Influence of landscape features on the populations of butterflies

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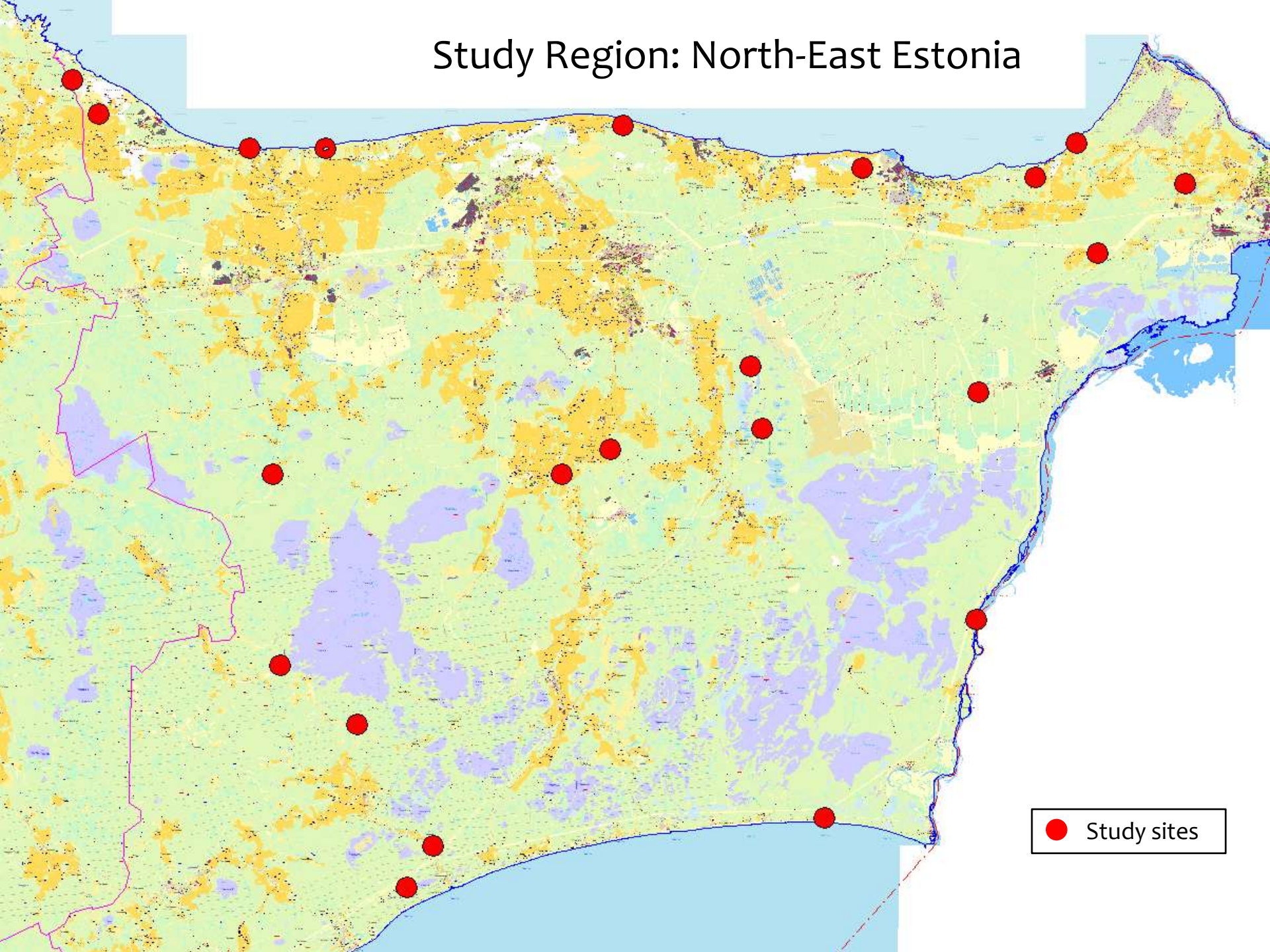
Study Region: North-East Estonia



