Relationship between species richness and landscape heterogeneity

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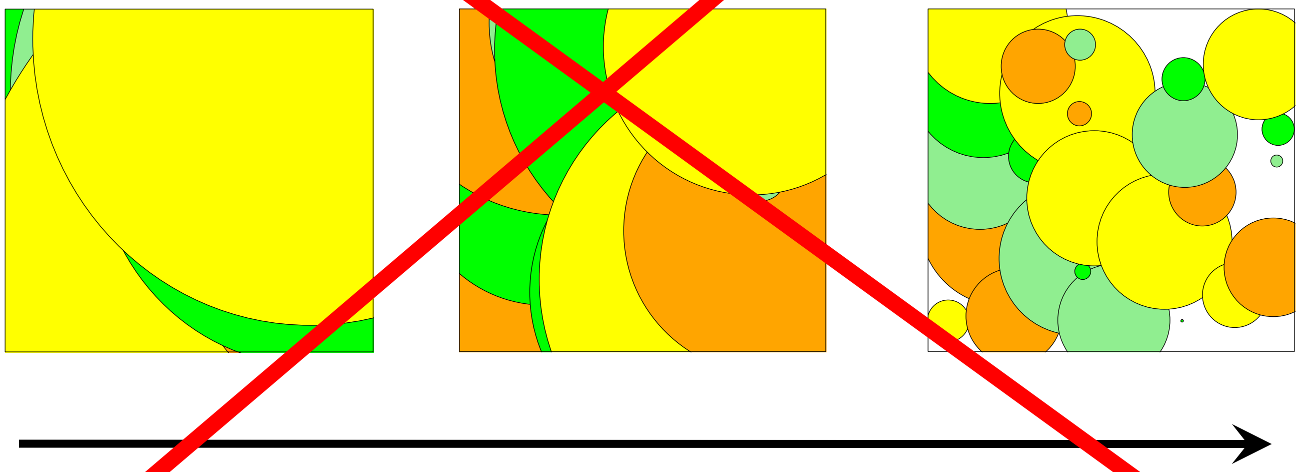
Diversity – heterogeneity relationship

Effect of landscape heterogeneity on **gamma** diversity:

