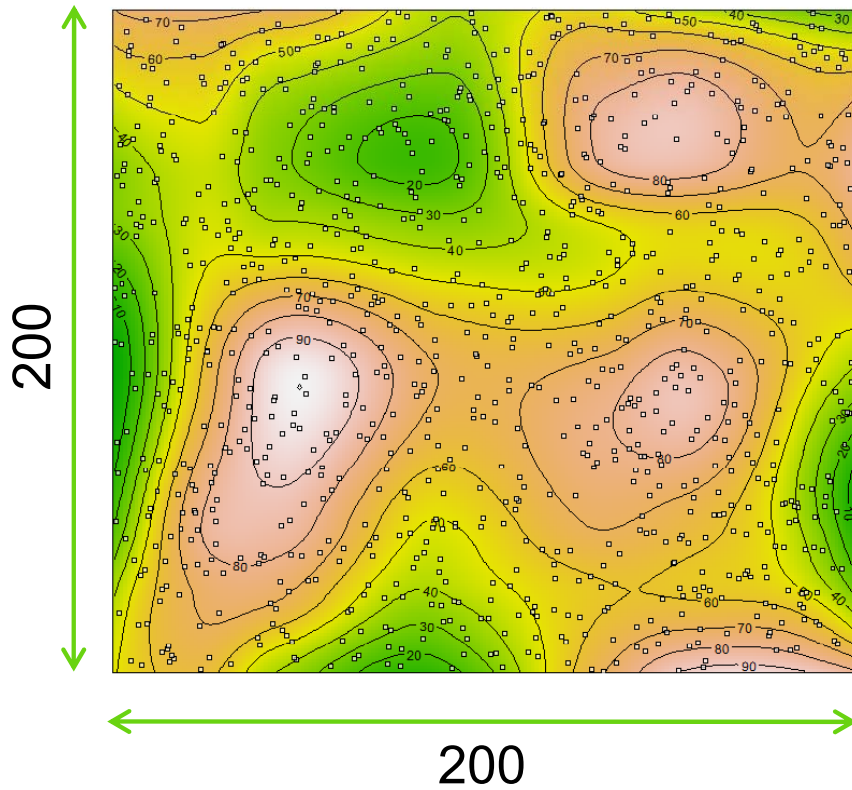


generalist – occurs on **different** habitats with **different** species composition

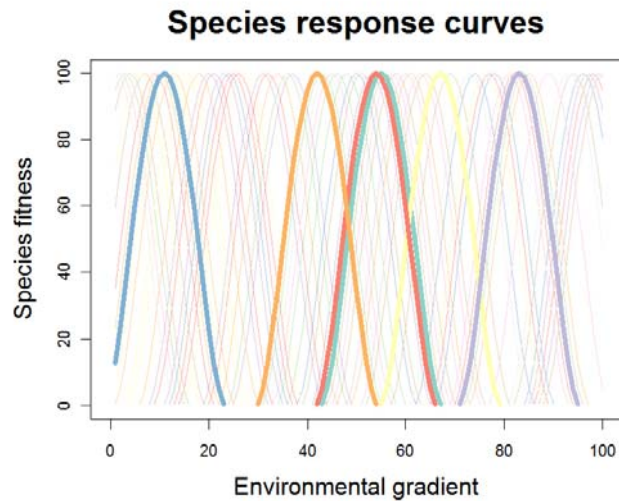
Fridley et al. (2007): **Co-occurrence based assessment of habitat generalists and specialists: a new approach for measurement of niche width.** *Journal of Ecology*

SIMULATED DATA

(NICHE + DISPERSAL + SPATIAL MASS EFFECT)

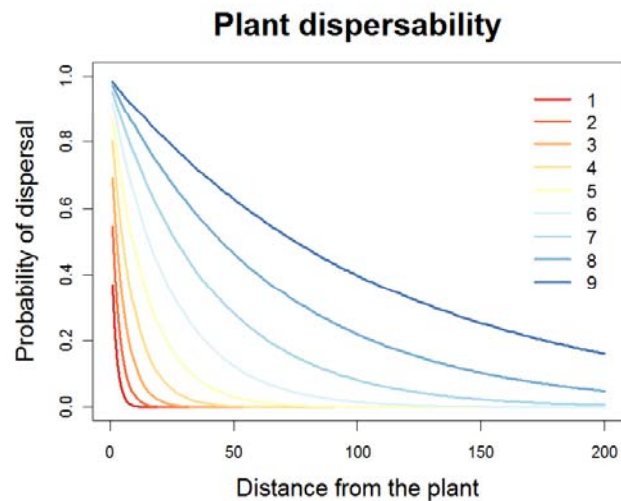


SIMULATED DATA (NICHE + DISPERSAL + SPATIAL MASS EFFECT)



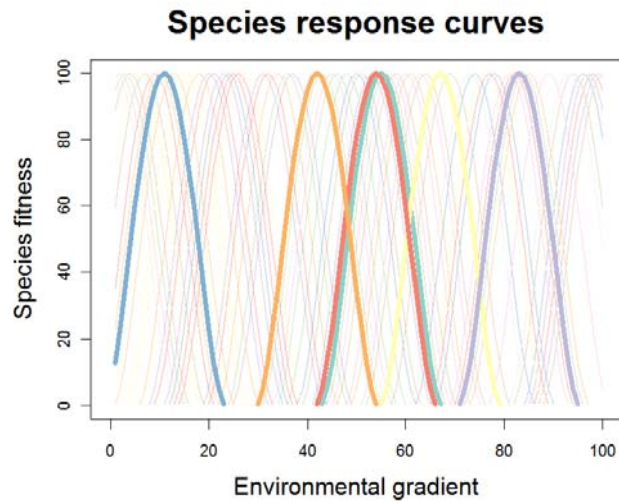
all species have

- different species optima along the environmental gradient
- the same width of fundamental species niche