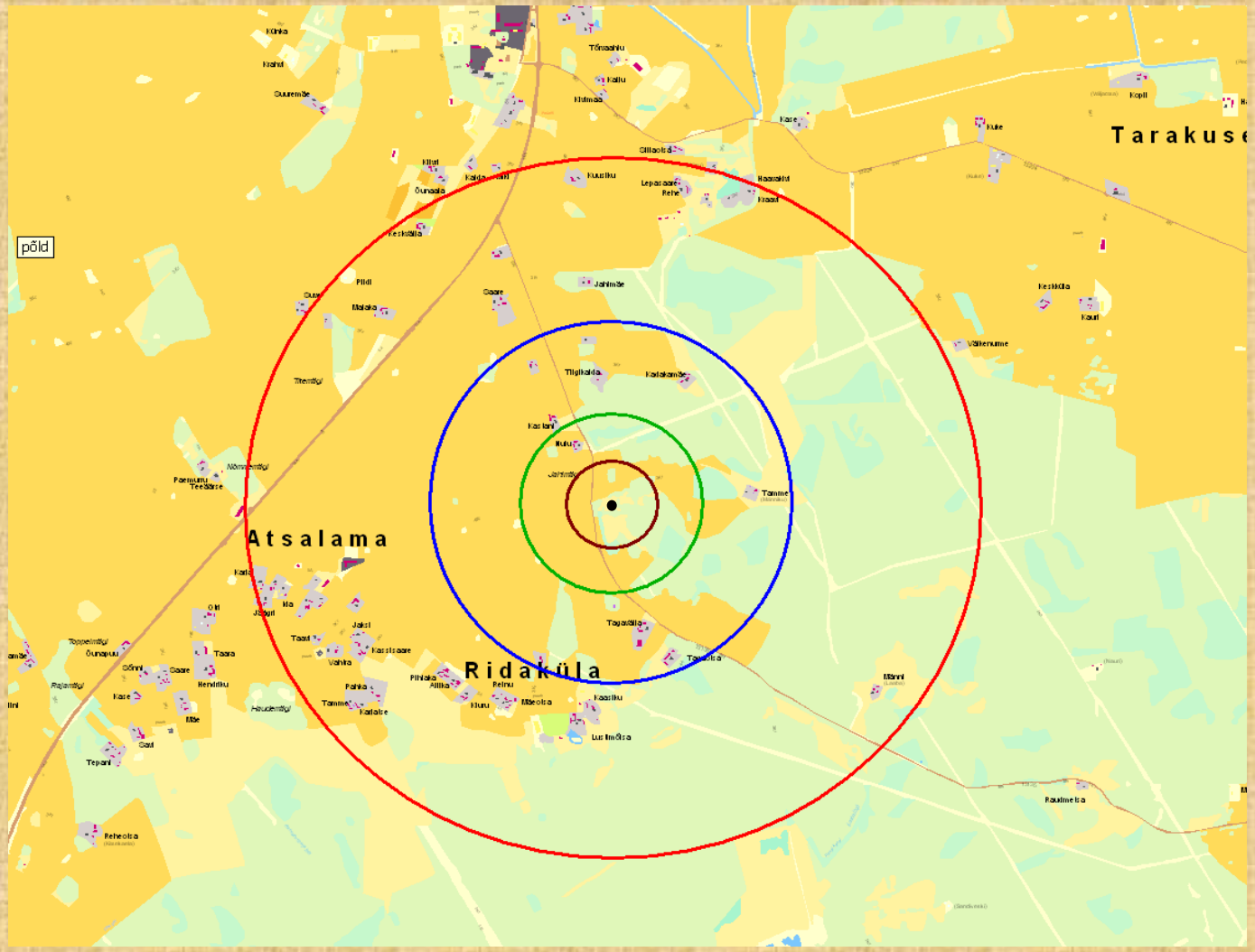
Methodology

- Habitat type: Meadows (0.2-4 ha)
- Field work - summer 2008, 2009
- 22 study sites
- Two visits per site (June, August), around one hour transect walk.
- Identification of species and counting of individuals: by sight or with an insect net.
- Indicator species:
  - Butterflies
  - Daytime flying moths
  - Bumblebees

- Patch scale factors:
  - Vegetation
    - Number of species of flowering plants
    - Average percent cover of flowering plants
    - Average grass height (cm)
  - Indices (FRAGSTATS Version 3.3)
    - Area (ha)
    - Perimeter (m)
    - Shape Index
    - Fractal Dimension Index
    - Edge Density (m/ha)

Variables at Landscape Scale

Proportion of different land cover types in the surrounding area (Radius of 250, 500, 1000 and 2000m) of each study site (Calculated by ArcGIS 9.3)



- Variables at Landscape Scale

Classification of land cover types:

Meadows	Abandoned peatland
Forests	Fresh waterbodies: lakes, ponds, streams
Young forests	Sea
Bushes	Human settlements: residential areas, private areas, buildings, cattle sheds, roads, ruins, green houses
Mires: fens, bogs, wetlands	Green areas and gardens: public gardens, yards, gardens, cemeteries
Arable land	Others: Abandoned areas, open land

- Variables at Landscape Scale (Radius of 250, 500, 1000 and 2000m):

Landscape configuration (FRAGSTATS version 3.3)

- Patch Richness Density – PRD (No/100ha)
- Interspersion and Juxtaposition Index – IJI
- Patch Cohesion Index – COHESION
- Edge Density – ED Land (m/ha)
- Shannon's Diversity Index – SHDI
- Simpson's Diversity Index – SIDI
- Mean Patch Area of Forests – AREA MN (ha)
- Area Weighted Mean Patch Area of Forests – AREA AM

Overall Results

Total number of species found:

- Butterflies = 56
- Daytime flying moths = 42

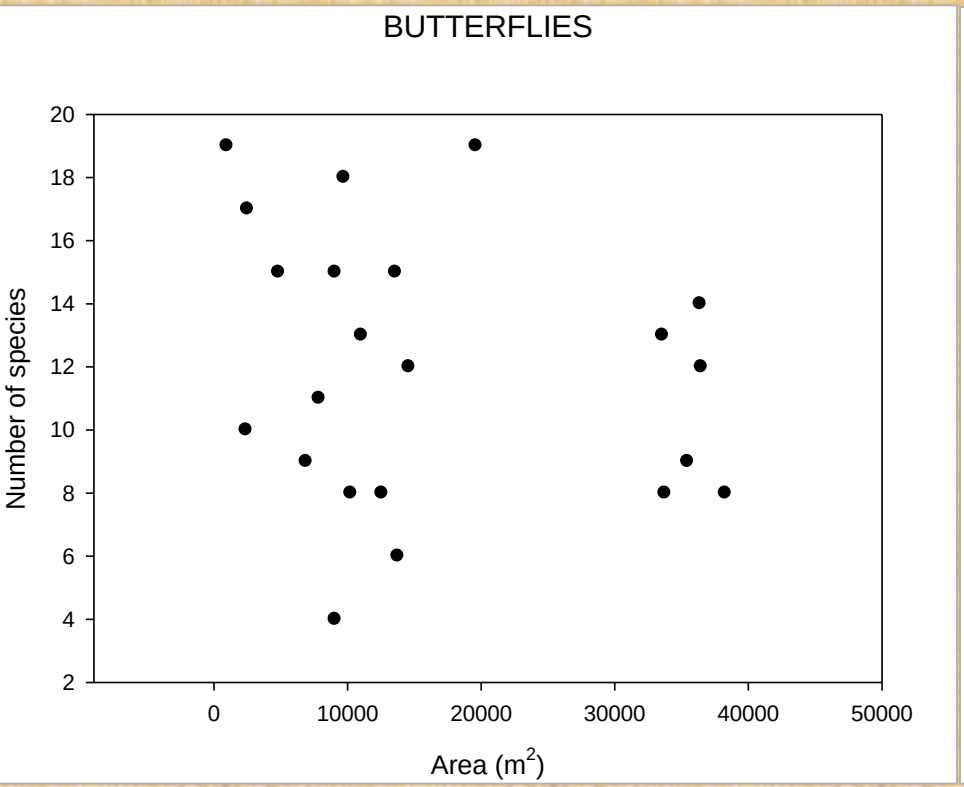
Total number of individuals found:

Butterflies = 768

Daytime flying moths = 330

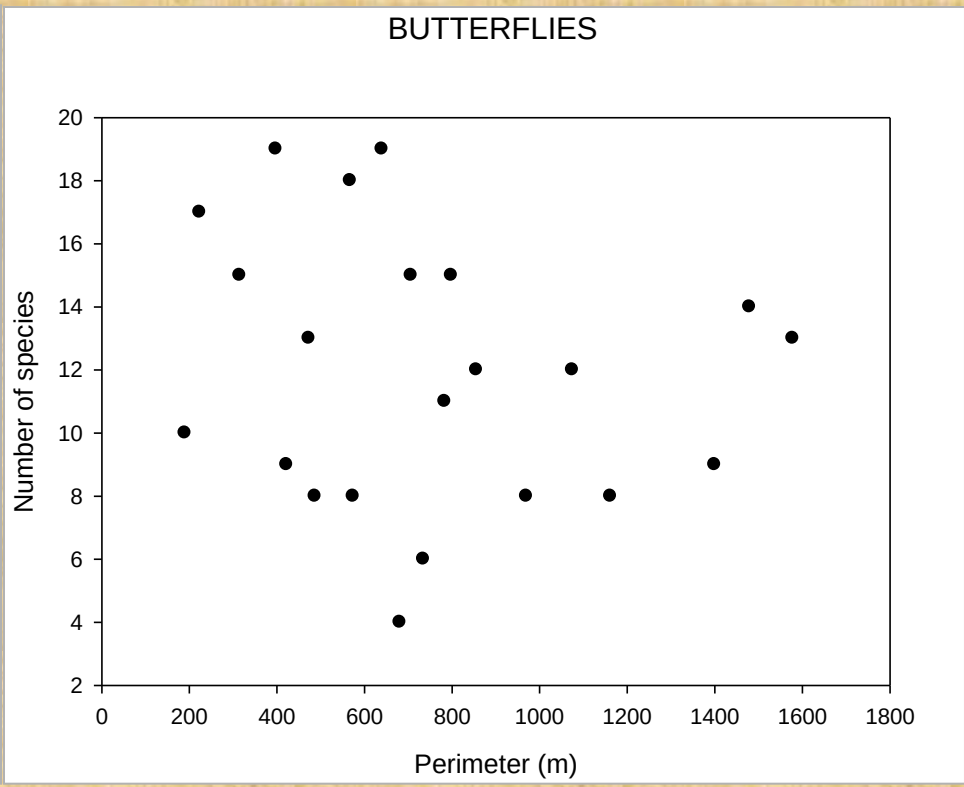
Analyses at patch level:

Species Richness vs Habitat Area



No clear relationship

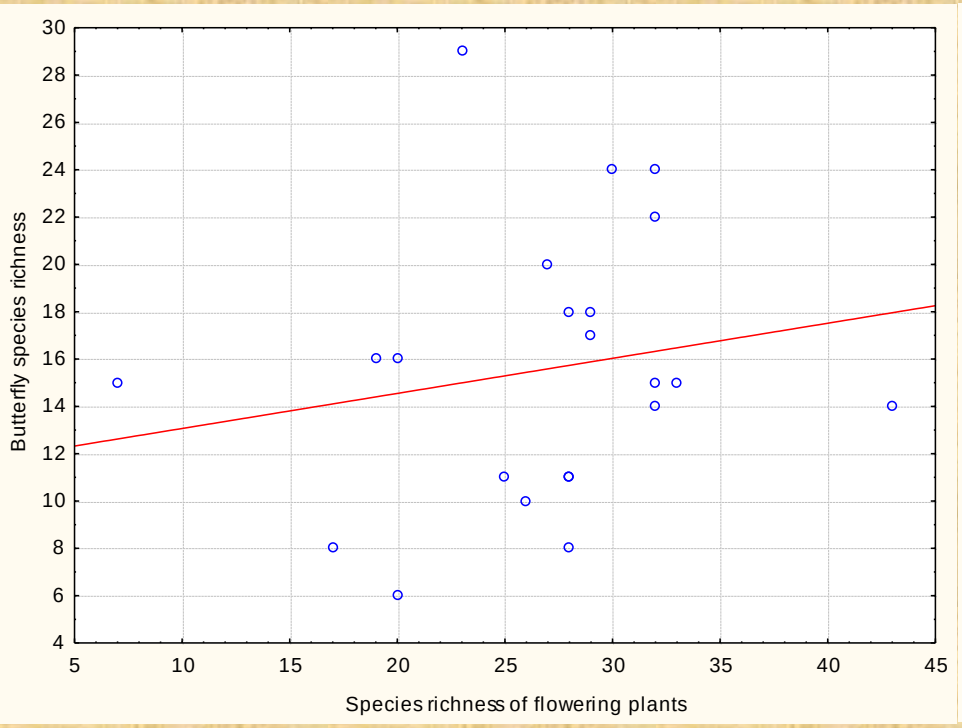
Species Richness vs Habitat Perimeter



No clear relationship

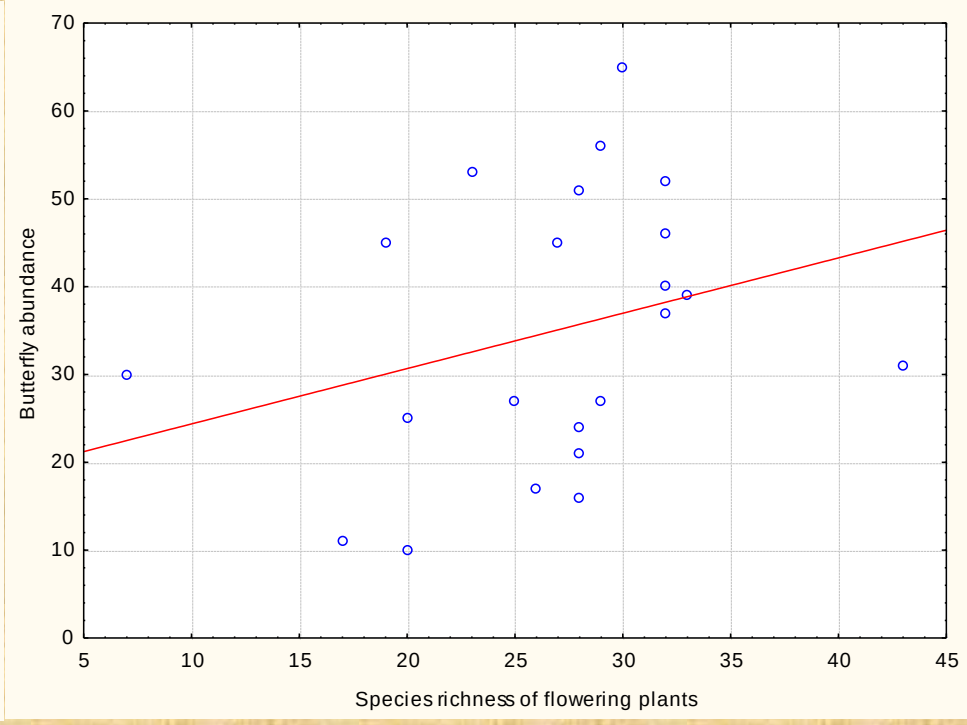
Richness of flowering plants vs:

Species Richness of butterflies



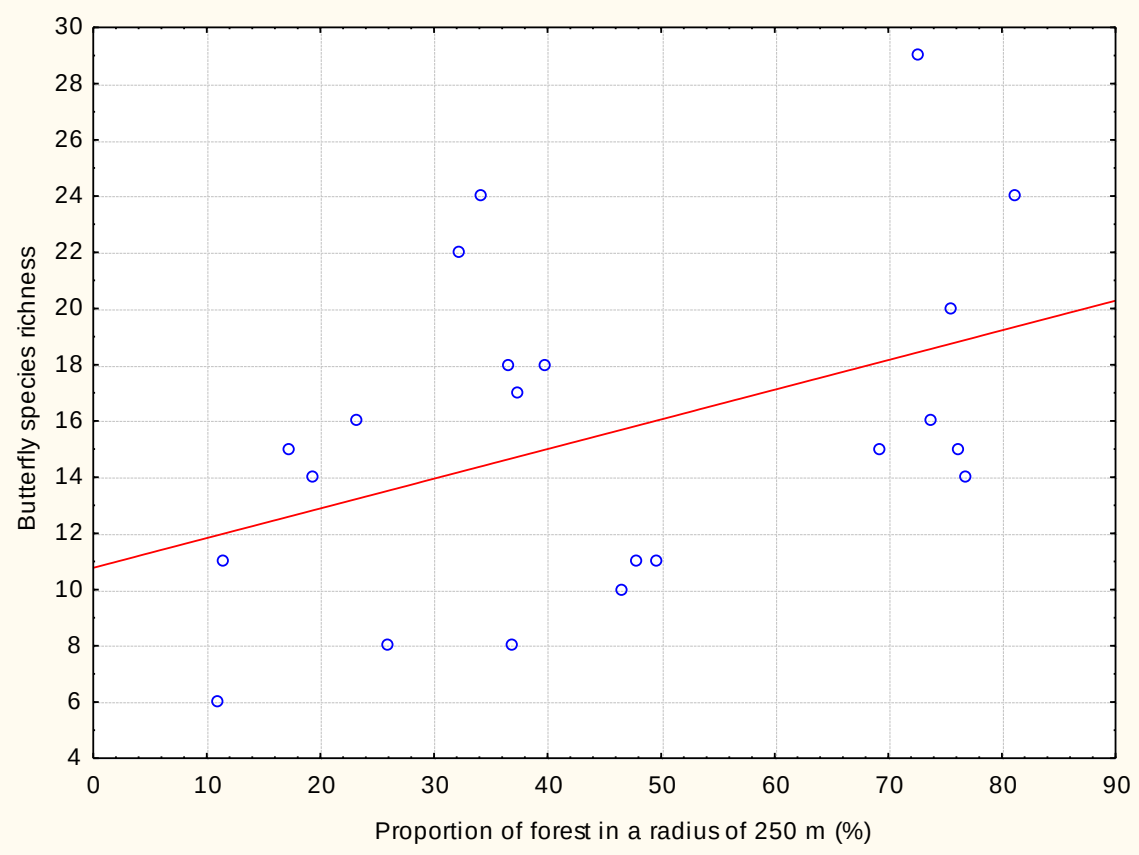
not significant.

