WHY ARE ELLENBERG INDICATOR VALUES SO GOOD EXPLANATORY VARIABLES?

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ELLENBERG INDICATOR VALUES

3   2   6   6   5   2

Calculation of mean Ellenberg indicator values

	EIV-reaction	1	2	3
Mycelis muralis	6	1	0	0
Moehringia trinervia	7	0	1	1
Mercurialis perennis	7	1	0	1
Lathyrus vernus	4	0	1	0
Myosotis sylvatica	7	1	1	0
Milium effusum	5	0	0	1
Melica nutans	3	1	1	0
Melampyrum pratense	2	0	1	1
Myosotis ramosissima	1	1	1	0
Lychnis viscaria	2	0	0	1
Melittis melissophyllum	3	0	1	0

CALCULATION OF MEAN ELLENBERG INDICATOR VALUES

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Myosotis ramosissima	1	1	1	0
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4.8

mean

CALCULATION OF MEAN ELLENBERG INDICATOR VALUES

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Myosotis ramosissima	1	1	1	0
Lychnis viscaria	2	0	0	1
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mean EIV:		**4.8**	**3.9**	**4.6**

CALCULATION OF MEAN ELLENBERG INDICATOR VALUES

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Lathyrus vernus	4	0	1	0	0
Myosotis sylvatica	7	1	1	0	0
Milium effusum	5	0	0	1	1
Melica nutans	3	1	1	0	0
Melampyrum pratense	2	0	1	1	1
Myosotis ramosissima	1	1	1	0	0
Lychnis viscaria	2	0	0	1	1
Melittis melissophyllum	3	0	1	0	0
mean EIV:		**4.8**	**3.9**	**4.6**	**4.6**

mean EIV inherits information about compositional similarity between plots

Randomization of EIVs among species

Randomization of EIVs among species

3   2   6   6   5   2

Calculation of mean randomized Ellenberg indicator values

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Lathyrus vernus	4	0	1	0	0
Myosotis sylvatica	7	1	1	0	0
Milium effusum	5	0	0	1	1
Melica nutans	3	1	1	0	0
Melampyrum pratense	2	0	1	1	1
Myosotis ramosissima	1	1	1	0	0
Lychnis viscaria	2	0	0	1	1
Melittis melissophyllum	3	0	1	0	0

CALCULATION OF MEAN RANDOMIZED ELLENBERG INDICATOR VALUES

	EIV-reaction	1	2	3	4
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Lathyrus vernus	2	0	1	0	0
Myosotis sylvatica	3	1	1	0	0
Milium effusum	2	0	0	1	1
Melica nutans	7	1	1	0	0
Melampyrum pratense	3	0	1	1	1
Myosotis ramosissima	7	1	1	0	0
Lychnis viscaria	6	0	0	1	1
Melittis melissophyllum	1	0	1	0	0
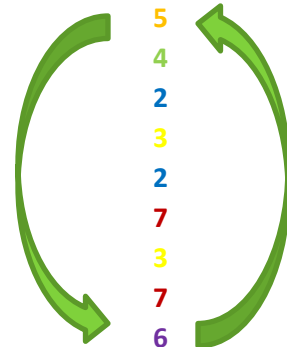
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Milium effusum	6	0	0	1	1
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Milium effusum	7	0	0	1	1
Melica nutans	7	1	1	0	0
Melampyrum pratense	1	0	1	1	1
Myosotis ramosissima	7	1	1	0	0
Lychnis viscaria	2	0	0	1	1
Melittis melissophyllum	2	0	1	0	0
Mean RANDOMIZED EIV:		**5.6**	**4.1**	**3.4**	**3.4**
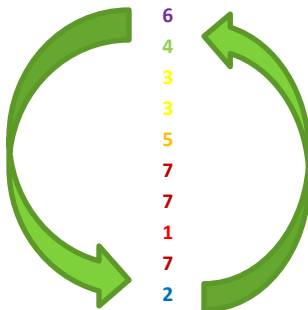
THREE TYPES OF VARIABLES:

	EIV-reaction	1	2	3
Mycelis muralis	6	1	0	0
Moehringia trinervia	7	0	1	1
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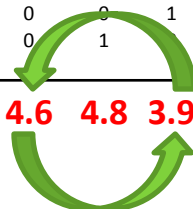
Mean EIV: 4.8 3.9 4.6

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Mean RANDOMIZED EIV: 5.6 4.1 3.4

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Myosotis ramosissima	1	1	1	0
Lychnis viscaria	2	0	0	1
Melittis melissophyllum	3	0	1	

Random variable: 4.6   4.8   3.9

DATA USED FOR ANALYSES

Dataset 1

- 94 vegetation plots
- forest vegetation in Vltava river valley
- measured soil pH

Dataset 2

- 1000 vegetation plots
- forest vegetation
- randomly selected from Czech National Phytosociological Database