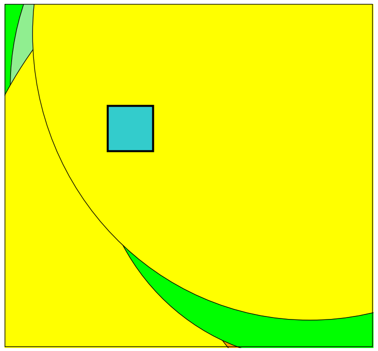


higher landscape heterogeneity

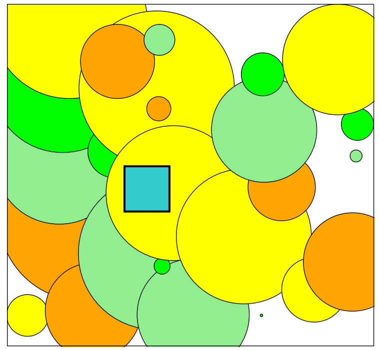
more habitat types

higher overall (gamma) diversity

Diversity – heterogeneity relationship



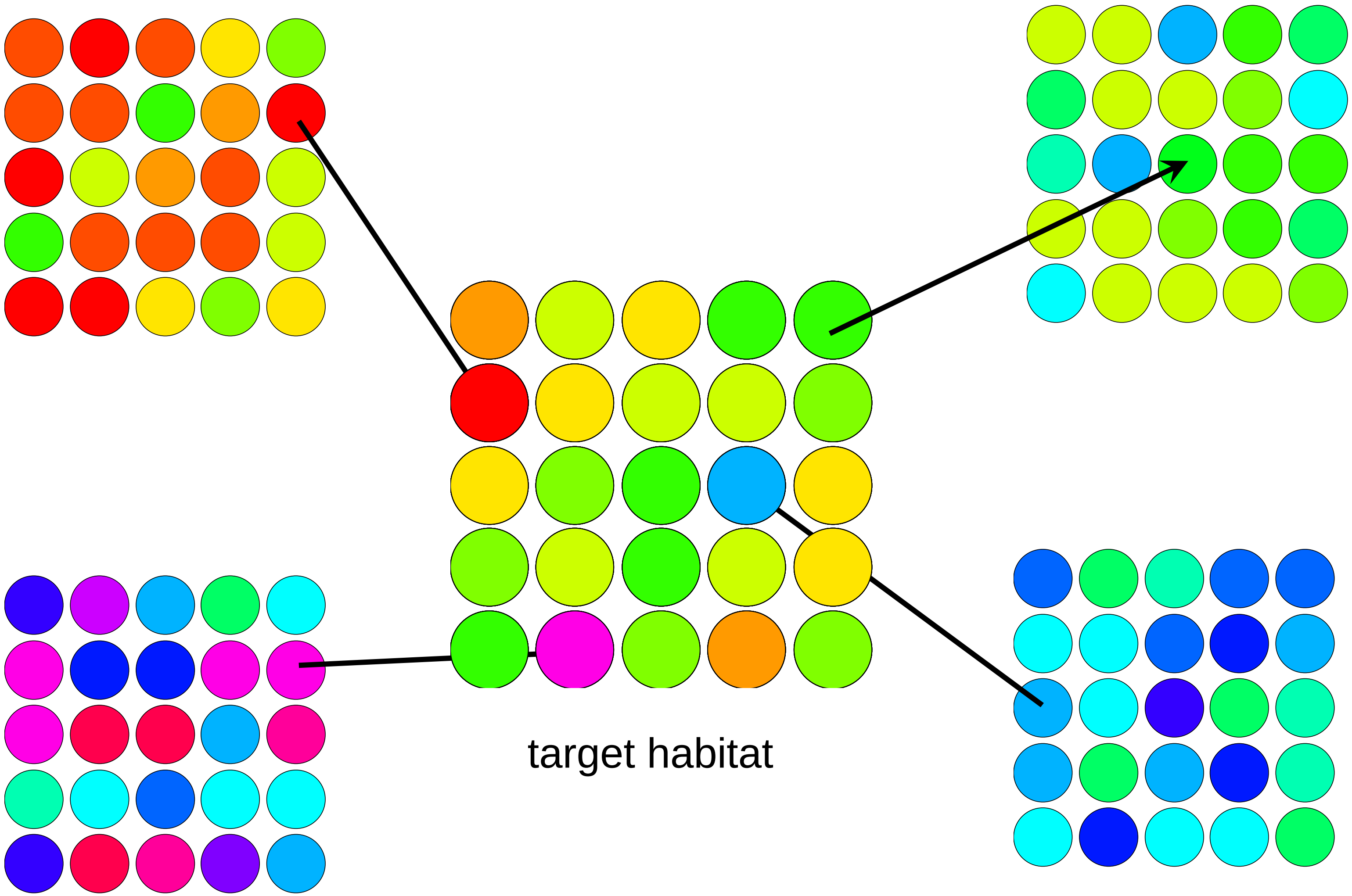
homogeneous landscape



heterogeneous landscape

Question: will be the number of species within the plot influenced by the heterogeneity of the surrounding landscape?

Spatial mass effect (vicinism):
why is it good to have various neighbors?



Methods

Study area:

eastern part of the Czech Republic

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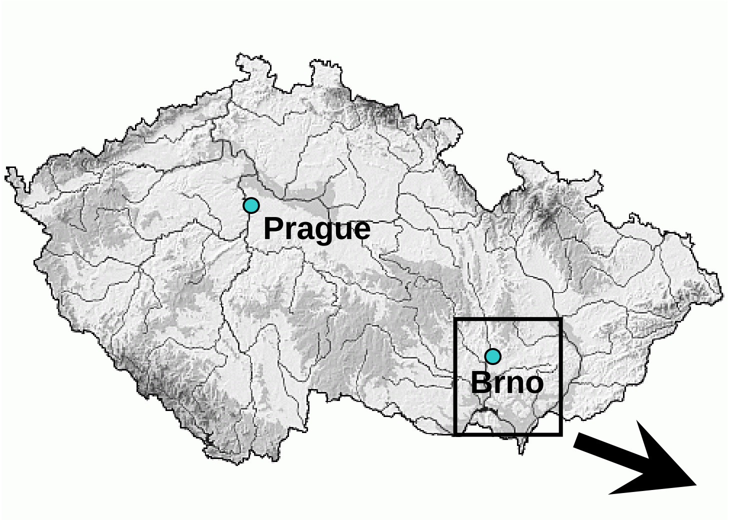
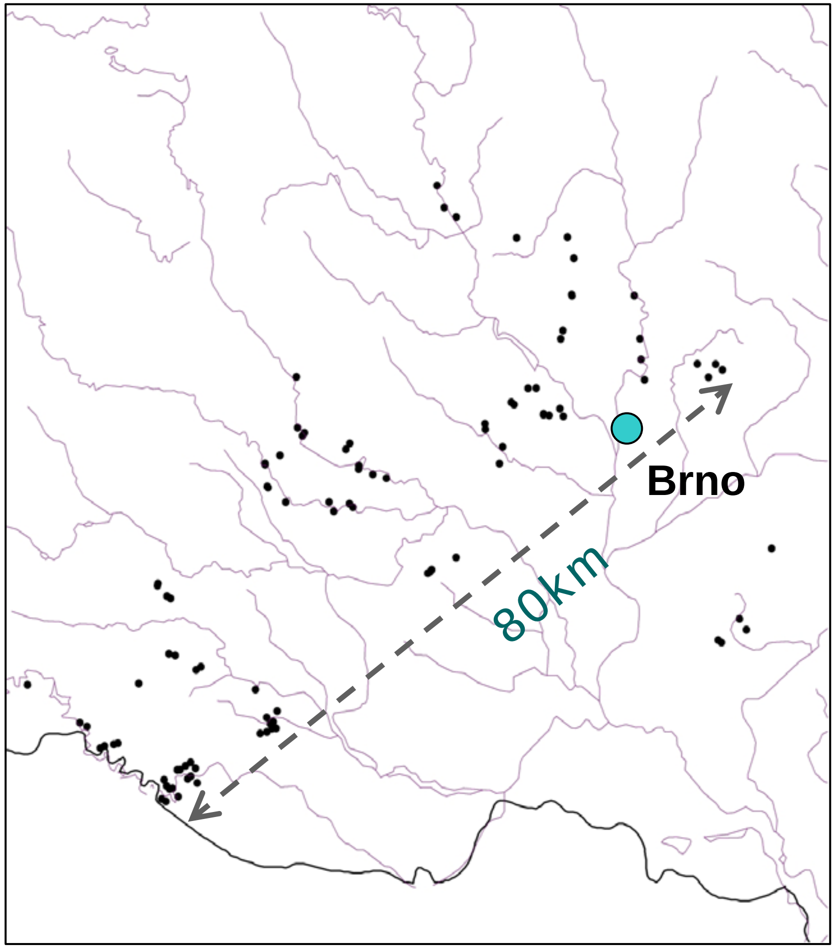
Study area & plot distribution