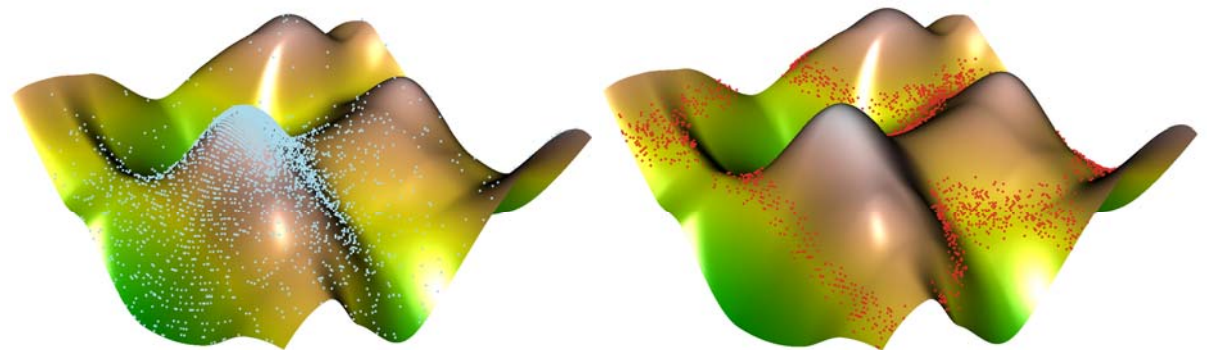
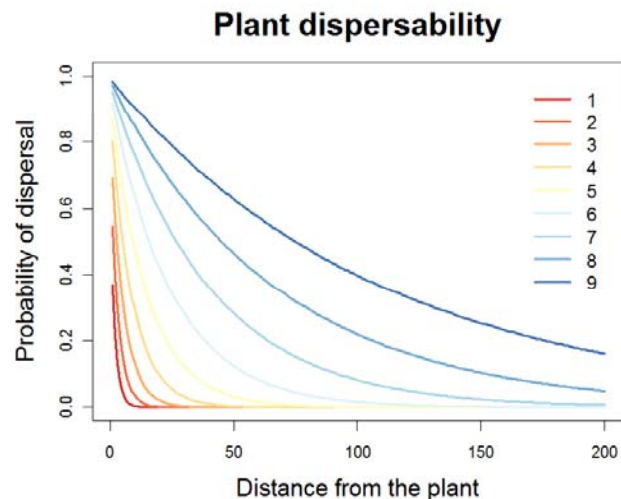


9 categories of species dispersal abilities (from low to high, 1-9)

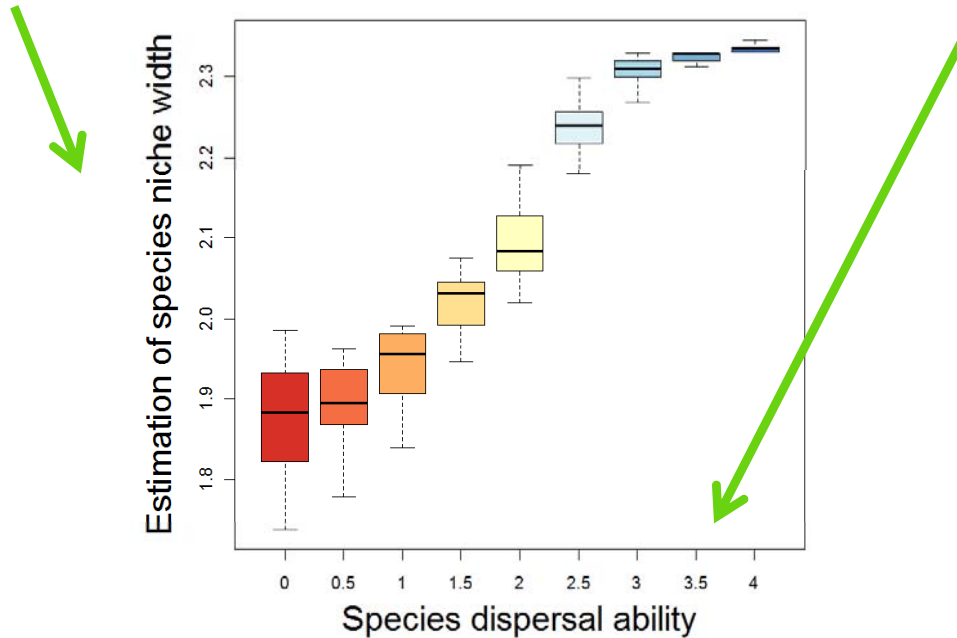
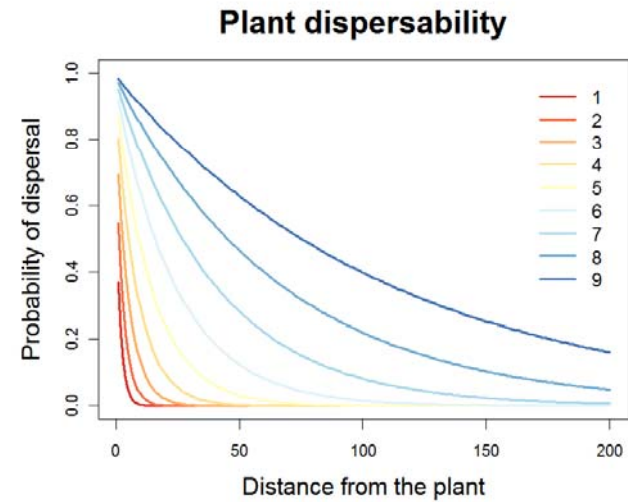
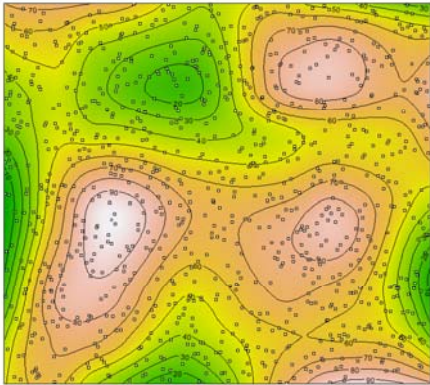
SIMULATED DATA (NICHE + DISPERSAL + SPATIAL MASS EFFECT)



1. species are randomly distributed into the landscape
2. species outside their fundamental niche die
3. surviving species disperse according to their dispersal abilities
4. seeds germinate
5. repeat steps 2 to 4



SIMULATED DATA (NICHE + DISPERSAL + SPATIAL MASS EFFECT)



REAL VEGETATION DATA

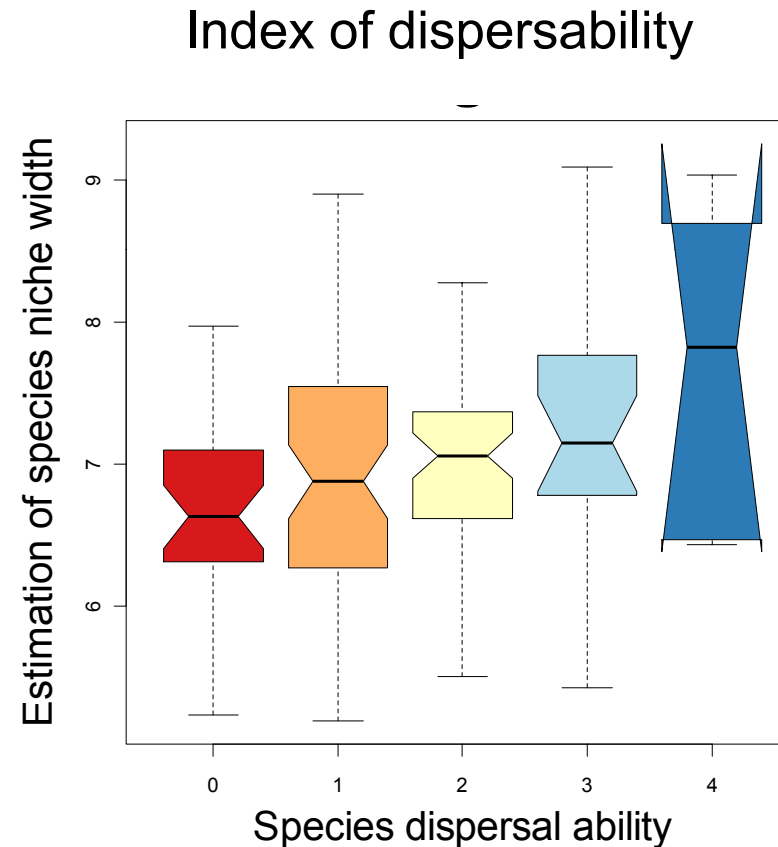
DISPERSAL × HABITAT SPECIALIZATION

Vegetation data

- Czech National Phytosociological database
- selected **8 239 forest vegetation** plots
- focus only on herb species of forest understory