INFORMATION ABOUT COMPOSITIONAL SIMILARITY AMONG PLOTS INHERITED INTO

measured pH

calculated mean EIV for soil reaction
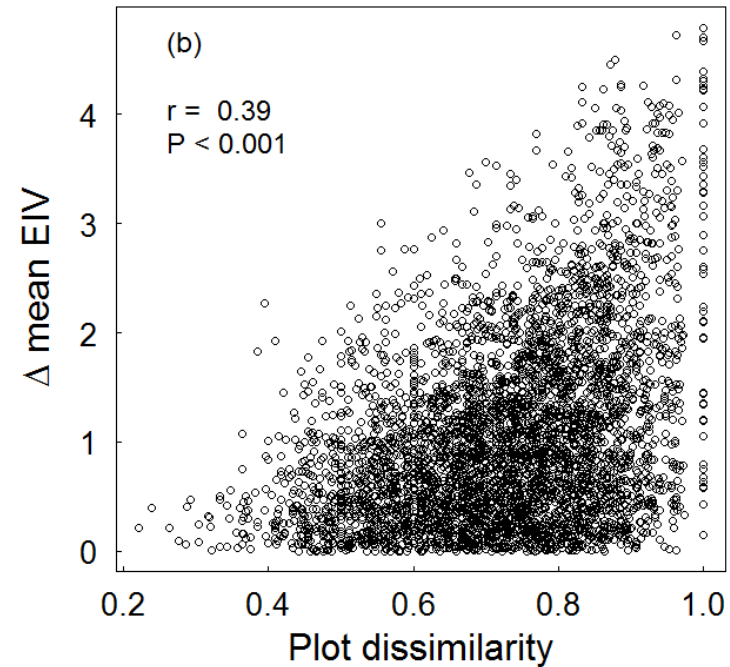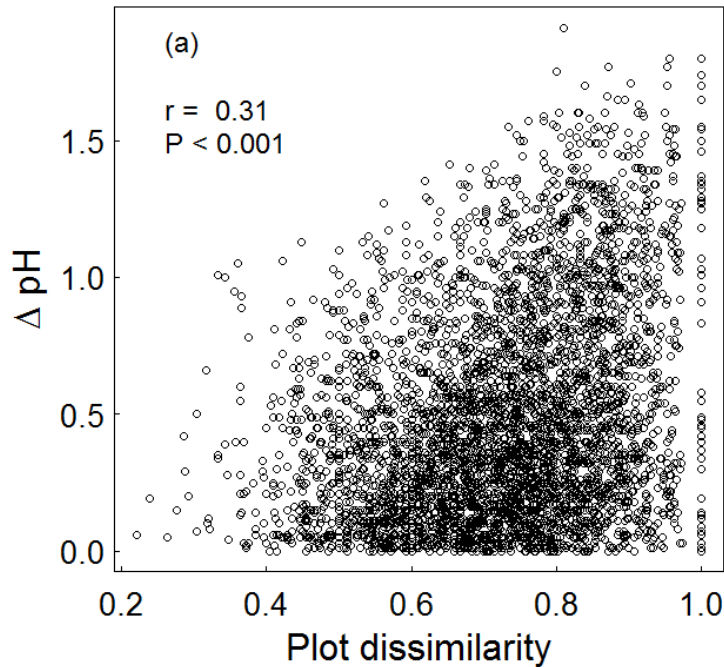
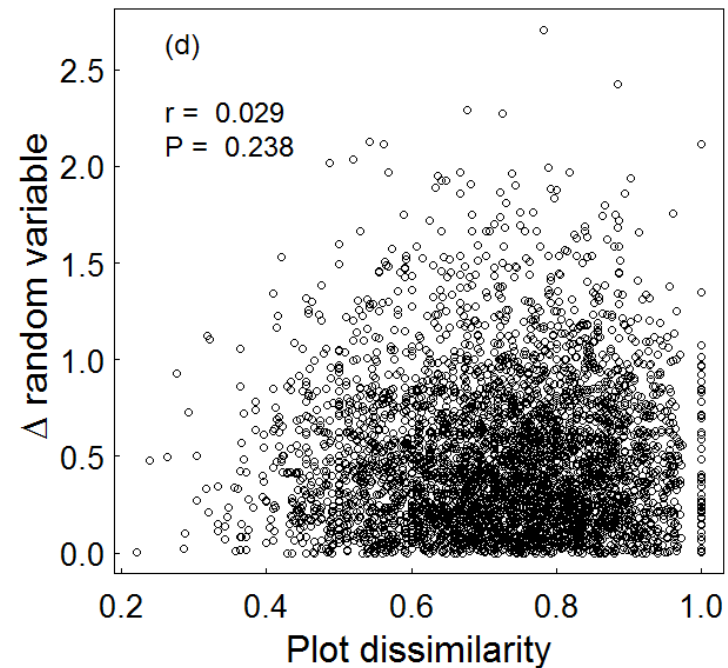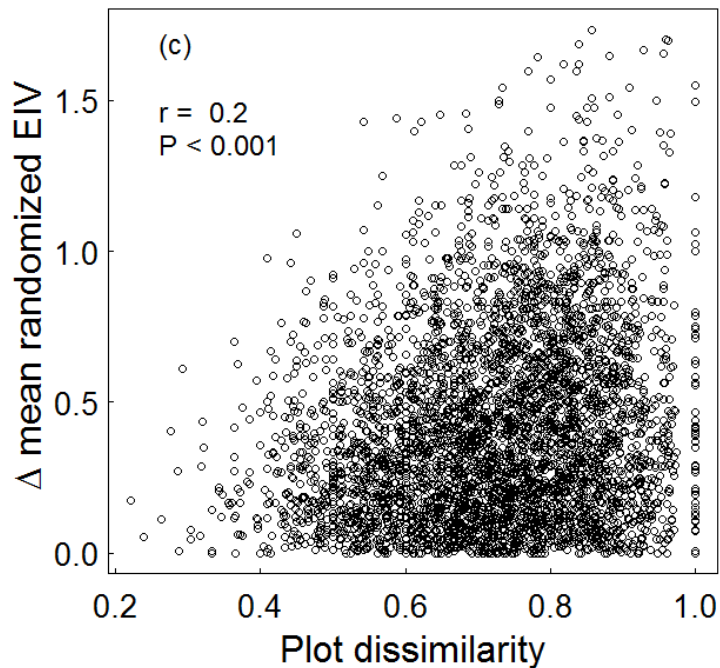r , P - results of Mantel's test of correlation between two dissimilarity matrices

plot dissimilarity

	plot 1	plot 2	plot 3	plot 4
plot 2	0.33			
plot 3	0.34	0.37		
plot 4	0.35	0.22	0.42	
plot 5	0.84	0.84	0.76	0.82

Bray-Curtis distance

Δ measured pH

		plot 1 5.10	plot 2 4.09	plot 3 4.10	plot 4 4.15
plot 2	4.09	1.01			
plot 3	4.10	1.00	0.01		
plot 4	4.15	0.95	0.06	0.05	
plot 5	5.35	0.25	1.26	1.25	1.20

Information about compositional similarity among plots inherited into

measured pH

calculated mean EIV for soil reaction
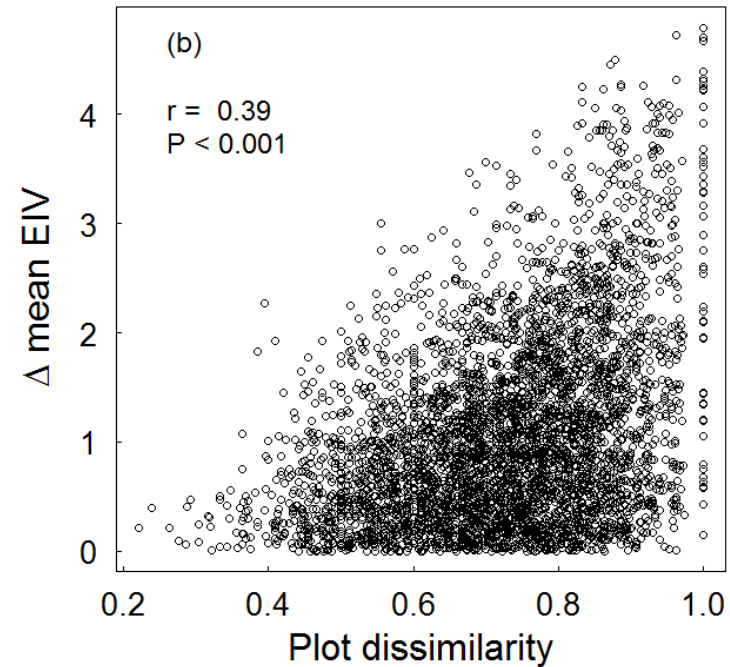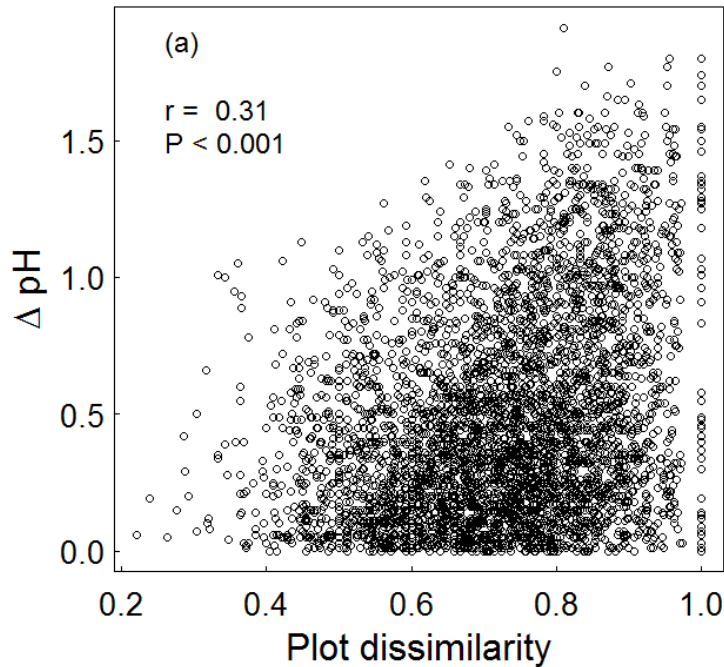
r , P - results of Mantel's test of correlation between two dissimilarity matrices