100 plots distributed across southern Moravia

Methods

Study area:

eastern part of the Czech Republic

Studied vegetation type:

forest vegetation dominated with oak

Oak dominated forest …

Methods

Study area:

eastern part of the Czech Republic

Studied vegetation type:

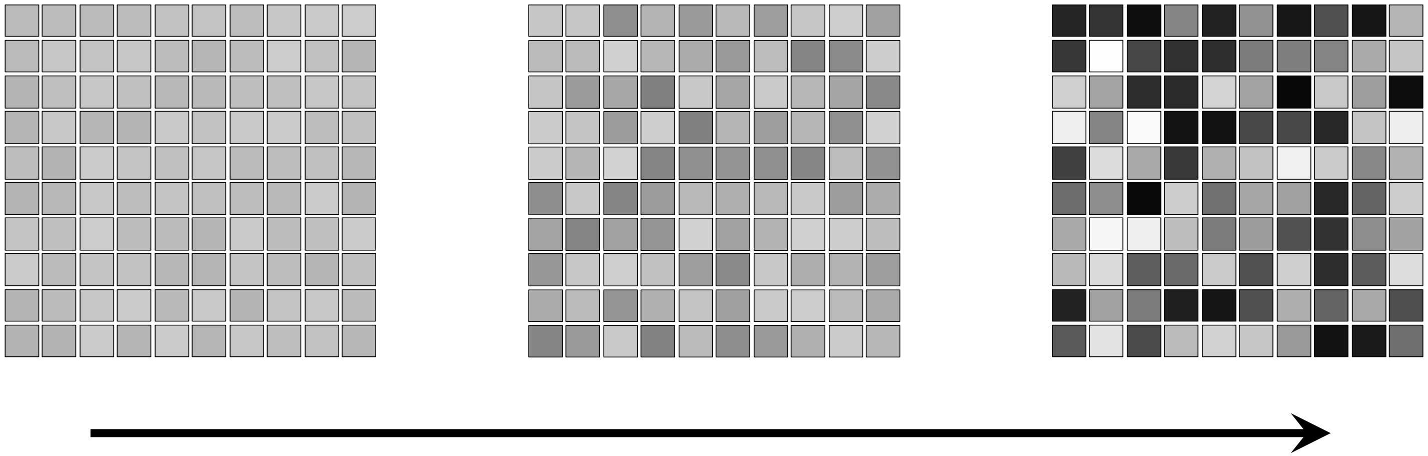
forest vegetation dominated with **oak**

Sampling design:

sampling stratified along the gradient of **habitat productivity** and **landscape heterogeneity**