Trait data

- LEDA, BioFlor, Flora DDR
- traits related to dispersal
 - seed weight
 - number of seeds per shoot
 - seed terminal velocity
 - prevailing dispersal mode



REAL VEGETATION DATA

DISPERSAL × HABITAT SPECIALIZATION

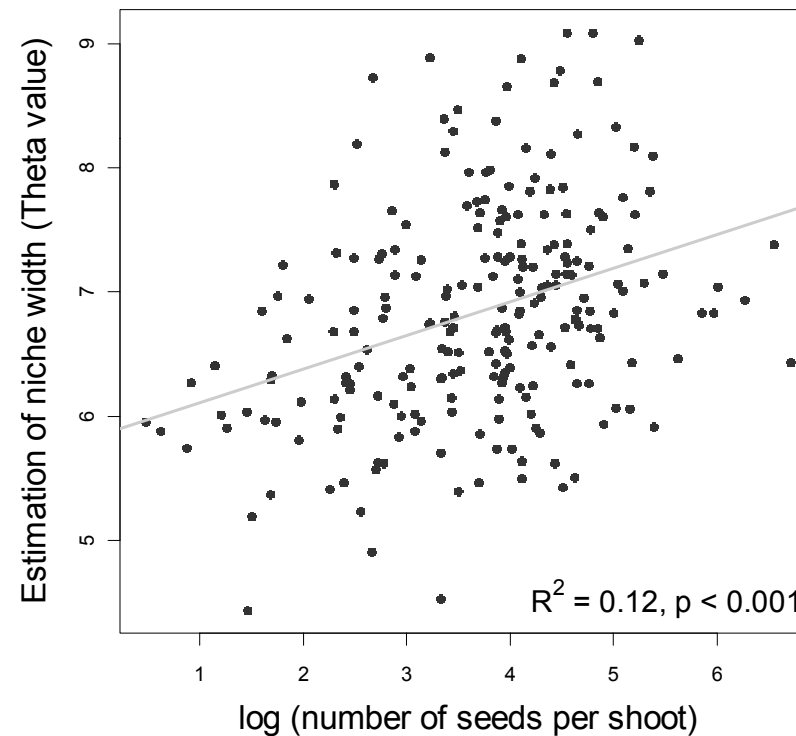
Vegetation data

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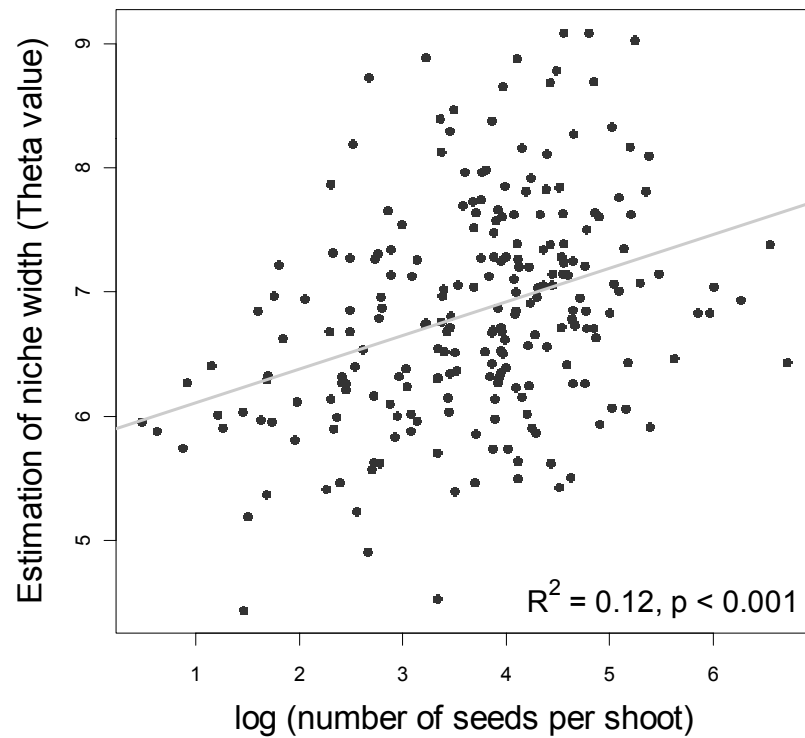
number of seeds