Abundance of butterflies

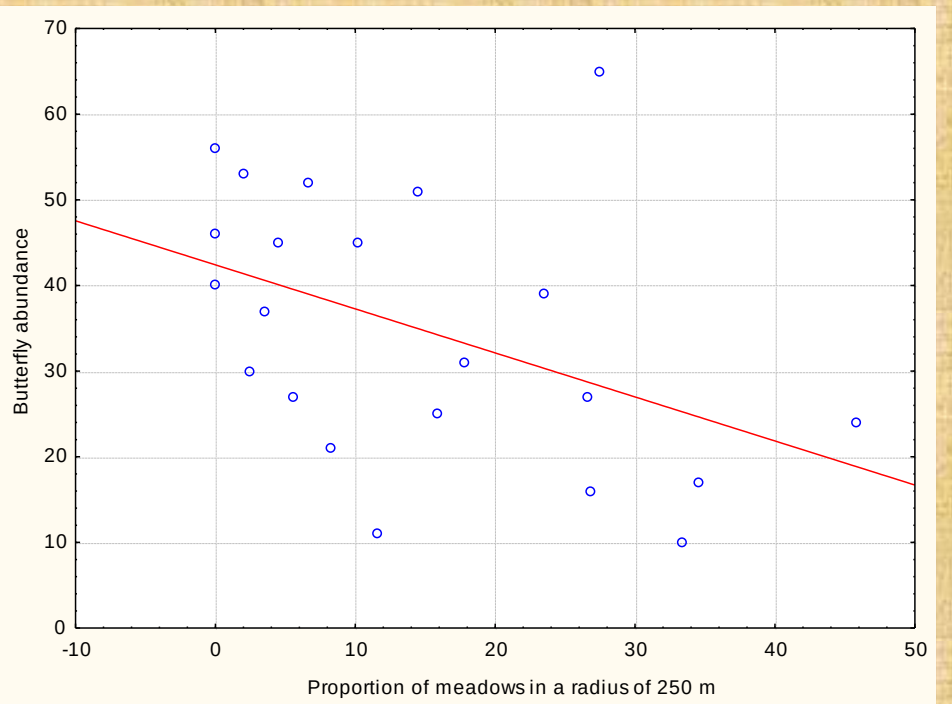


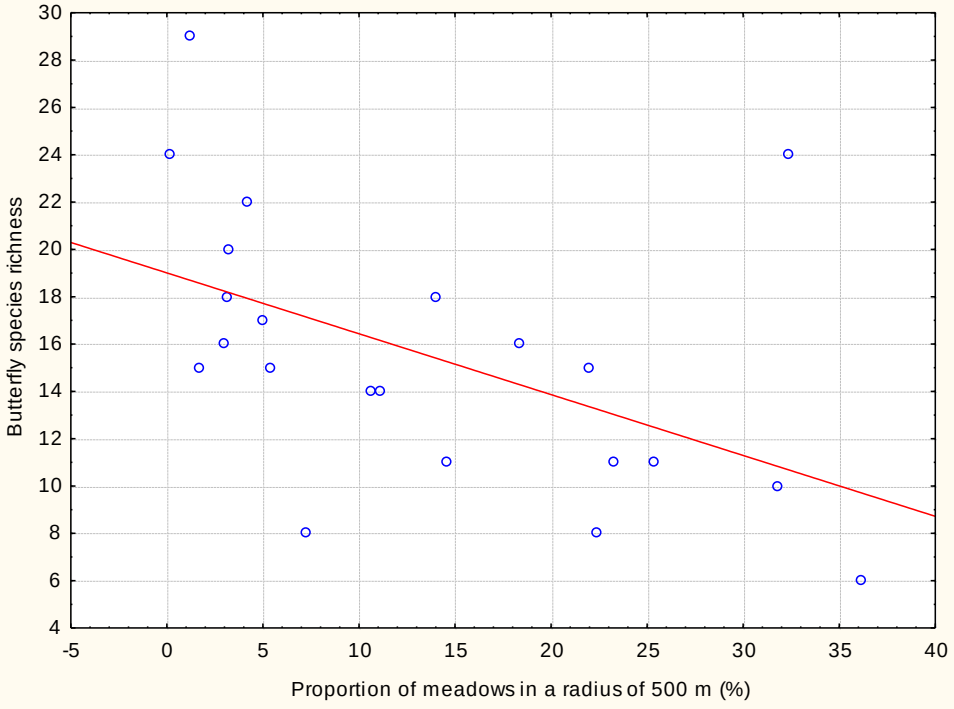
not significant.

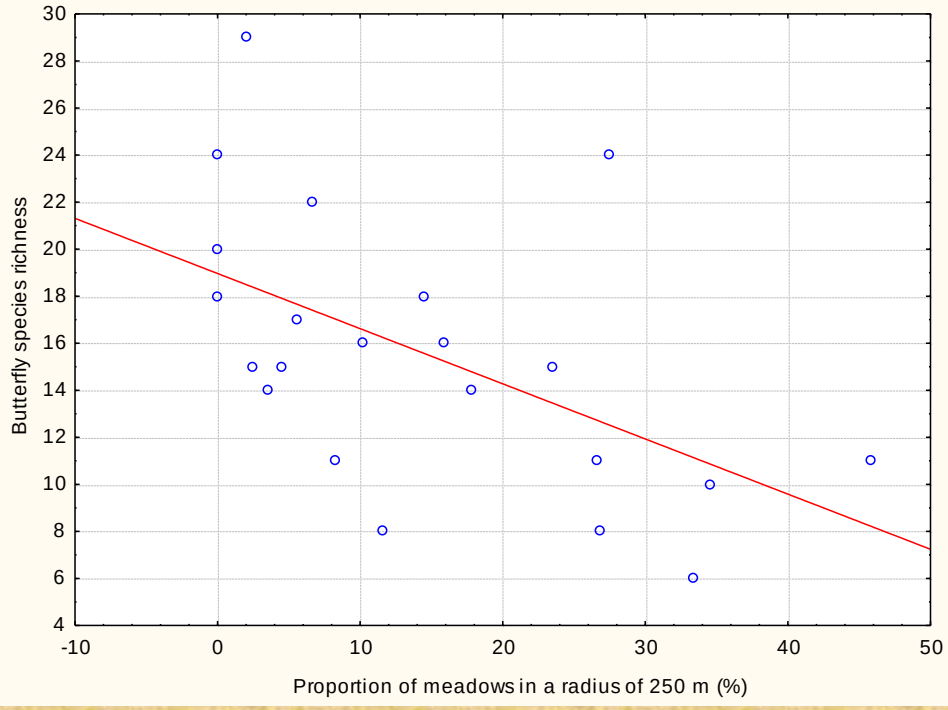
Influence of the bordering forest (R-250m) has positive impact on the species richness of butterflies



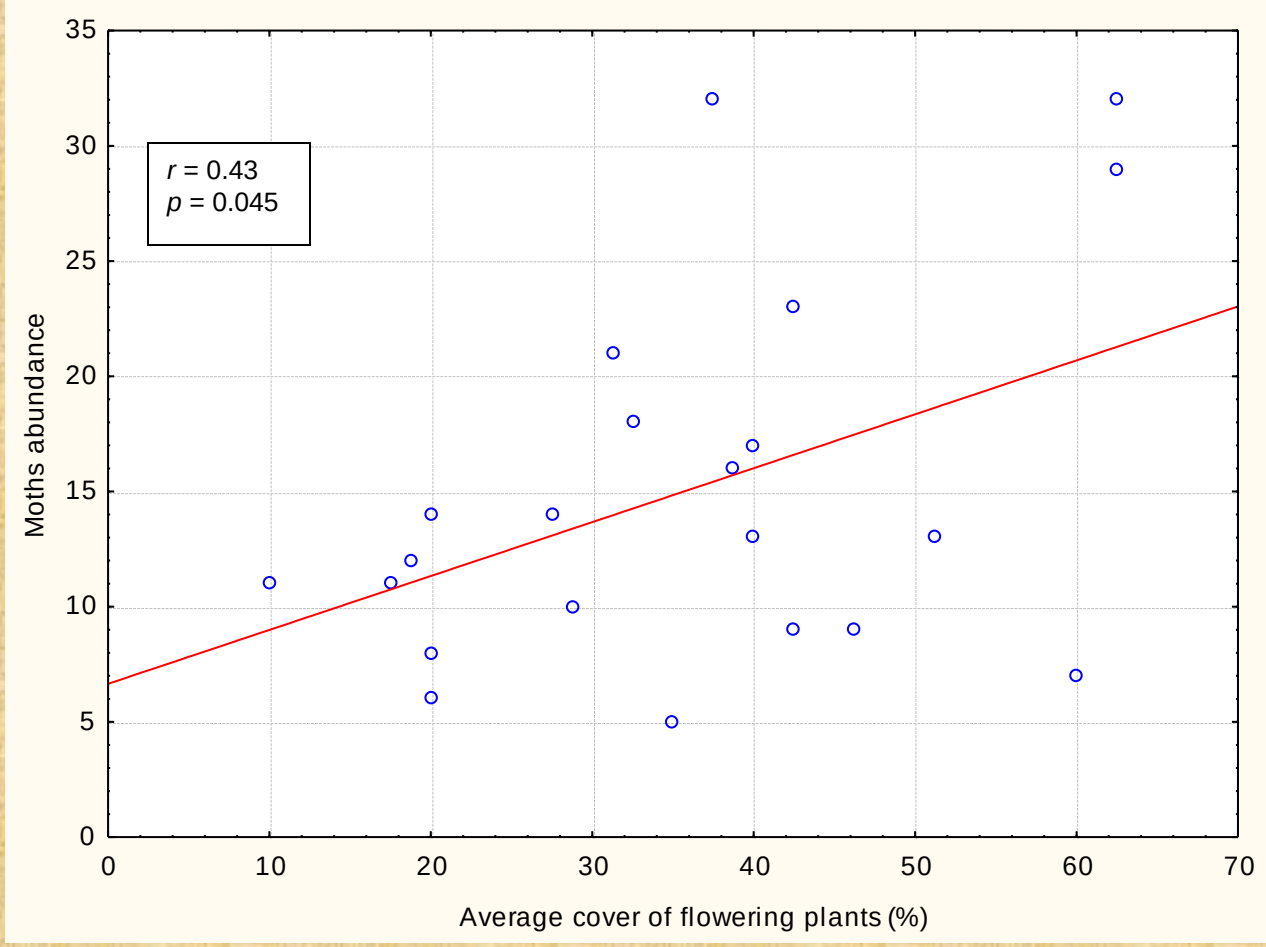
Influence of meadows to the species richness and abundance of butterflies