Information about compositional similarity among plots inherited into

mean randomized EIV for soil reaction	random variable

r , P - results of Mantel's test of correlation between two dissimilarity matrices

EIVs as explanatory variables in CCA

Ecological knowledge (Ellenberg)

vegetation

Species composition

Calculated mean EIV

Circularity of reasoning
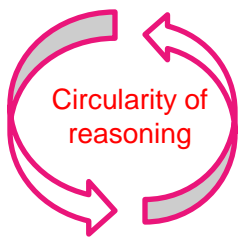
explanatory variable

dependent variable

CCA

Comparison of measured pH and calculated EIV for soil reaction
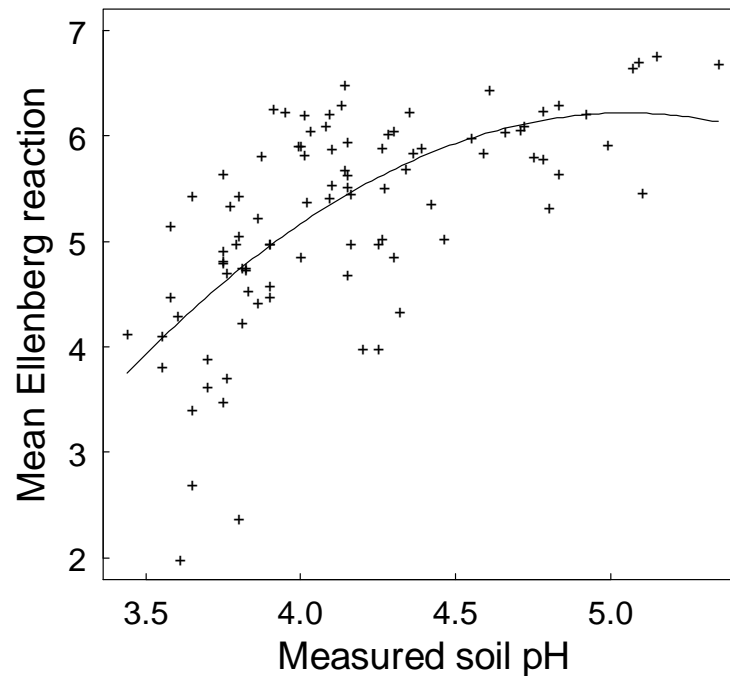
Data: dataset 1 – river valley

CCA: COMPARISON OF MEASURED pH AND CALCULATED EIV FOR SOIL REACTION
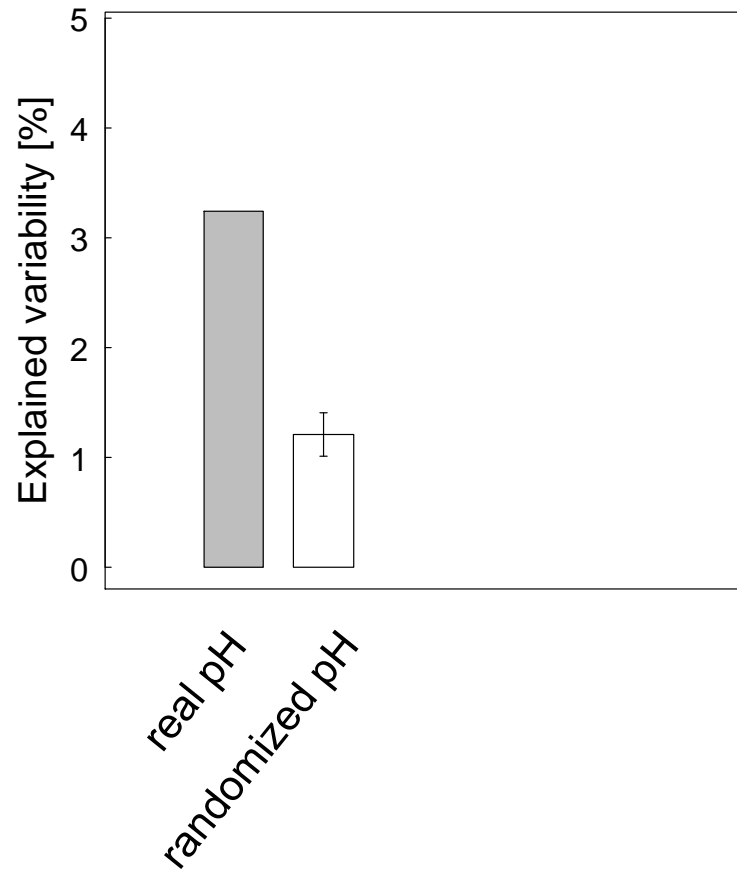
CCA: COMPARISON OF MEASURED PH AND CALCULATED EIV FOR SOIL REACTION
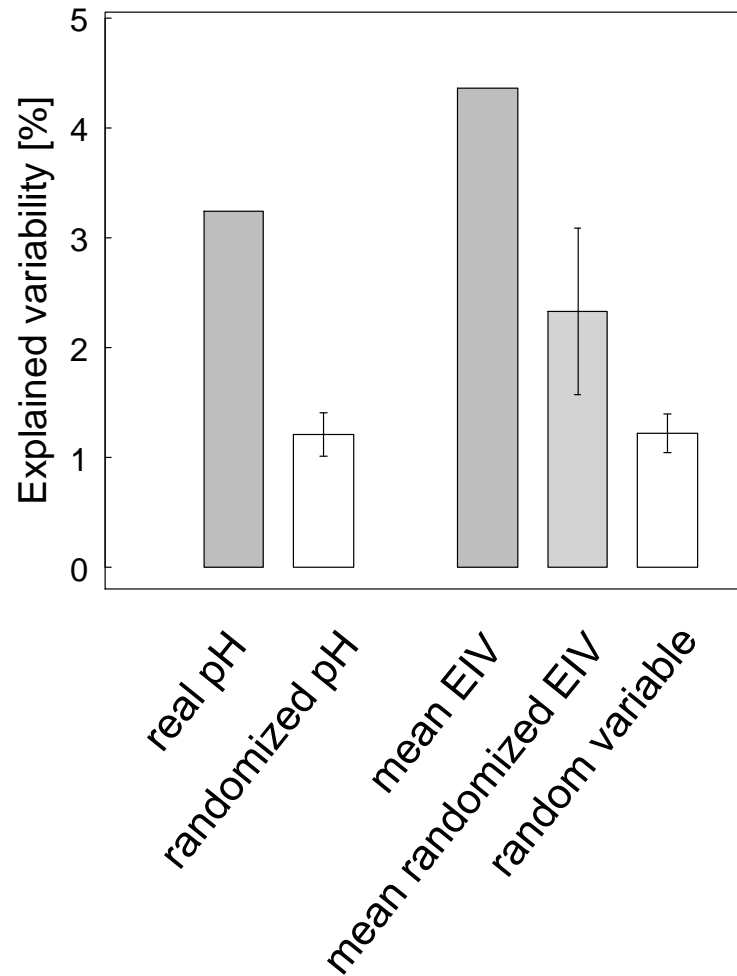
CCA: COMPARISON OF MEASURED pH AND CALCULATED EIV FOR SOIL REACTION