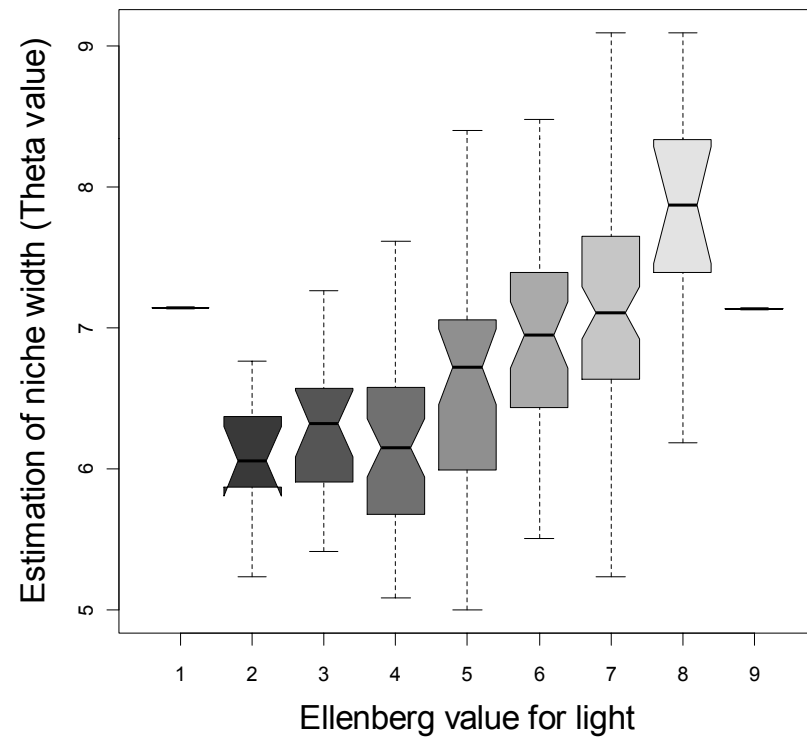
REAL VEGETATION DATA

DISPERSAL & ENVIRONMENT × HABITAT SPECIALIZATION

number of seeds



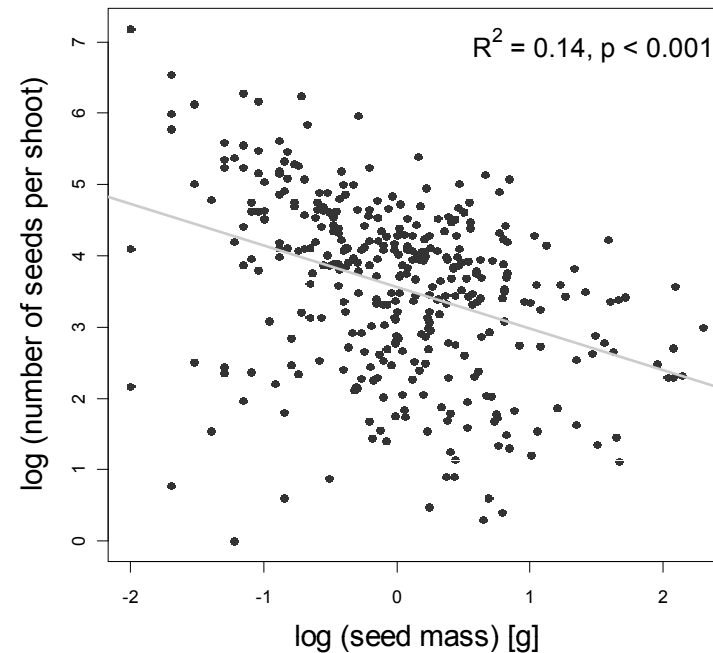
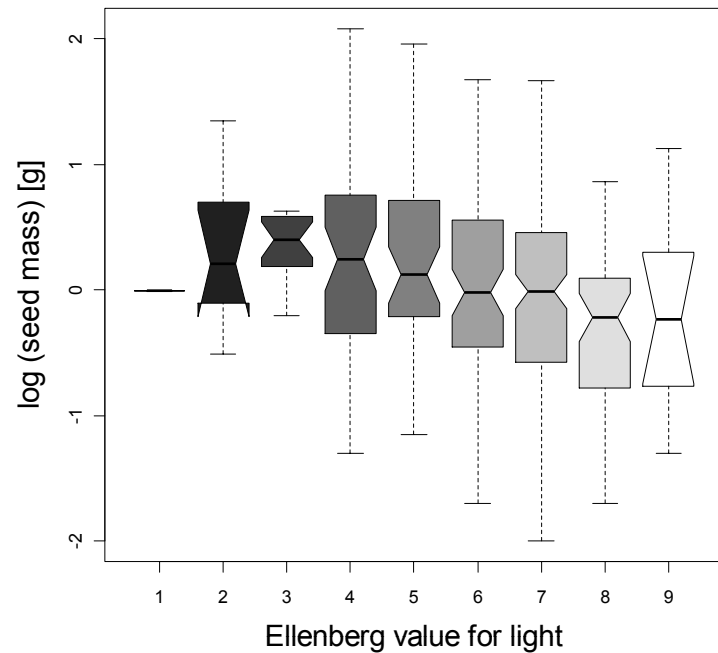
light



REAL VEGETATION DATA

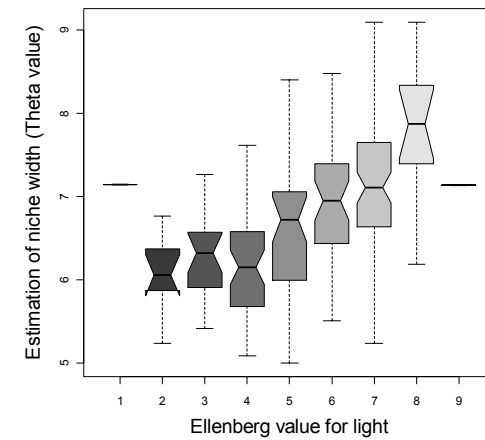
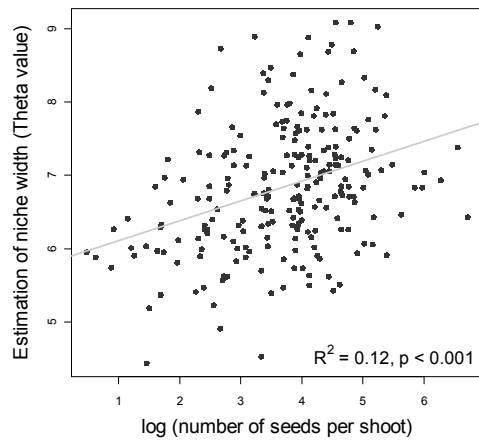
LINK BETWEEN LIGHT AND DISPERSAL

- shade tolerant species have larger seeds
- light demanding species have smaller seeds
- trade off between seed size and number of seeds per shoot



REAL VEGETATION DATA

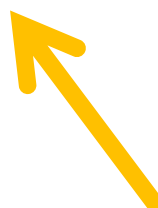
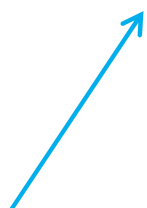
DISPERSAL & ENVIRONMENT × HABITAT SPECIALIZATION



realized
species
niche

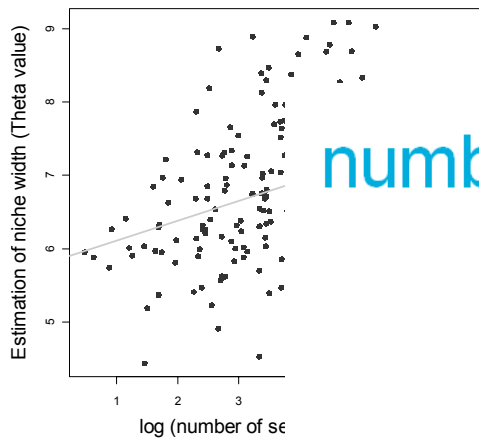
dispersal

environment
(light)