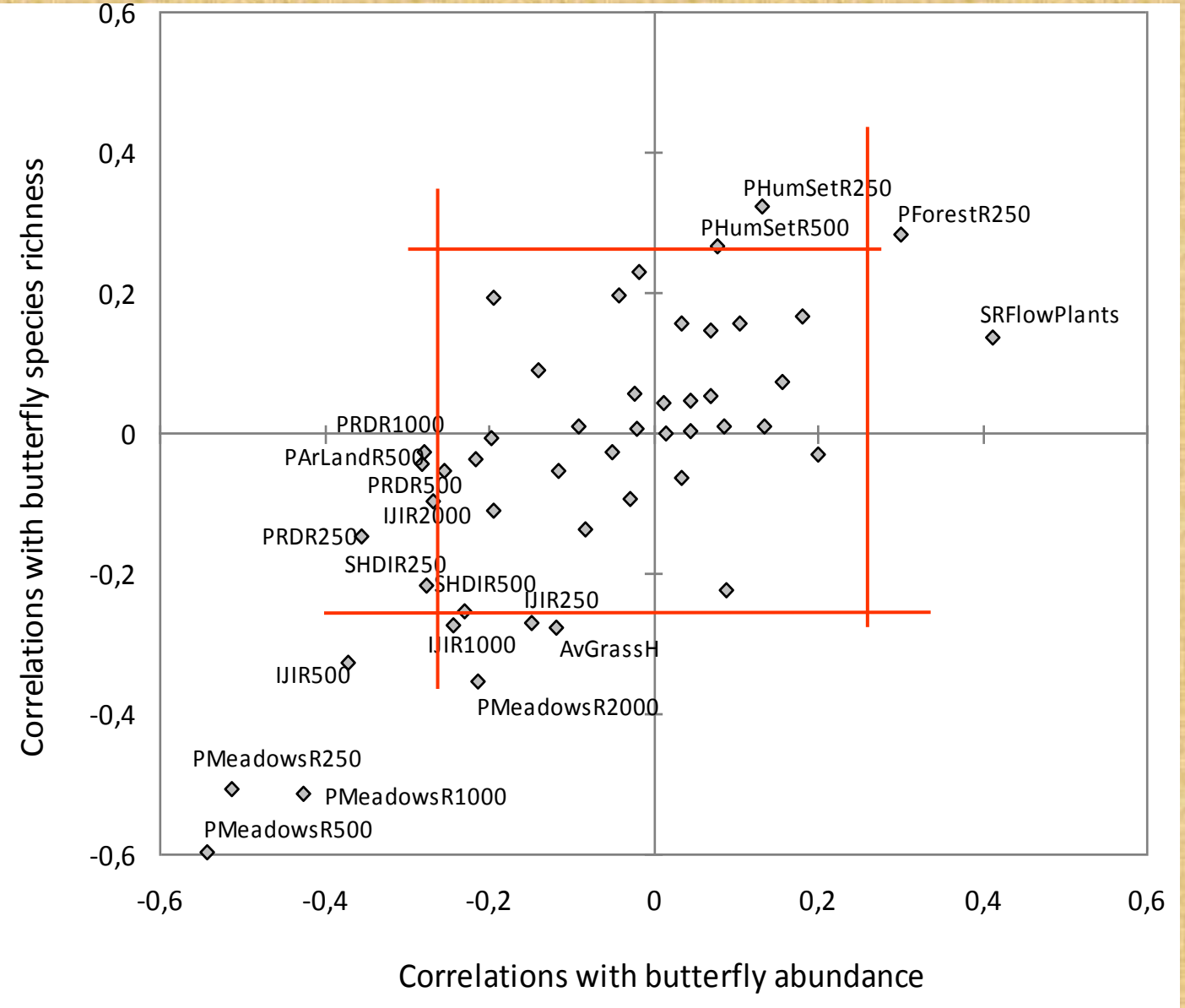
Influence of average cover of flowering plants to the species richness of daytime flying moths