EIVs correlated with DCA scores

Species composition ← vegetation

Ecological knowledge (Ellenberg) →

Calculated mean EIV

Circularity of reasoning

DCA

sample scores on DCA axis
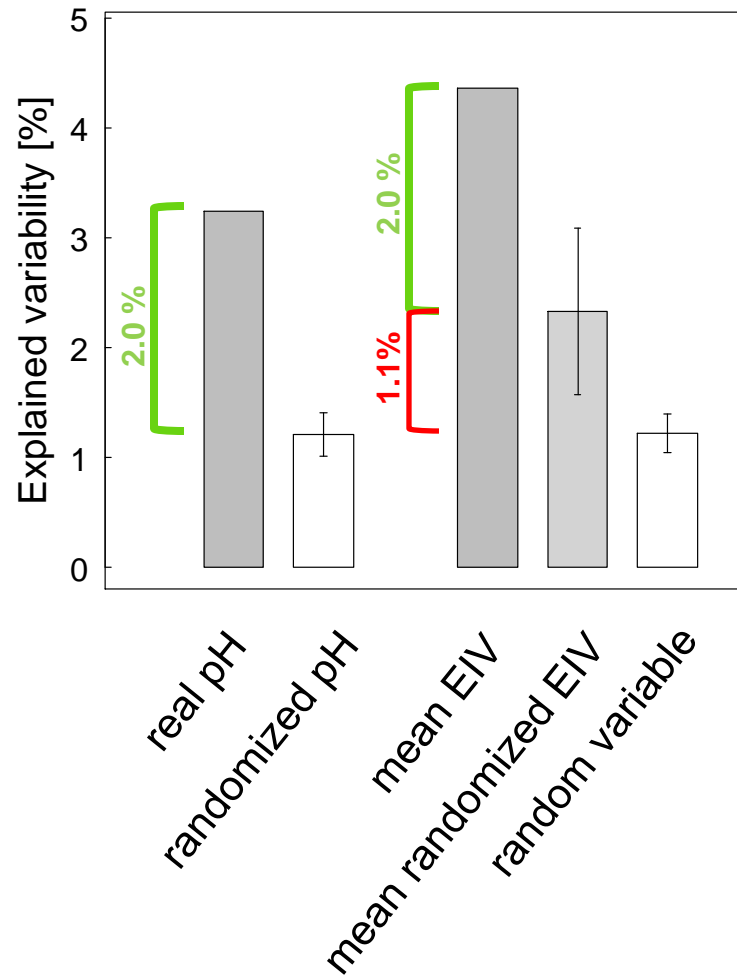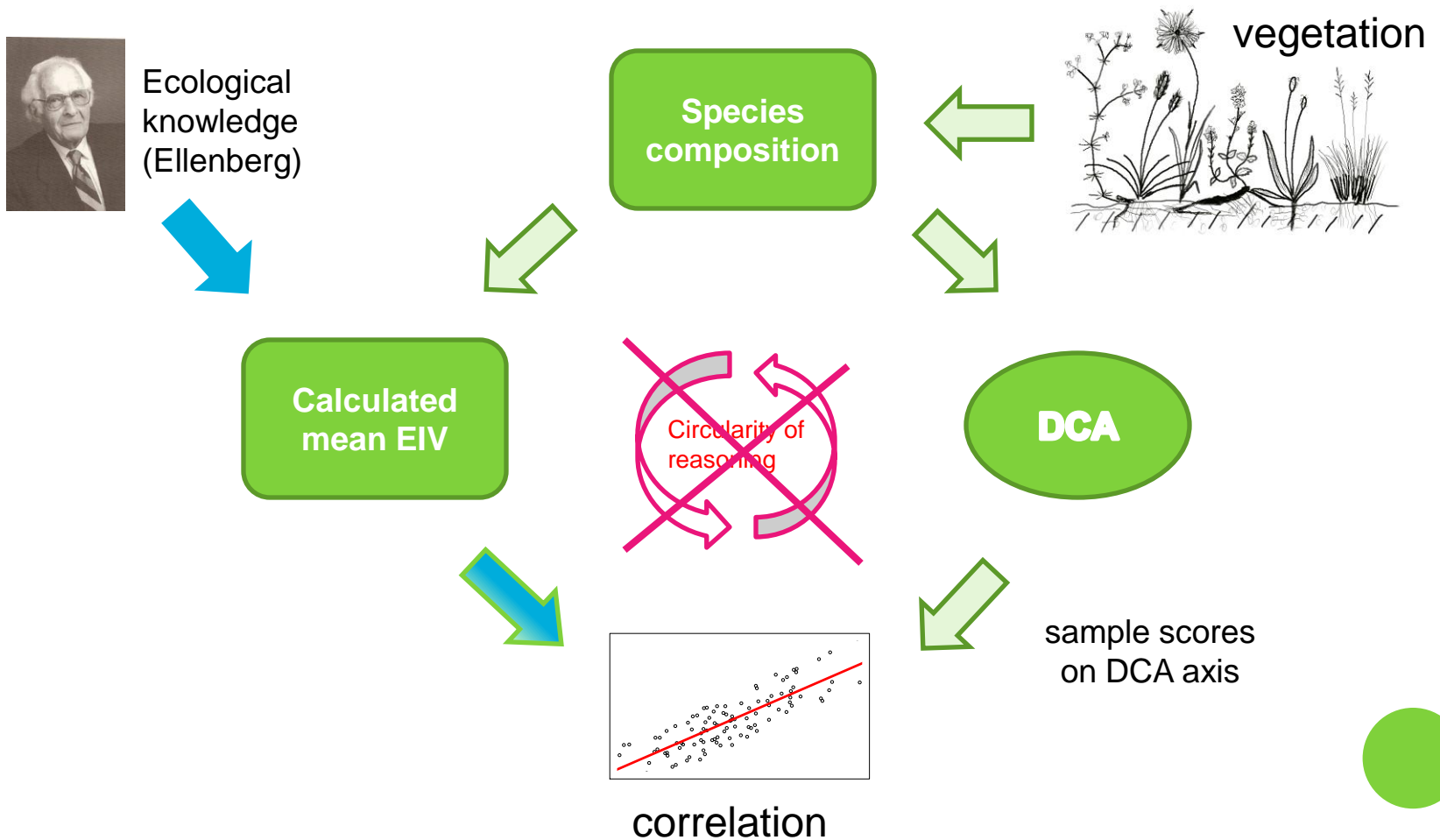
correlation