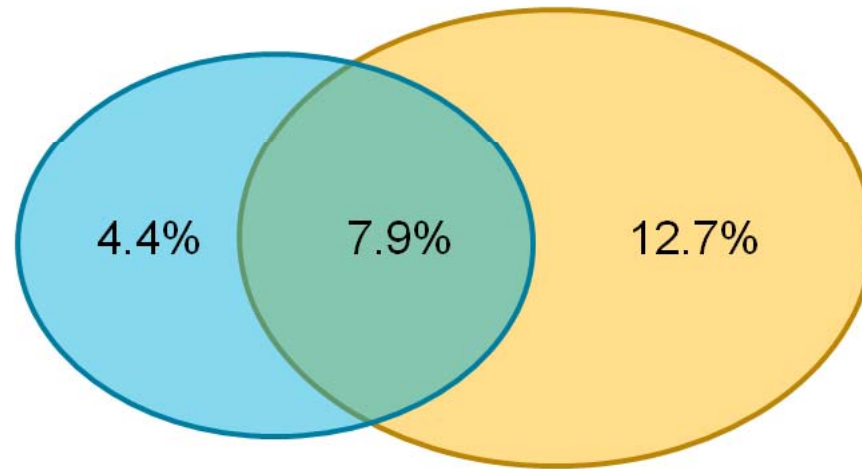
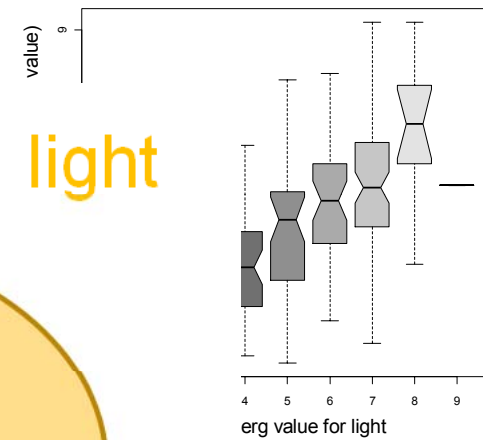
REAL VEGETATION DATA

DISPERSAL & ENVIRONMENT × HABITAT SPECIALIZATION



number of seeds

realized

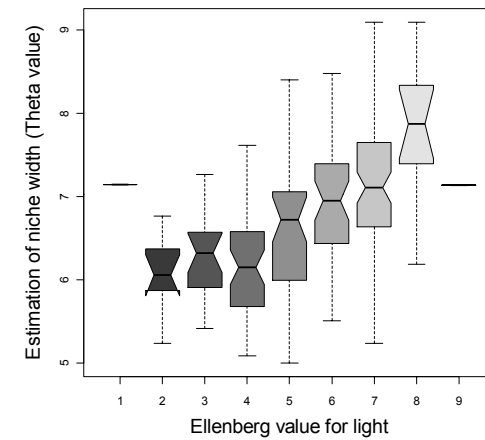
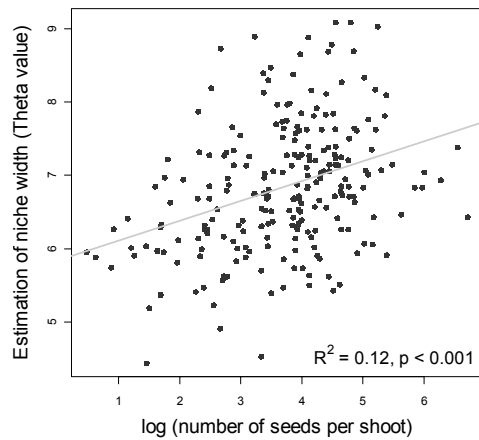


25.0%

nt

REAL VEGETATION DATA

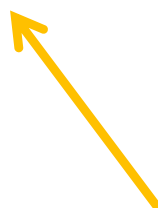
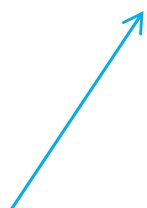
DISPERSAL & ENVIRONMENT × HABITAT SPECIALIZATION



realized
species
niche

dispersal

environment
(light)



CONCLUSIONS

Option 1

species with better dispersal have wider realized niche – at least in case of herb understory in the forest

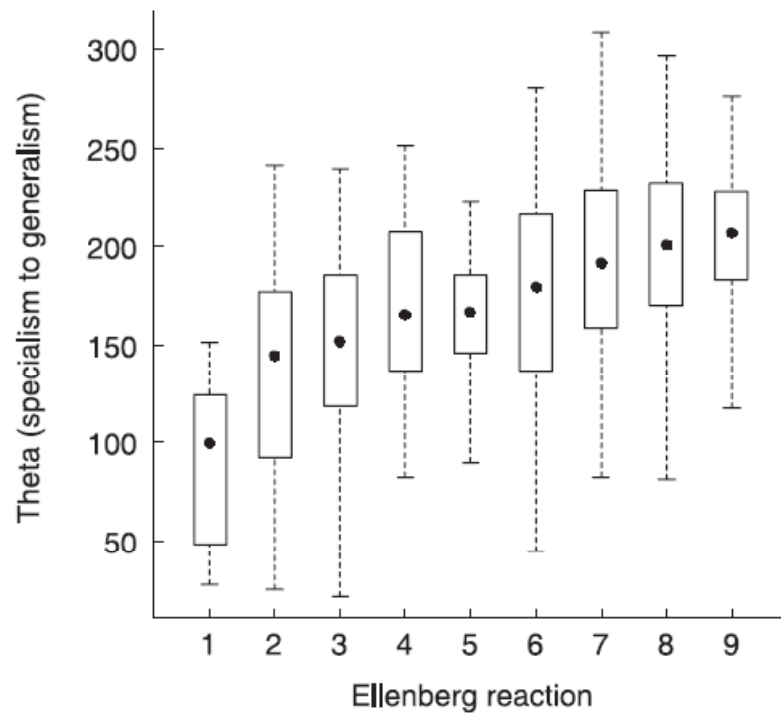
Option 2

realized niche is influenced by environment (light), and relationship with dispersal is just a side effect caused by link between light and dispersal