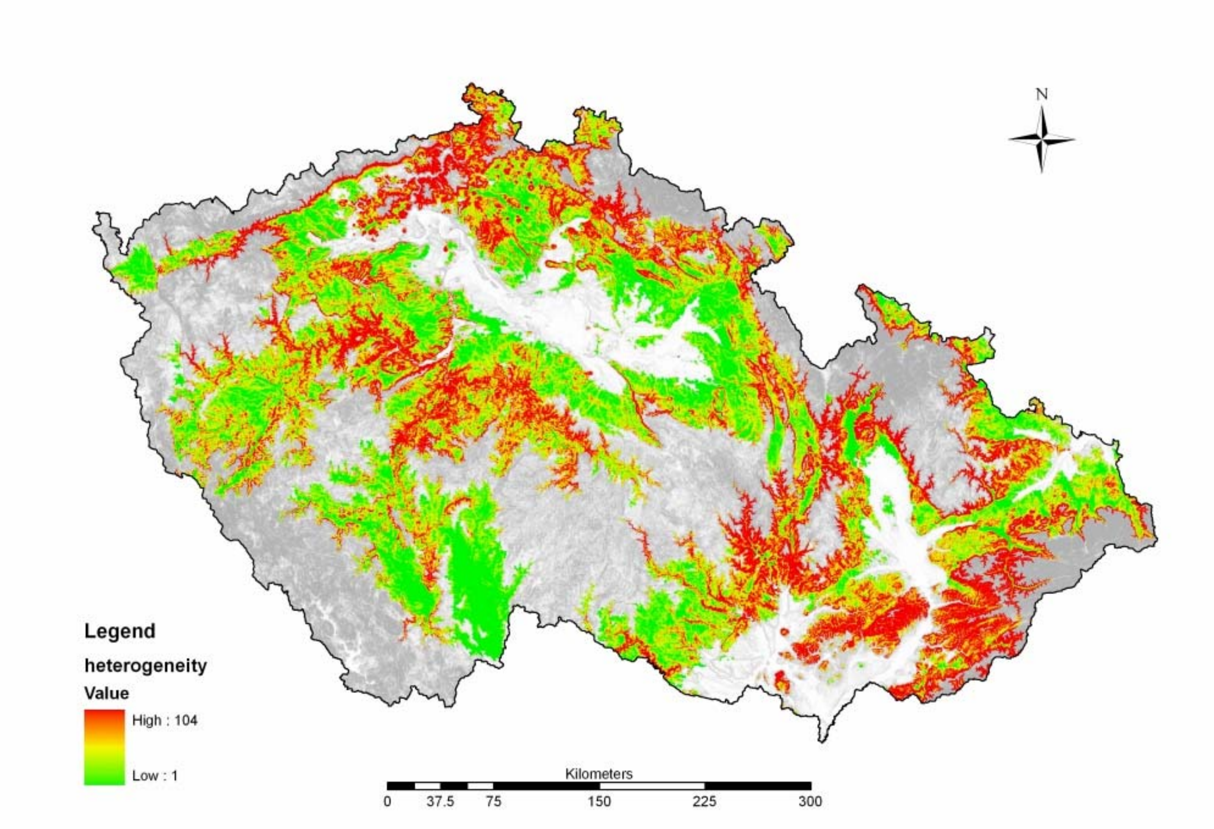
Landscape heterogeneity

= topographical heterogeneity

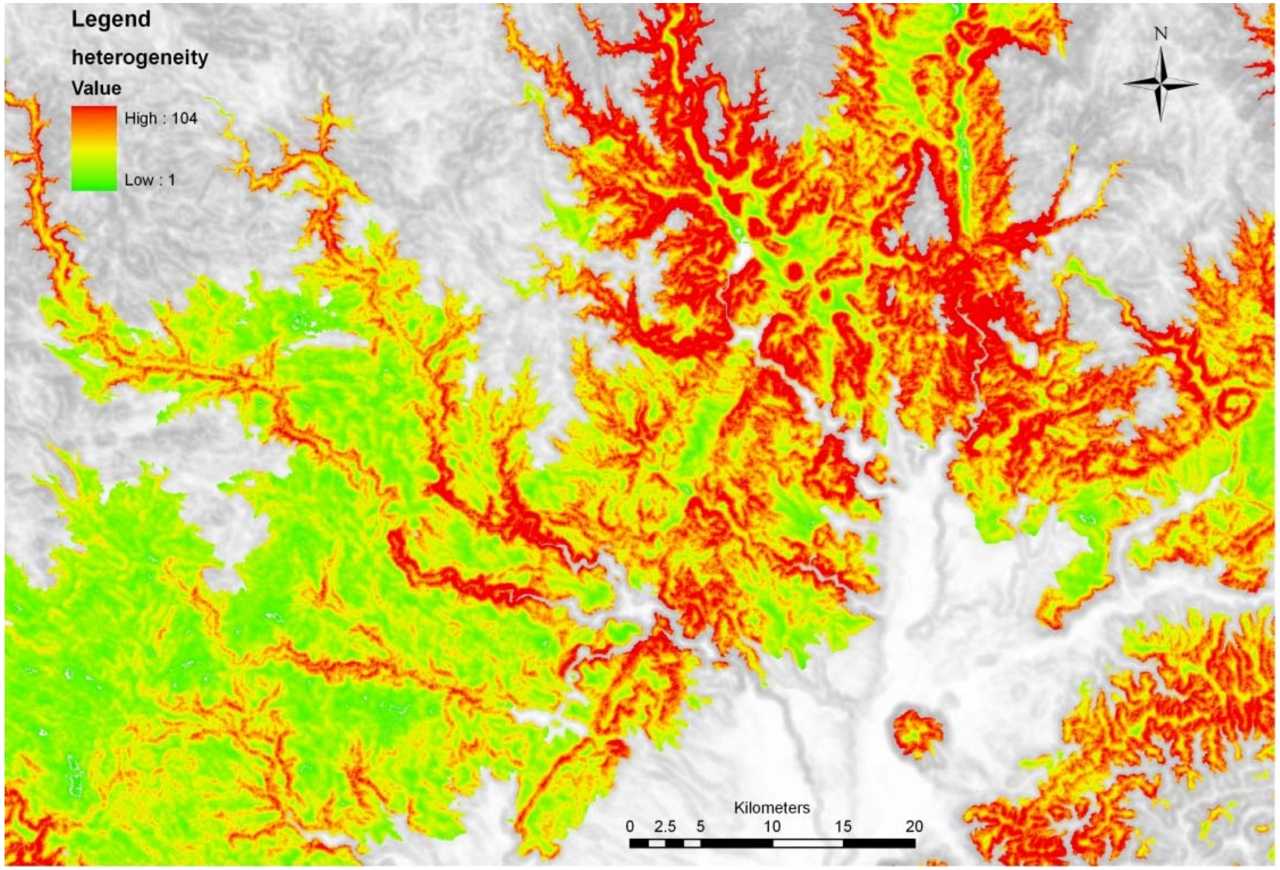


increasing topographical heterogeneity of the landscape

Landscape heterogeneity



Landscape heterogeneity



Sampling procedure

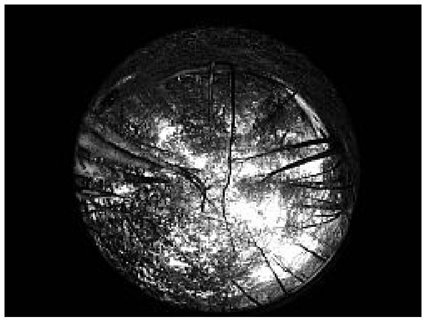
- generate localities for sampling (based on stratification)
- go to the field with GPS and search for the locality
- if locality fits to our criteria, set up a permanent plot and make a relevé
- sampling involves: recording all vascular plant species, estimate environmental characteristics of the plot, measure canopy cover and take soil sample
- in the end of the season, moisture measuring on selected localities was conducted