Mean EIVs correlated with DCA scores
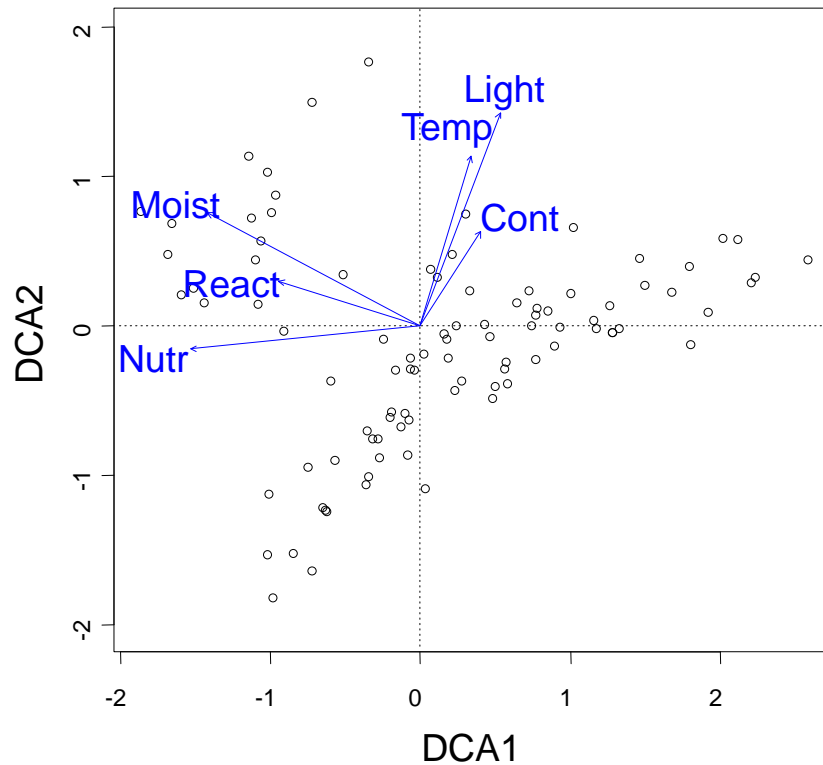
	DCA1	DCA2
Light	+++	+++
Temp	++	+++
Cont	++	+++
Moist	- - -	n.s.
Nutr	- - -	n.s.
React	- - -	n.s.