Option 3

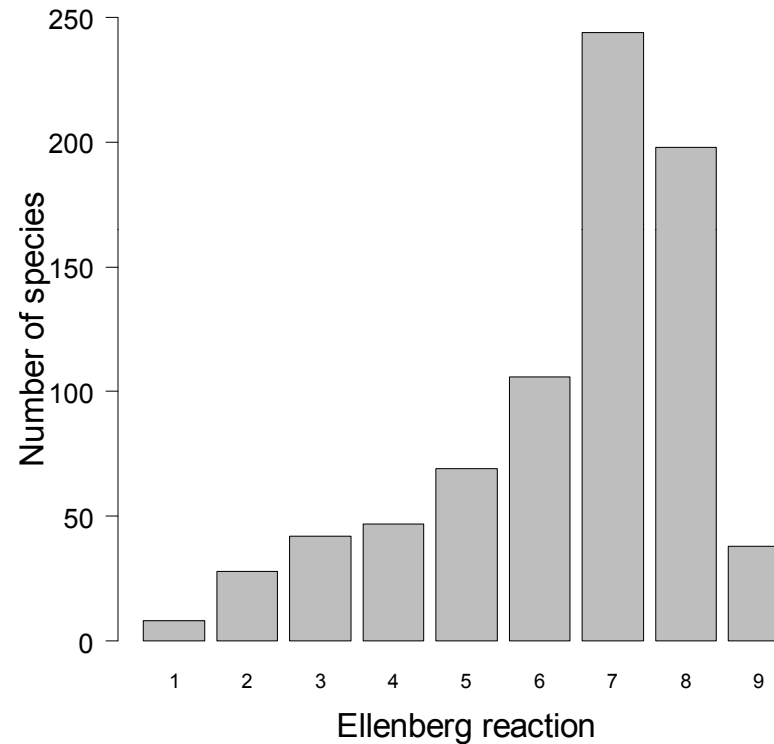
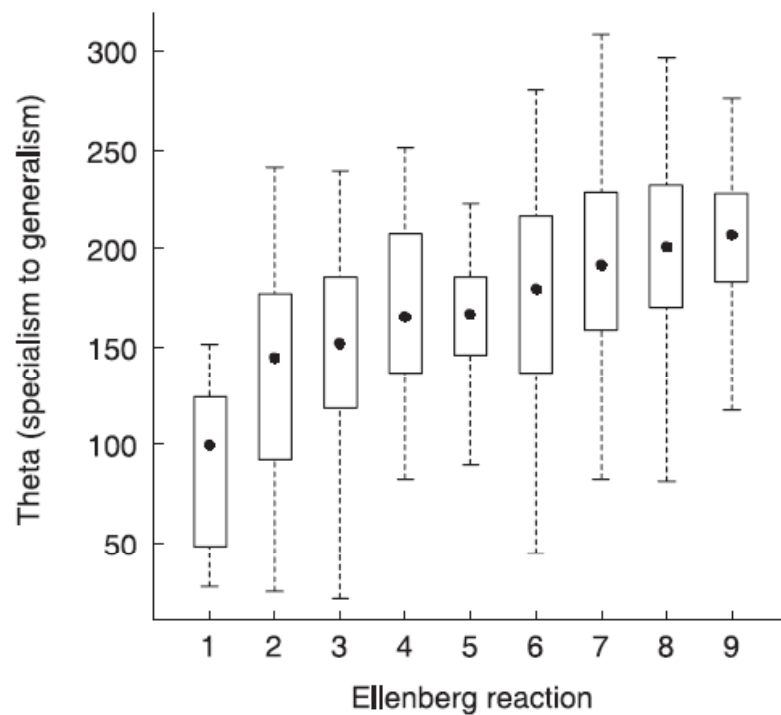
both dispersal and light play a role, each different

CO-OCCURRENCE BASED HABITAT SPECIALIZATION AND ELLENBERG INDICATOR VALUES



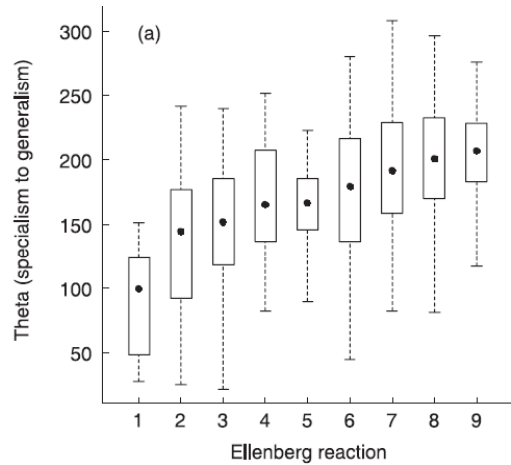
- vegetation database with more than 43.000 vegetation plots
- Ellenberg indicator values for species

CO-OCCURRENCE BASED HABITAT SPECIALIZATION AND ELLENBERG INDICATOR VALUES

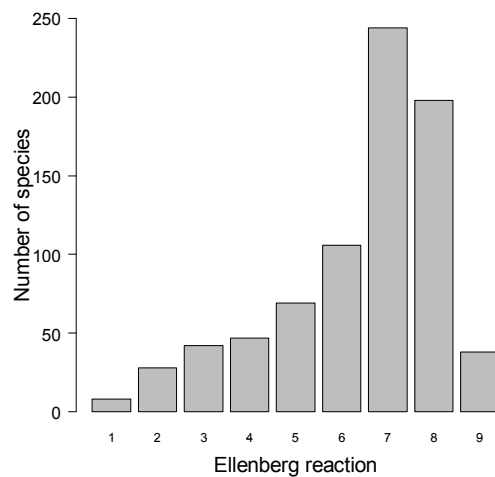
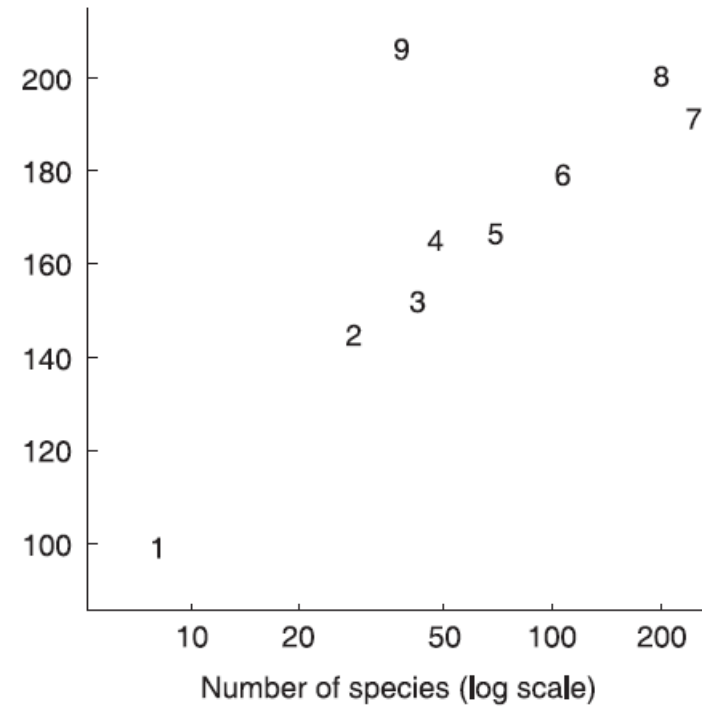