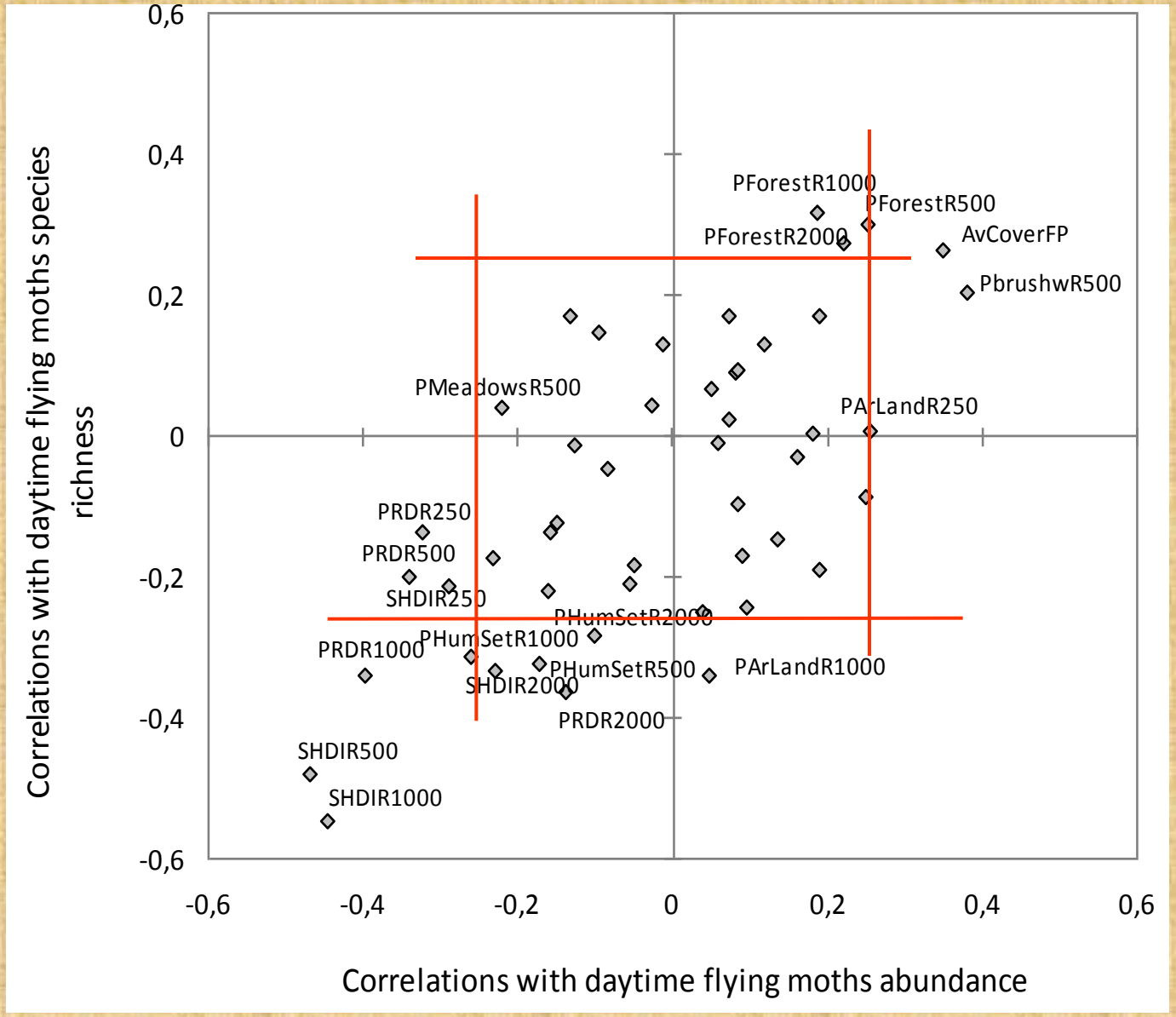
Multiple regression models for total butterfly and daytime flying moths abundance and species richness (adjusted to common number of individuals)

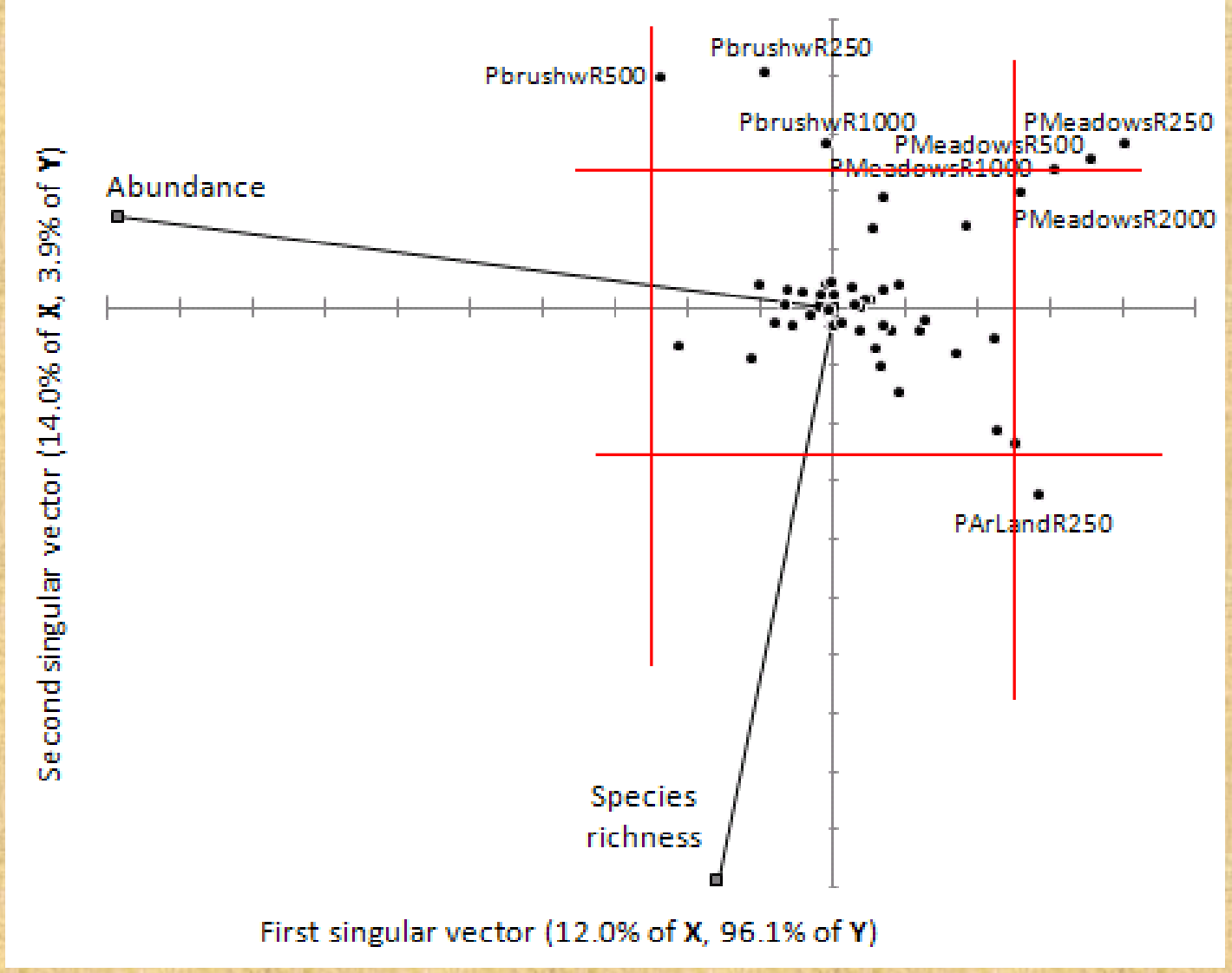
Dependent variable	R^2 (p-value)	Variable included in the model	Regression coefficient	p-value
Total butterfly abundance	0.68 (0.002)	SRFlowPlants	1.61	<0.001
		AvCoverFP	-0.38	0.008
		PMeadowsR500	-0.33	0.135
		PRDR250	-0.39	0.084
Total butterfly species richness (adjusted)	0.29 (0.010)	PMeadowsR500	-0.04	0.010
Total daytime flying moths abundance	0.70 (<0.001)	ED	-0.01	0.003
		SRFlowPlants	0.49	0.013
		PArLandR250	0.15	0.030
		SHDIR500	-23.21	<0.001
Total daytime flying moths species richness (adjusted)	0.71 (0.002)	AvGrassH	0.02	0.010
		Pbrushw R500	-0.09	0.039
		PRDR2000	-3.64	0.004
		SHDIR1000	-1.98	0.026
		AREAMNR250	-0.17	0.026