Tab.: significance of Pearson's correlation coefficient

MEAN EIVS CORRELATED WITH DCA SCORES

mean EIV

sample scores on DCA axis

information about **compositional similarity**
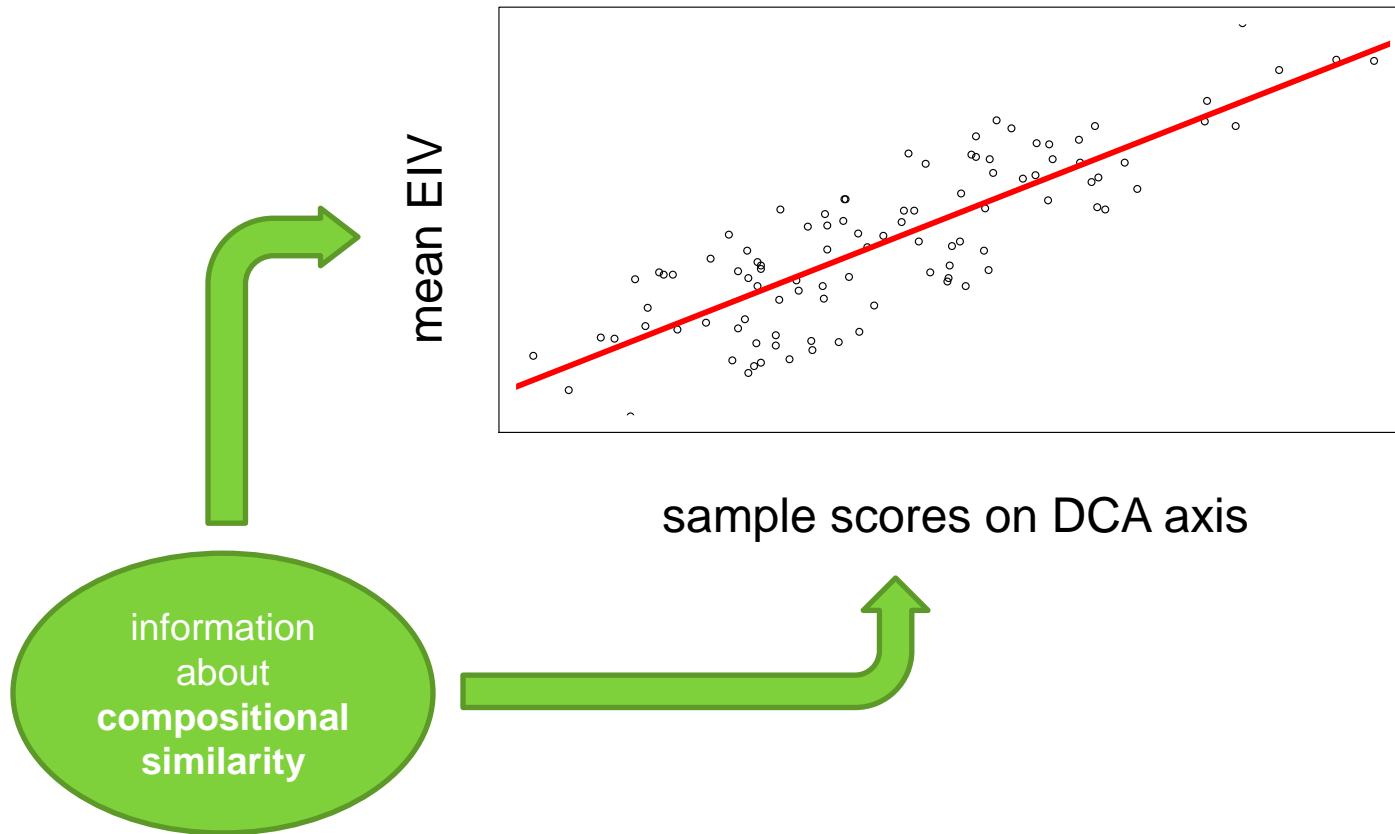
MEAN RANDOMIZED EIV CORRELATED WITH DCA SCORES
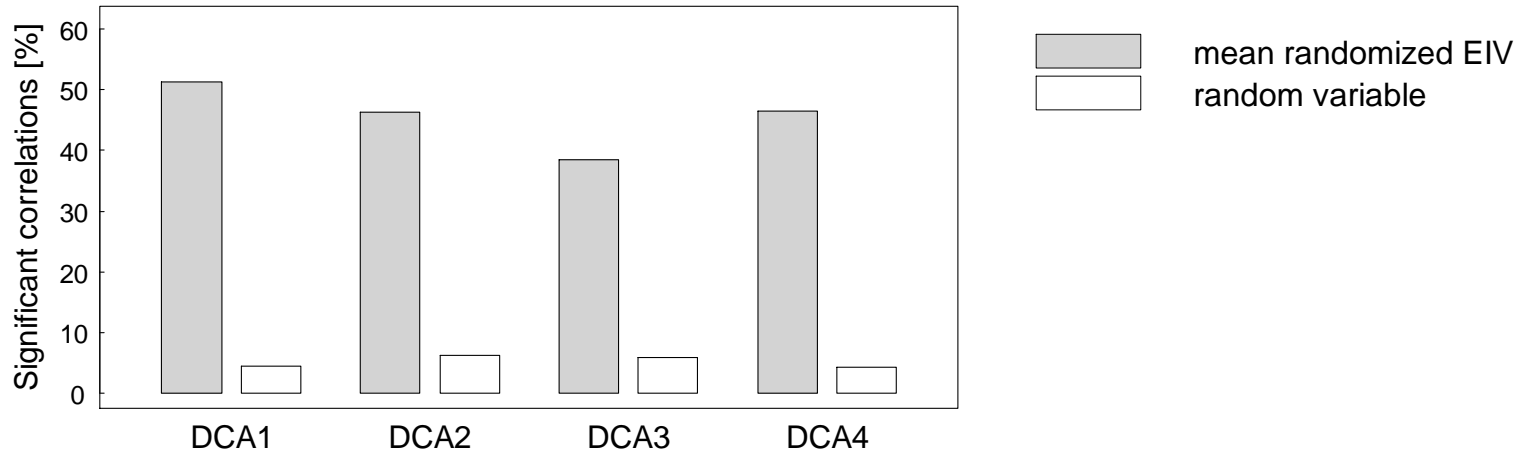
Mean randomized EIV

- inherits information about compositional similarity among plots
- carry no ecological information

- **more than 50% are significantly (p < 0.05) correlated with the first DCA axis!**
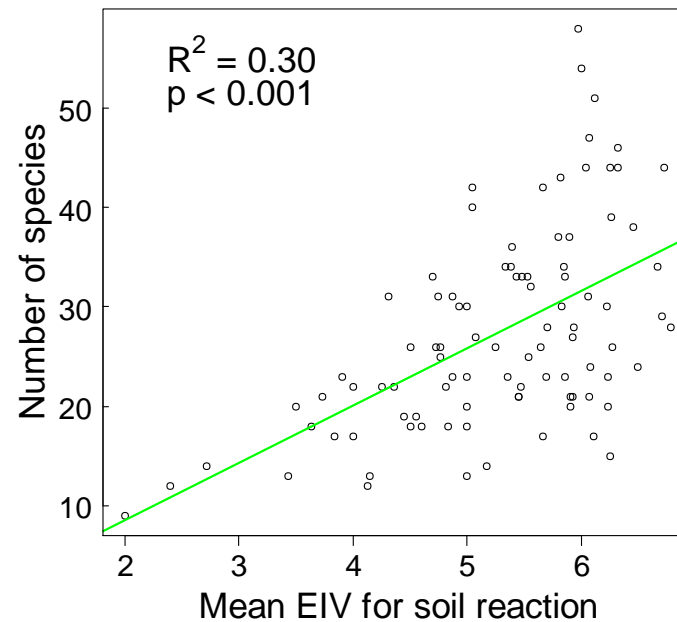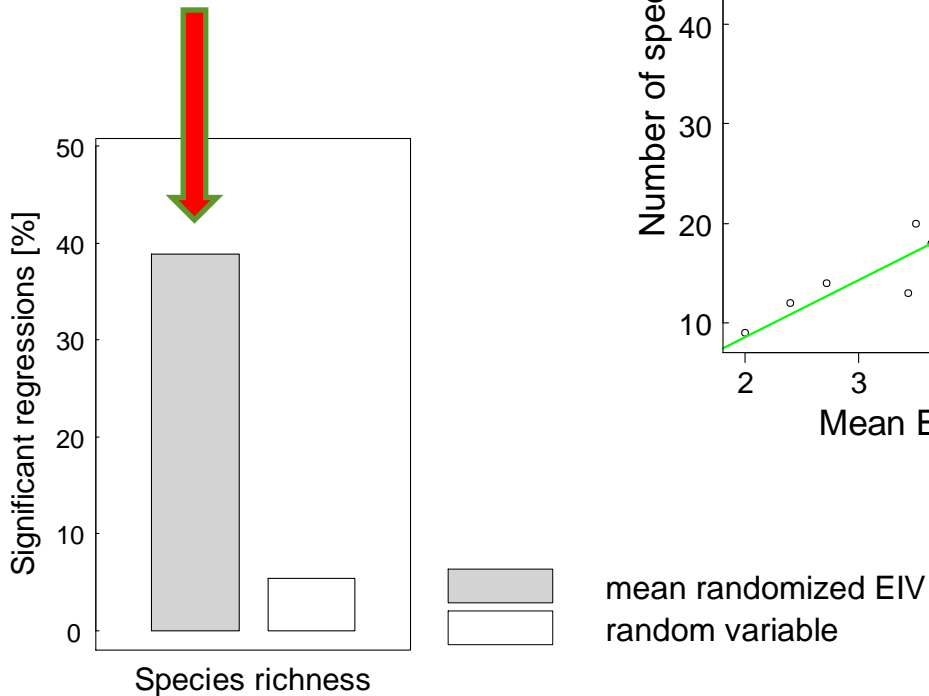
REGRESSION OF SPECIES RICHNESS ON MEAN EIVS
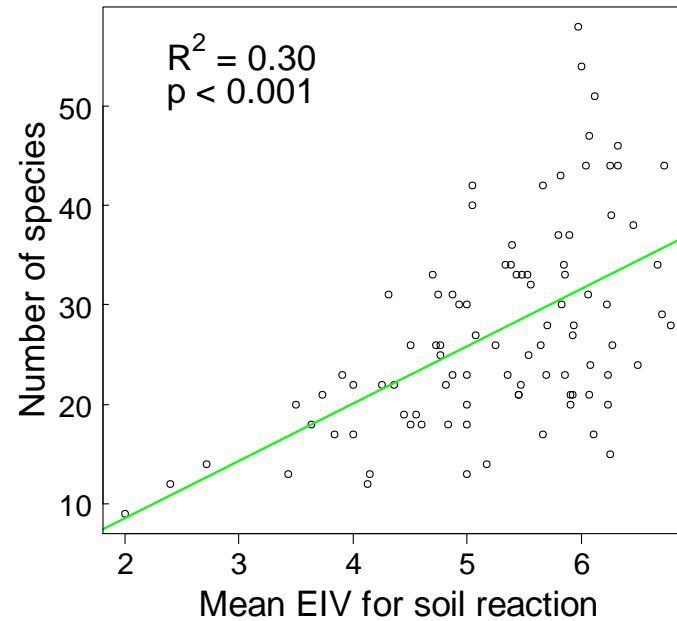
REGRESSION OF SPECIES RICHNESS ON MEAN EIVs