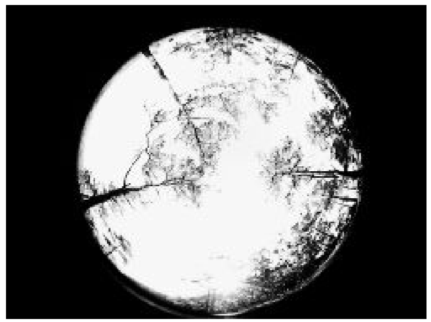
Measuring canopy openness

Nikon Coolpix 4500 +
Nikon FC-E8 fish-eye
converter

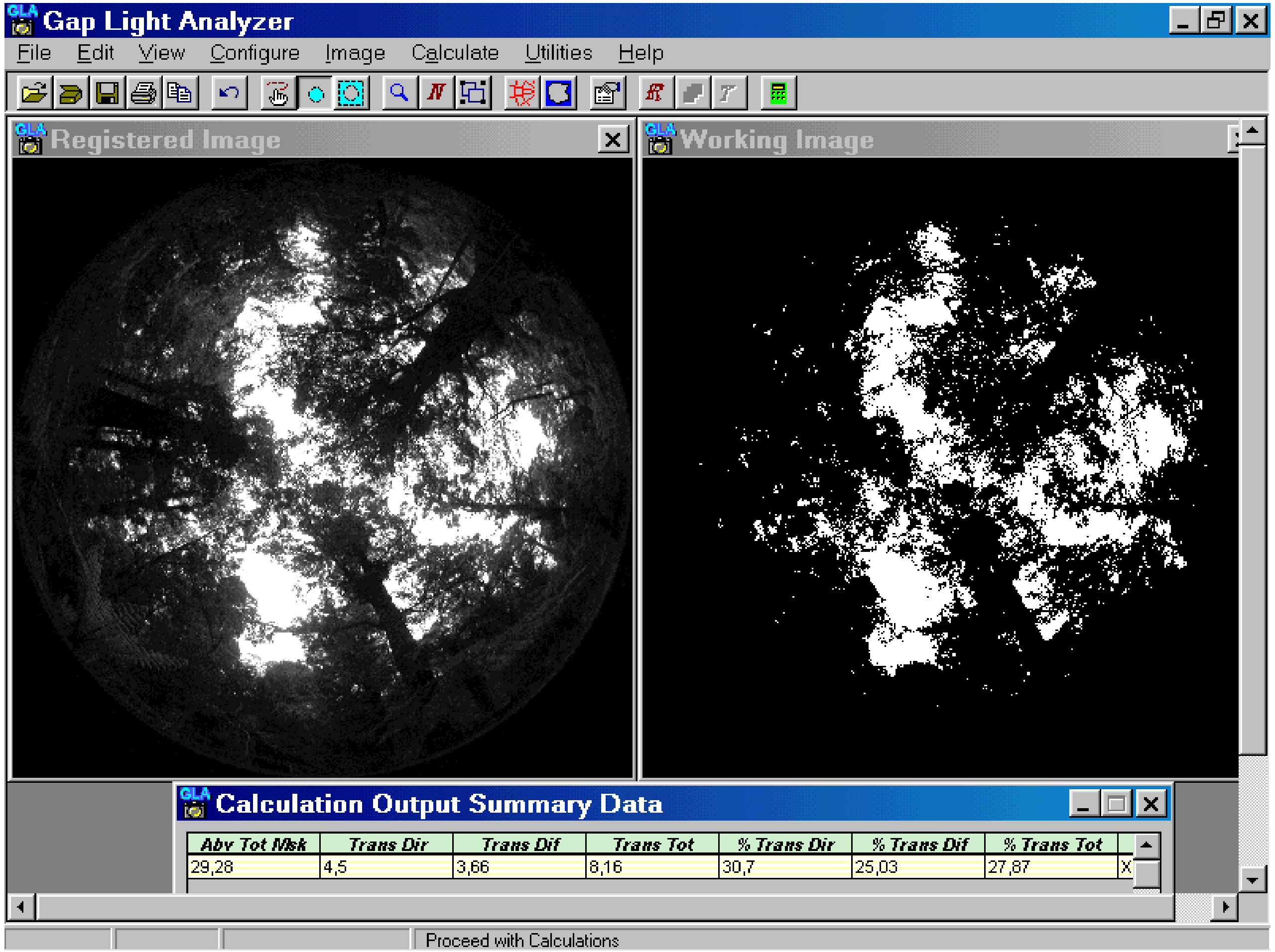
Measuring canopy openness



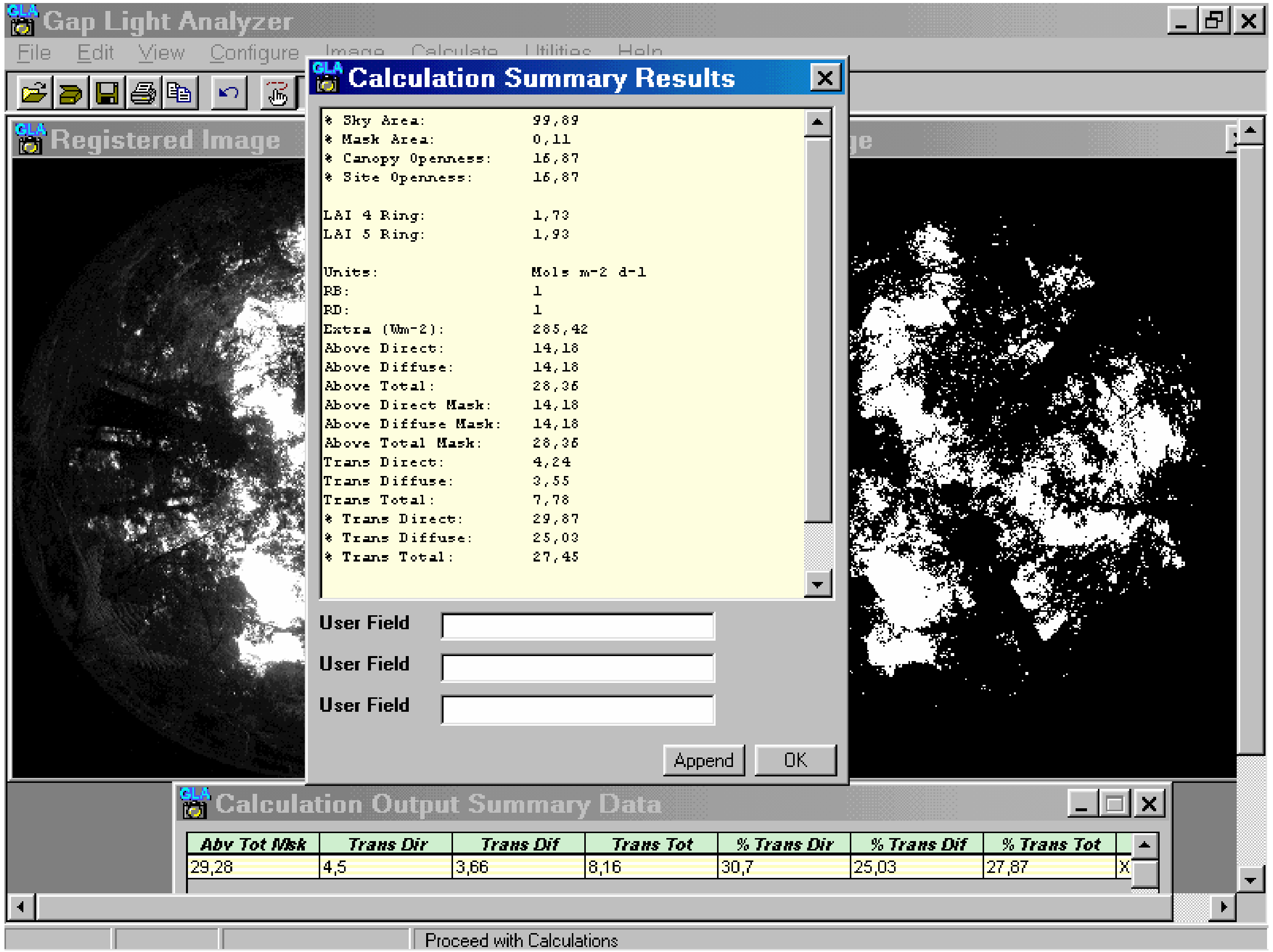





Measuring canopy openness



Measuring canopy openness



How to measure the productivity of habitat?

1) chemical analysis of the soil sample for nutrient content

Advantage:

- fast and easy

Disadvantage:

- not all nutrients present in the soil may be reached and used by plants

How to measure the productivity of habitat?

2) measuring the real biomass production
(cut – dry – weight)

Advantage:

- not so fast, but still quite easy

Disadvantage:

- depends on species composition of the biomass (presence of large species)
- will be influenced by number of other factors (in forest mainly by light)

How to measure the productivity of habitat?

3) bioassay greenhouse experiment

How does it work:

- take the soil sample from each plot
- put it into the greenhouse and treat with unlimited water conditions
- grow selected bioassay species
- harvest, weight and analyze biomass for nutrient content

Bioassay experiment

How to measure the productivity of habitat?

3) bioassay greenhouse experiment

Advantage:

- measure the potential habitat productivity, not influenced by the differences in the species composition, water availability etc.

Disadvantage:

- time, money and work demanding

Bioassay experiment for productivity assessment

Journal of Vegetation Science 18: 665-674, 2007

Habitat engineering under dry conditions: The impact of pikas (*Ochotona pallasi*) on vegetation and site conditions in southern Mongolian steppes

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Abstract

Question: Does ecosystem engineering by small mammals have a significant influence on vegetation patterns in the arid steppe vegetation of southern Mongolia?

Location: Gobi Altay Mountains, southern Mongolia.

Methods: We assessed the impact of the small lagomorph *Ochotona pallasi* on plant community composition, nutrient levels and biomass production in montane desert steppes. Data were derived from vegetation relevés, harvests of above-ground standing crop and a bioassay, followed by analyses of soil and plant nutrient contents.