- vegetation database with more than 43.000 vegetation plots
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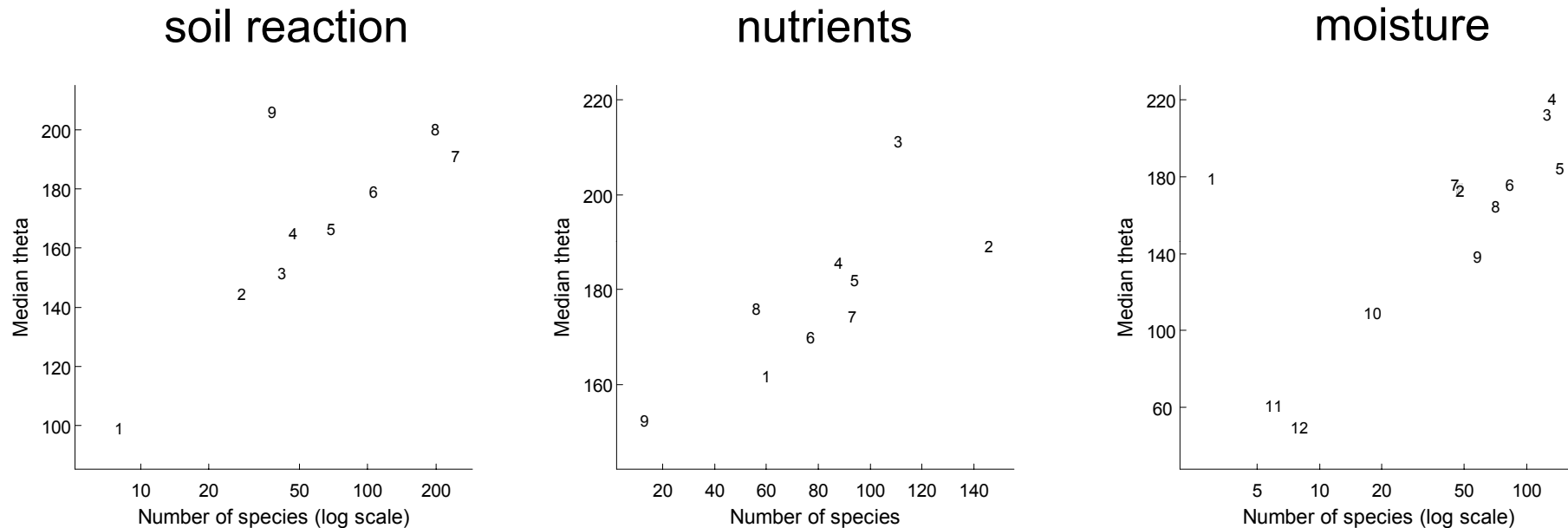
CO-OCCURRENCE BASED HABITAT SPECIALIZATION AND ELLENBERG INDICATOR VALUES



Median theta



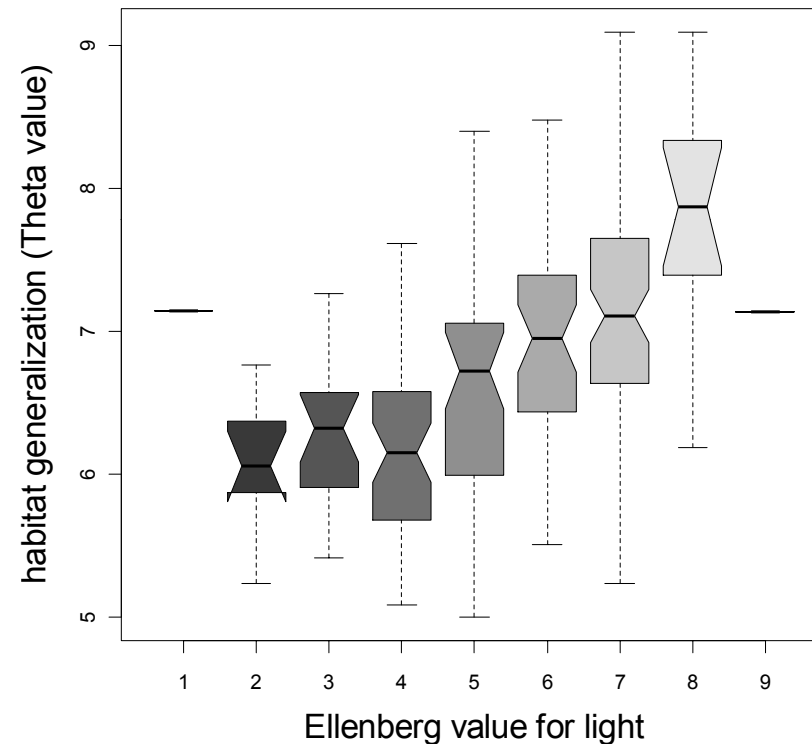
CO-OCCURRENCE BASED HABITAT SPECIALIZATION AND ELLENBERG INDICATOR VALUES



additive measure of beta diversity $\beta = \gamma - \text{mean}(\alpha)$
replaced by
multiplicative measure of beta diversity $\beta = \gamma / \text{mean}(\alpha)$

Zelený (2009): Co-occurrence based assessment of species habitat specialization is affected by the size of species pool: reply to Fridley *et al.* (2007). *Journal of Ecology*

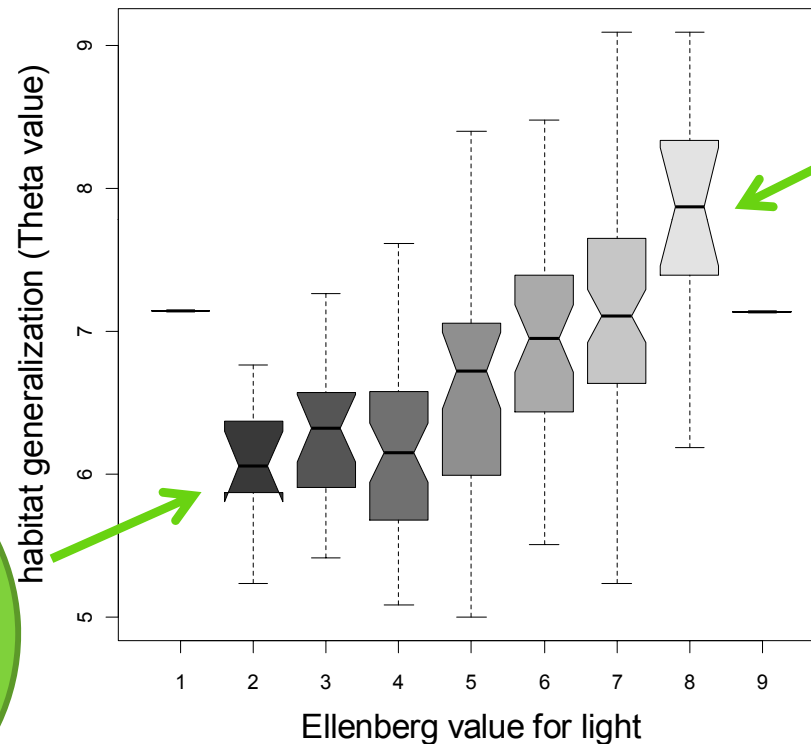
CO-OCCURRENCE BASED HABITAT SPECIALIZATION AND ELLENBERG INDICATOR VALUES FOR LIGHT



- 8.239 **forest** vegetation plots
- only herb species growing in understory
- only species with frequency > 100 (262 species)