Almost 40% of significant regressions !
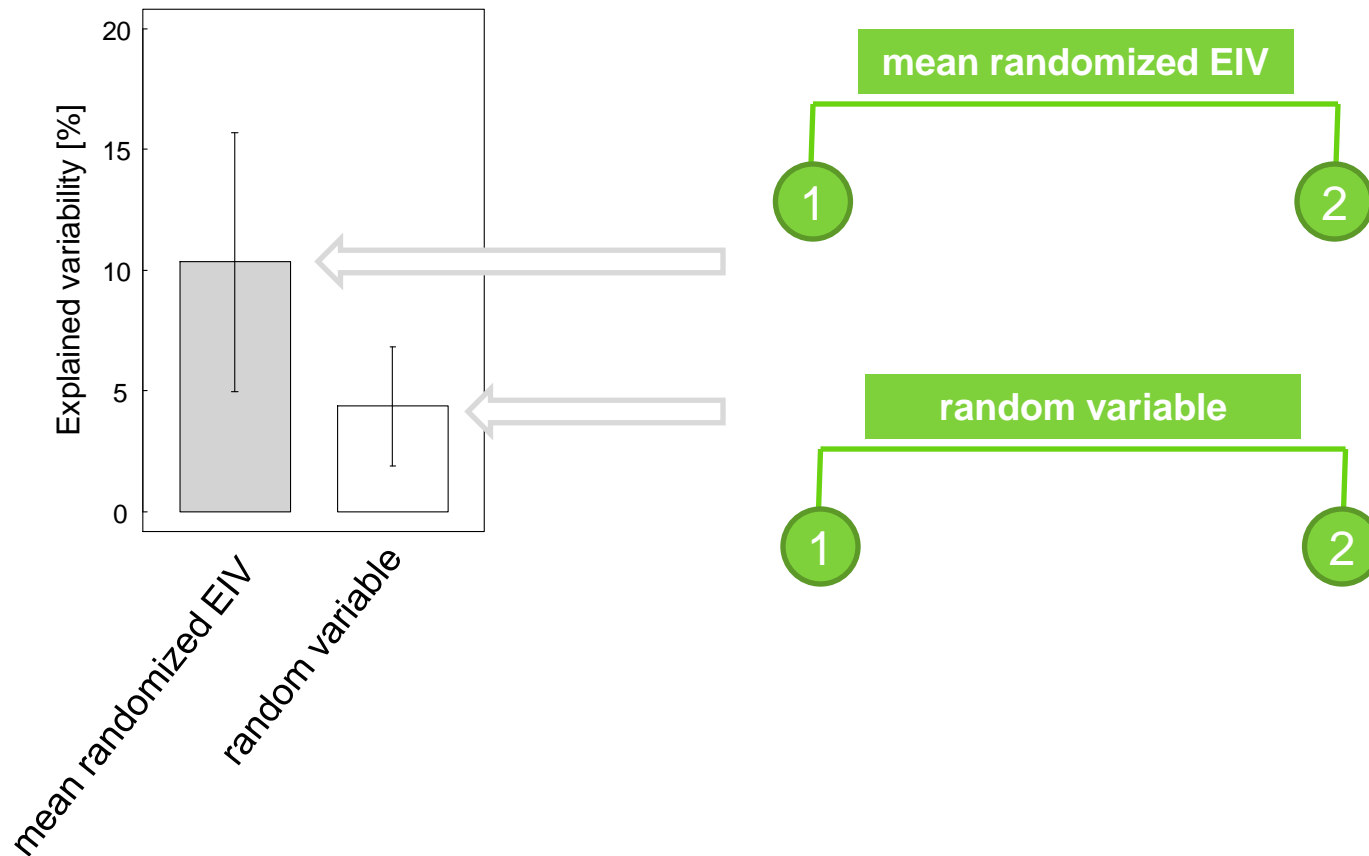
Dependent variable: species richness

Explanatory variables:　　mean EIV
　　　　　　　　　　　　measured variables

Regression trees – variability explained by mean randomized EIV

Summary

- mean Ellenberg indicator values inherits information about compositional similarity among plots

- use in **CCA** (as explanatory variables)
  - circularity of reasoning
  - unrealistically high explained variability