Results: Although the local climate is arid with <150 mm annual precipitation, clear evidence of allogenic ecosystem engineering was found. Plant communities on burrows differed

Bioassay experiment for assessment of site productivity in oak forests

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poster presented by **Irena Veselá** at the 17th Internation Workshop of European Vegetation Survey in Brno (May 2008)

Bioassay experiment for productivity assessment

The first week

After the third week – half of the experiment

Before harvesting

The most obvious differences

Control pot with Perlite
– the lowest concentration of fertilizer

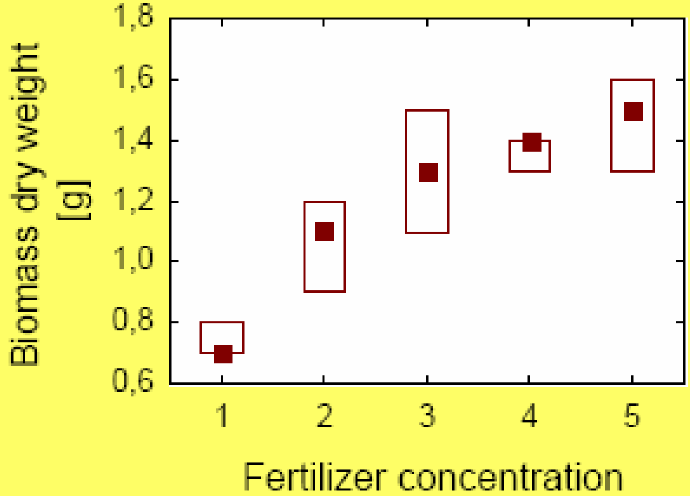
Control pot with Perlite
– the highest concentration of fertilizer

Veselá et. al (2008): Bioassay experiment for assessment of site productivity in oak forests. - 17th International Workshop European Vegetation Survey, Brno, Czech Republic, 1-4. 5. 2008.

Bioassay experiment for productivity assessment

The control experiment confirmed the limitation of radish biomass by amount of available phosphorus and potassium.

Control radish plants (fertilised)



Veselá et. al (2008): Bioassay experiment for assessment of site productivity in oak forests. - 17th International Workshop European Vegetation Survey, Brno, Czech Republic, 1-4. 5. 2008.

Bioassay experiment for productivity assessment

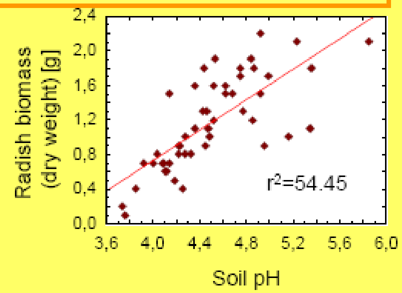
Results

Spearman correlations: significant correlations are marked with asterisks (*p* = 0.01 **, *p* = 0.05 *). Corresponding pairs of nutrient ratios are coloured.

		FOREST BIOMASS (herb layer)					RADISH BIOMASS				
		N/P	N/K	K/P	Ca_total	dry weight	N/P	N/K	K/P	Ca_total	dry weight
SOIL	N/P	0.426**	n.s.	n.s.	n.s.	n.s.	0.524**	0.336*	0.296*	-0.458**	-0.530**
	N/K	n.s.	0.312*	n.s.	n.s.	n. s.	n.s.	0.596**	-0.317*	-0.455**	-0.462**
	K/P	0.391**	n.s.	n.s.	-0.315*	-0.289*	0.506**	n.s.	0.395**	-0.355*	-0.427**
	Ca_total	-0.291*	-0.381**	n.s.	n.s.	n. s.	-0.550**	-0.429**	n.s.	0.495**	0.476**
	pH_H2O	-0.437**	-0.539**	n.s.	n.s.	n. s.	-0.562**	-0.527*	n.s.	0.833*	0.792*
	C/N	n.s.	0.388**	-0.467**	n.s.	n. s.	n.s.	n.s.	n.s.	-0.349*	n.s.

In contrast to the forest herb-layer biomass, the radish biomass better reflects soil characteristics (significant correlations between corresponding nutrient ratios). While neither the total amount of forest biomass nor its Ca content does not reflect soil pH, the radish biomass is significantly correlated with pH (see also the scatter plot).

As our sampling covered mostly forests on acidic soils, the availability of phosphorus increases with pH. The positive correlation of radish biomass with soil pH could be therefore caused by its relationship with phosphorus content.



Comparison of forest herb-layer biomass data and radish biomass data revealed that there is no significant correlation except for the N/P ratio, which has even the same range and median of attained values.

Veselá et. al (2008): Bioassay experiment for assessment of site productivity in oak forests. - 17th International Workshop European Vegetation Survey, Brno, Czech Republic, 1-4. 5. 2008.

Soil moisture measuring

Why to measure soil moisture?

Productivity of the habitat reflects not only amount of nutrients, which can be used by plants, but also water availability – soil may have high nutrient status, but due to dry conditions, the actual productivity of the stand is low.

But: soil moisture measuring, especially at larger scale, is technically rather complicated ...

Soil moisture measuring

Theta Probe ML2x sensor and reader

(Delta-T, United Kingdom)

Soil moisture measuring

Methods:

- select half of the permanent plots (technically it's not possible to visit all 100 plots during a short period)
- after the period of long lasting drought (5 days without rain) visit all these plots (took 4 days)
- within each plot, 10 measurements were taken from random positions