Multiple regression models for butterflies

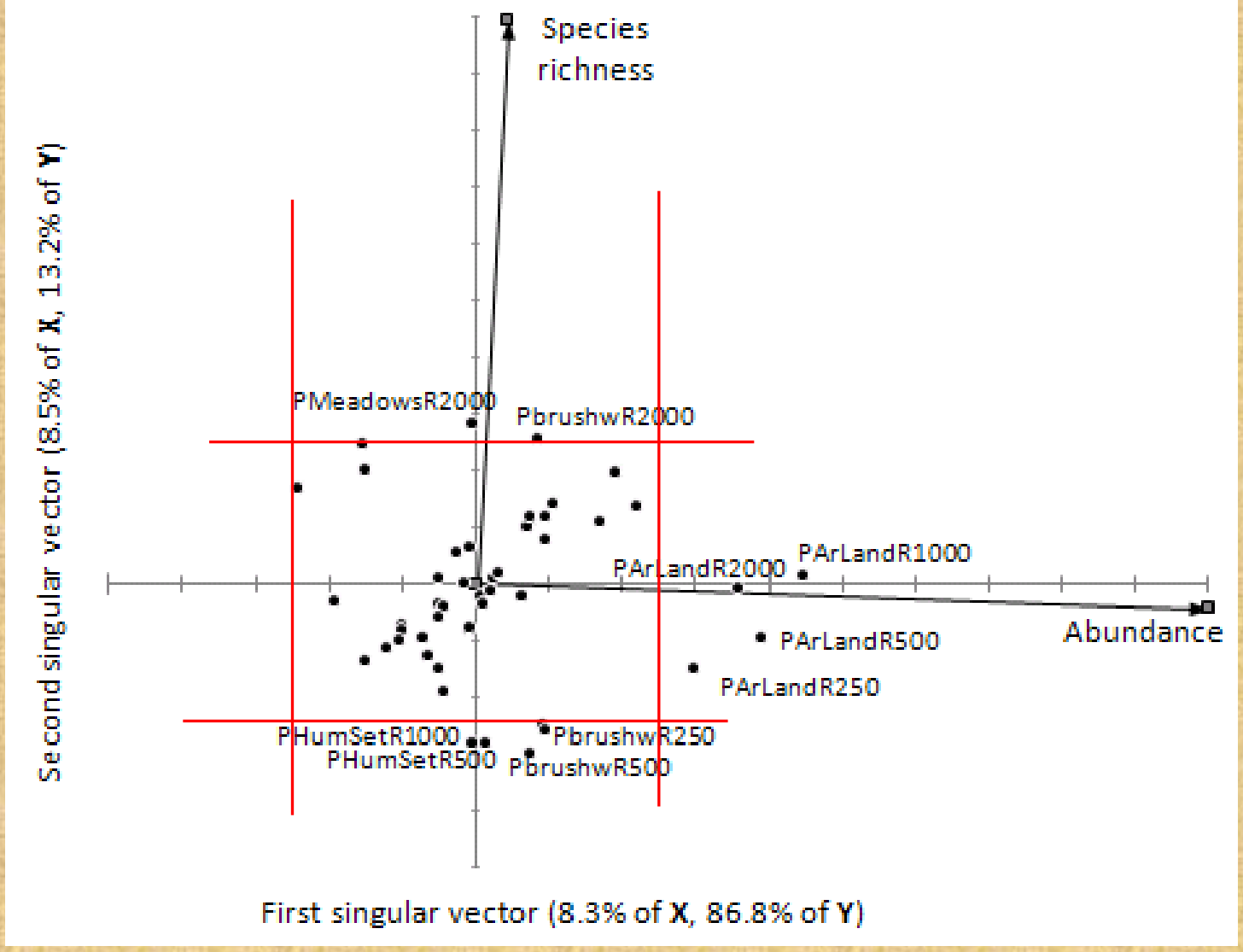


Multiple regression models for daytime flying moths





Results of the partial least squares correlation analyses (PLS) of butterflies. Dots mark the location of patch and landscape characteristics (**X**) and squares with arrows mark the location of the butterfly adjusted richness and abundance (**Y**) in relation to the two latent factors. The patch and landscape characteristics with $p < 0.1$ (as assessed through permutation tests) are presented with variable name.



Results of the partial least squares correlation analyses (PLS) of daytime flying moths. Dots mark the location of patch and landscape characteristics (**X**) and squares with arrows mark the location of the daytime flying moths adjusted richness and abundance (**Y**) in relation to the two latent factors. The patch and landscape characteristics with $p < 0.1$ (as assessed through permutation tests) are presented with variable name.

CONCLUSIONS

I. At patch level

- Most patch variables as well area and perimeter of patch do not seem to have an influence to the diversity and abundance of butterflies and daytime flying moths in our study sites.
- There was a positive impact of the diversity of flowering plants to the species richness and abundance of butterflies and abundance of daytime flying moths.

CONCLUSIONS

II. At landscape level

- The bordering forest and human settlement have positive impact on butterfly species richness
- The presence of meadows in the surrounding area of the habitat had a negative effect on the species richness and abundance of butterflies.
- The presence of forest in the surrounding area of the habitat had a positive effect on the species richness of butterflies and agricultural land to the abundance of daytime flying moths

CONCLUSIONS

- In general, the overall species richness and abundance of butterflies and daytime flying moths had few significant relationships with landscape characteristics and indices in our study
- However, the analyses on species level is needed


Thank you!