- use in **DCA** (correlation with DCA axis)
  - circularity of reasoning less obvious, but still present
  - unrealistically high correlation coefficients
  - ~ 50 % probability of significant result even in case of no ecological meaning
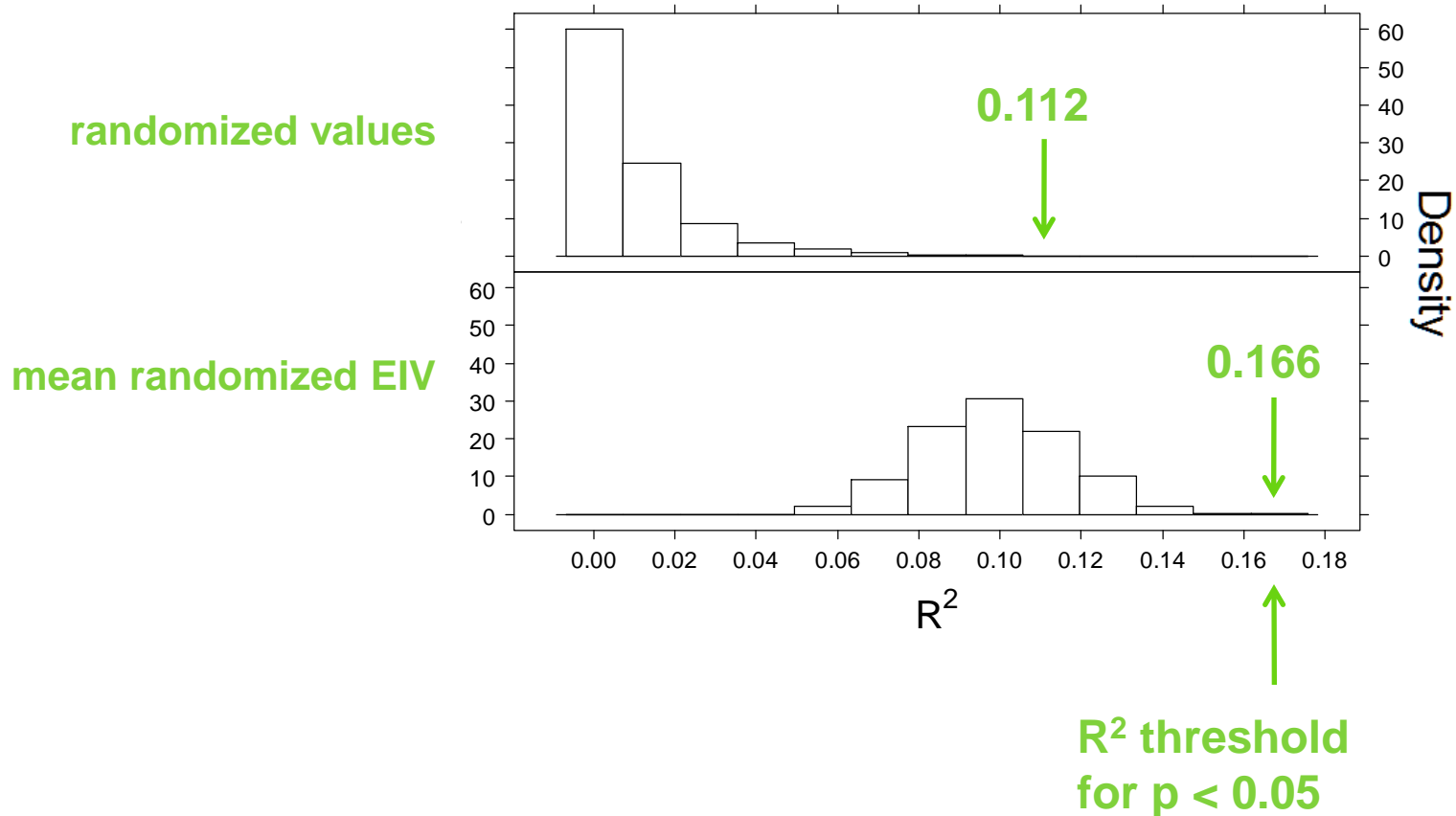
Summary

- correlation with **species richness**
  - unrealistically high correlation coefficients and higher probability of significant results

- use in **regression trees**
  - when mixing mean EIVs with measured variables, mean EIVs will perform as better predictors
  - unrealistically high explained variability

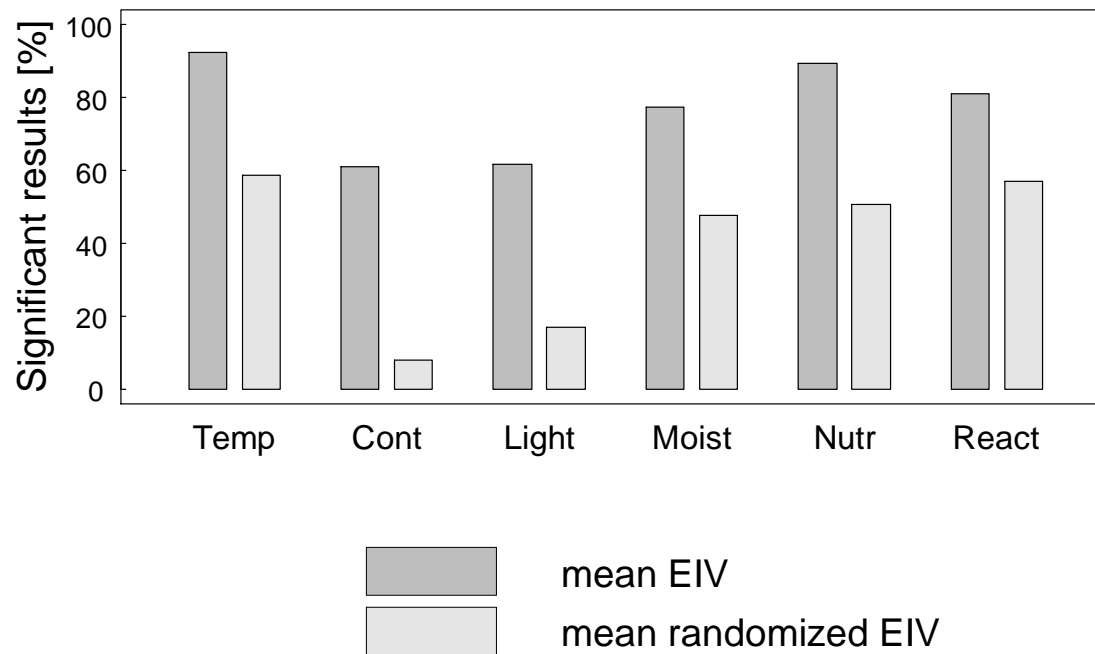# Regression of mean EIV with 1ST axis of DCA
modified Monte-Carlo permutation test

Monte-Carlo distribution of R^2

randomized values

0.112

mean randomized EIV

0.166

Density

R^2

R^2 threshold for $p < 0.05$

Regression of mean EIV with 1ST axis of DCA
modified Monte-Carlo permutation test

Data: dataset 2 – 100 plots randomly selected from database

Conclusions

- for **any analysis with mean EIV**: be careful with testing the significance of relationship

- for **DCA**: do not test the significance of correlation between mean EIV and plot scores on DCA axes - or use modified Monte-Carlo test

- for **correlation** with species richness or other vegetation-derived variable: expect unrealistically high correlation coefficient and higher probability of getting significant result

- for **regression and classification trees**: do not mix mean EIV with measured variables, if dependent variable is derived from species composition (species richness, classification)

Thank you for your attention!

ACKNOWLEDGEMENT