CO-OCCURRENCE BASED HABITAT SPECIALIZATION AND ELLENBERG INDICATOR VALUES FOR LIGHT

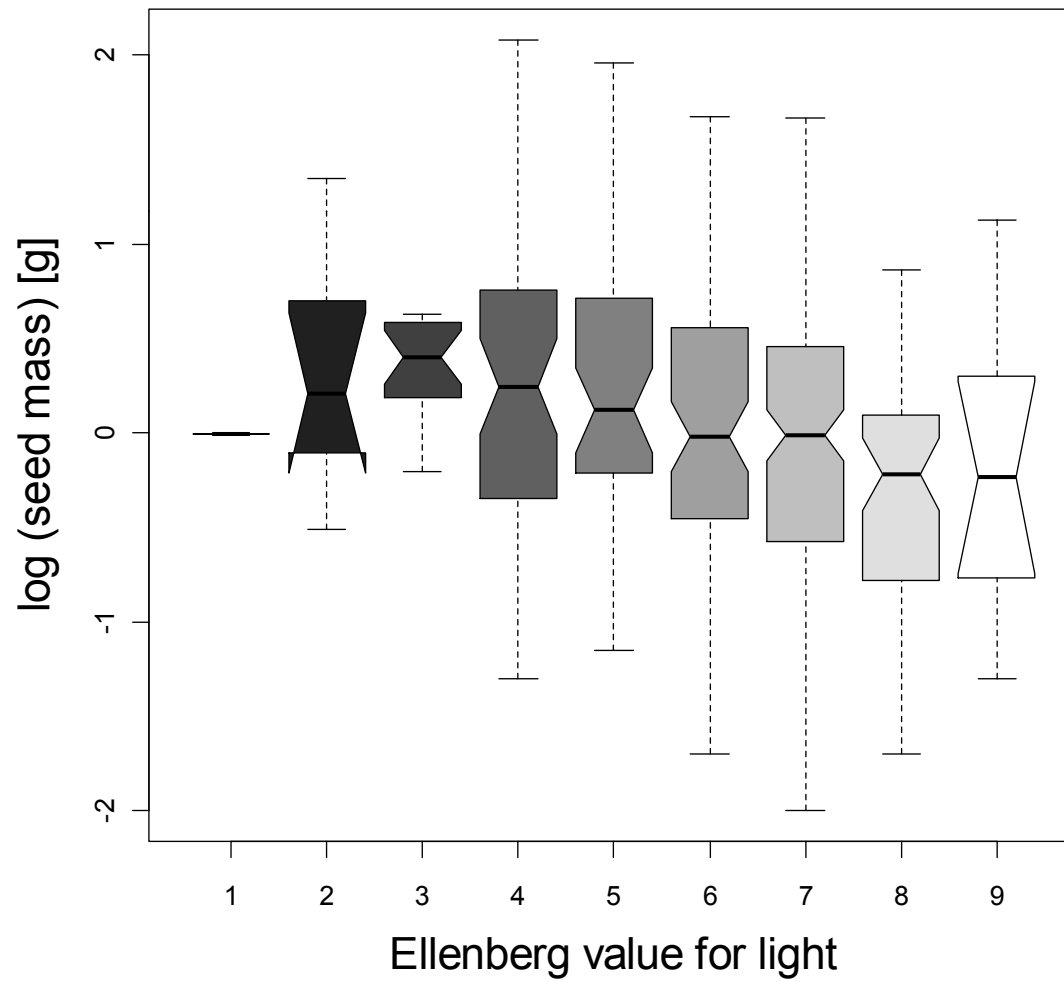
shade tolerant species are habitat specialists



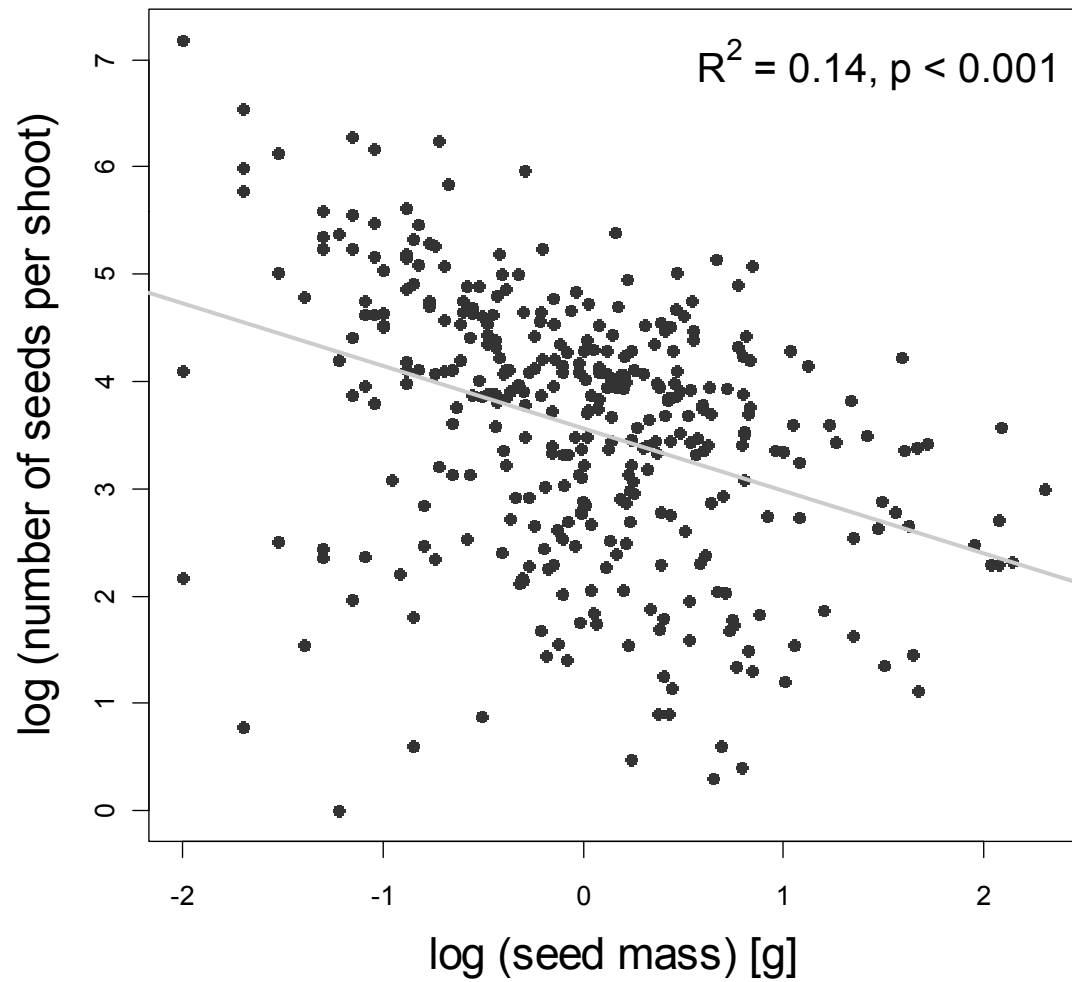
light demanding species are habitat generalists

- 8.239 **forest** vegetation plots
- only herb species growing in understory
- only species with frequency > 100 (262 species)

SEED MASS VS ELLENBERG VALUE FOR LIGHT



NUMBER OF SEEDS PER SHOOT VS SEED MASS



NUMBER OF SEEDS PER SHOOT VS LIGHT