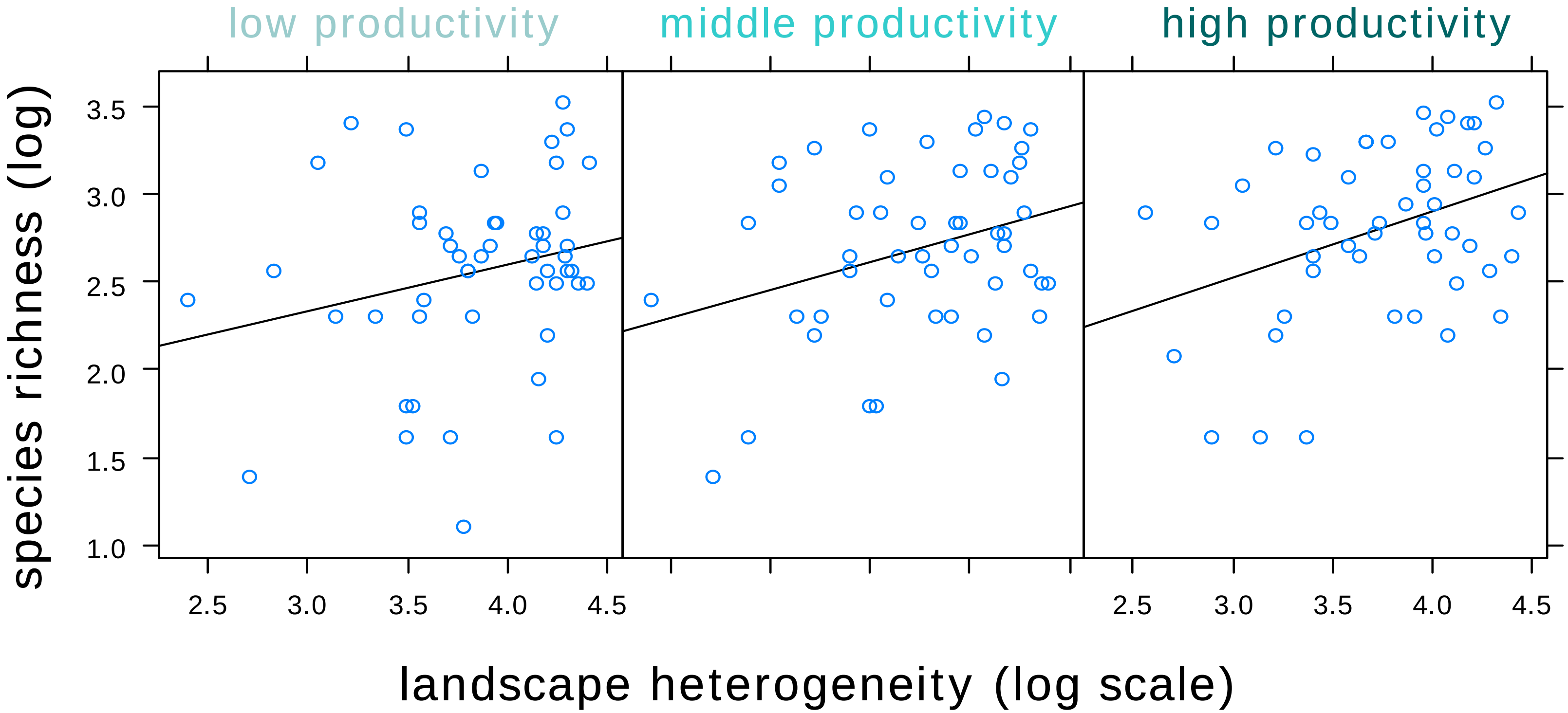
Soil moisture measuring

Question: which environmental factors does measured soil moisture reflect?

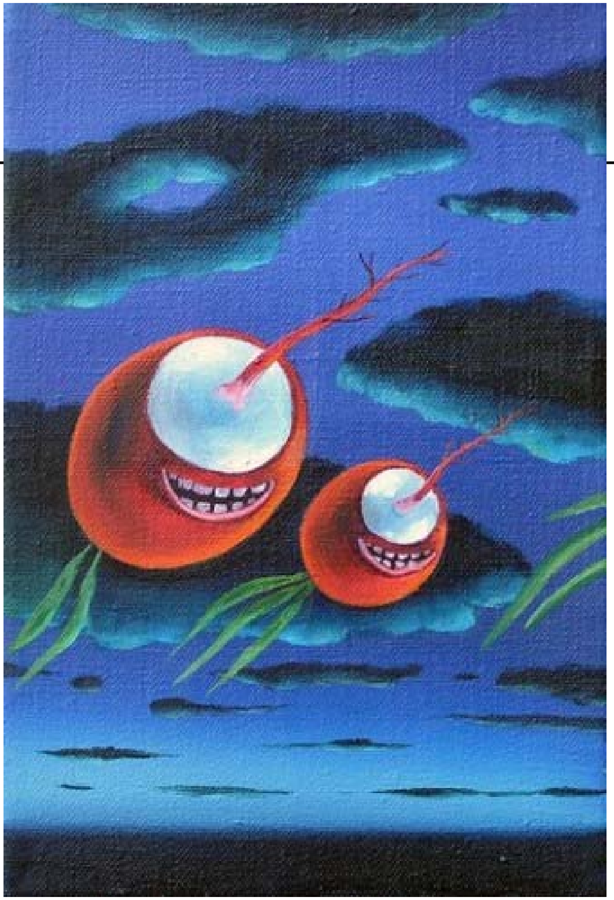
Analysis: Generalized Linear Models

Result: the most important factors are **slope**, **cover of tree layer** and **soil type**

Results



low productivity
middle productivity
high productivity
species richness (log)
3.5
3.0
2.5
2.0
1.5
1.0
2.5
3.0
3.5
4.0
4.5
landscape heterogeneity (log scale)



Thank you for your attention!

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