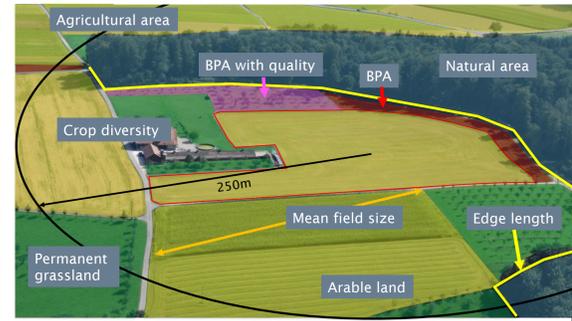
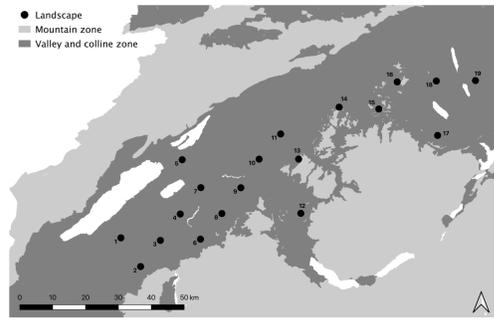


# The effect of the surrounding landscape on carabid beetle communities in cereal fields



## Abstract

The intensification of agricultural practices and the simplification of the landscape that followed the Green Revolution are two of the main drivers of farmland biodiversity loss. Not only some species disappeared, the abundance of many others strongly decreased, which can have negative effects beyond wildlife conservation as the equilibrium between some ecosystem processes and agriculture production might be disrupted. In this context, how the management and composition of the surrounding landscape shape beneficial organism communities in Swiss cereal fields has rarely been studied.

Here, we selected carabid beetles, as an important component of the farmland beneficial invertebrate community, to investigate the question in 55 cereal fields located in the Swiss lowland. Carabids were caught in pitfall traps 3 m from the edge and in field center in each cereal field. Landscape composition and configuration variables were calculated for two radii of 250 m and 500 m, to describe the landscape around the cereal fields. We studied the within-field distribution and influence of the surrounding landscapes on species richness, abundance and trait composition with generalized linear mixed-effect models.

Our results show that the carabid communities were dominated by few species with high activity densities. Carabid abundance varied between sampling positions and was highest in field center, although we found no difference in species richness between the sampling positions. The surrounding landscape, with a high-intensity but small-scaled management system, had no significant effect on carabid species richness. However, the composition of the carabid beetle communities did respond to landscape metrics, as smaller fields benefitted abundance and increased mean body size, whereas edge length favored the share of carnivore, larger and specialist species.

The results of the present study indicate that small-scale agricultural landscapes with a network of hedgerows and forest edges can promote farmland carabid communities and thus contribute to functional diversity.

## Material and methods

- ▶ Sampling of carabids in 55 cereal fields in the Swiss lowland (BE, LU, FR) with two pitfall traps per field (field center vs. field edge), traps installed begin of May 2016 and emptied three times approximately every 12 days
- ▶ **Carabid metrics** calculated per pitfall trap: Total species richness, mean abundance, Shannon-weaver index (H) for species diversity, community specialization index (generalist vs. specialist), community flight ability (poor vs. dimorphic vs. good), community mean body size, community trophic index (herbivore vs. carnivore)
- ▶ For each field, **landscape metrics** calculated in QGIS with the different land-use types within two circles around field center (250m and 500m): Agricultural area, natural area (forest and waterbodies), arable land, permanent grassland, biodiversity promotion areas, biodiversity promotion areas with quality, Shannon-weaver index (H) for crop diversity, mean field size, edge length (= length of forest edges and hedgerows)
- ▶ Statistical analysis with linear mixed effect models and automated model selection to find most parsimonious model ( dredge function)

## Results

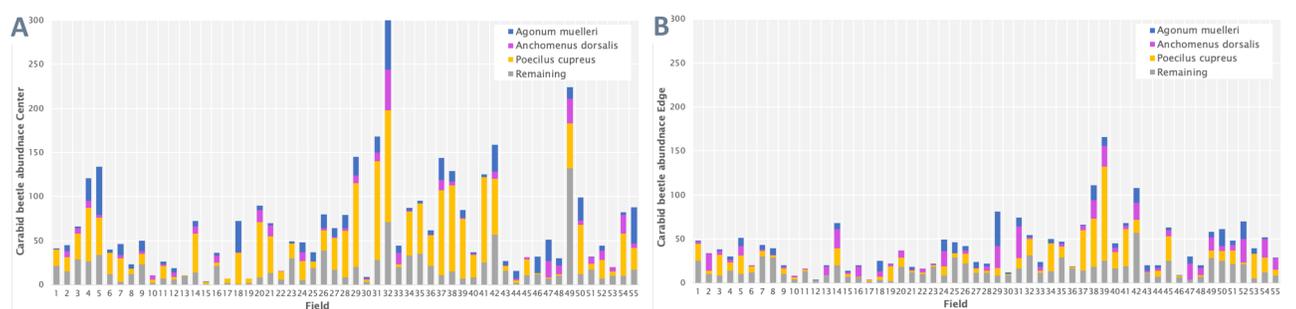


Figure 1: Total (sum) abundance of carabid beetles in all cereal fields at field center (A) and in field edge (B). Overall, 5'973 individuals from 61 species were found. However, communities were dominated by few species. Carabid abundance varied between sampling position, but no difference in species richness was found.

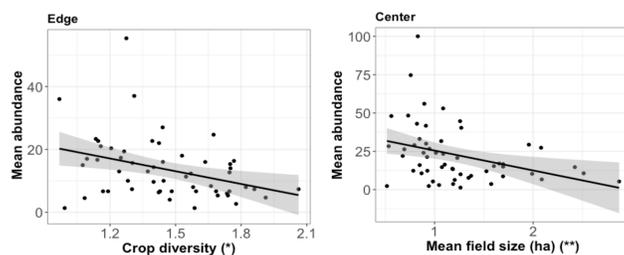


Figure 2: The surrounding landscape had no significant effect on species richness, however higher crop diversity and larger fields decreased mean abundance (effect plots for 250m, level of significance and p-value: (\*\*\*) < 0.001, (\*\*) < 0.01, (\*) < 0.05, (.) < 0.1).

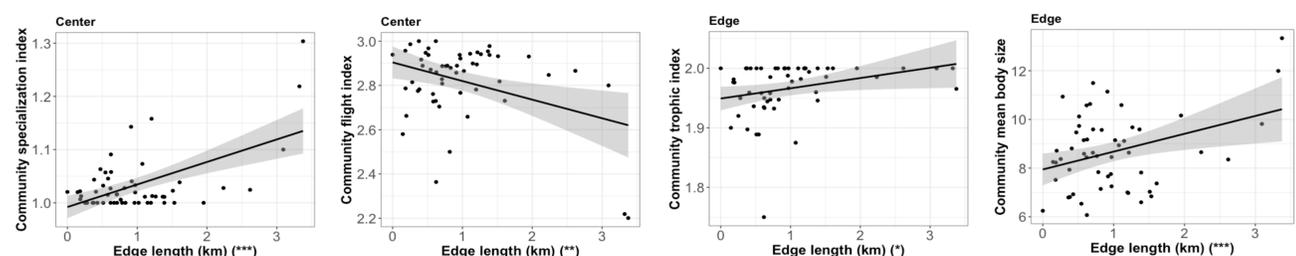


Figure 3: With increasing edge length more specialists, more carnivores and larger beetles were found, but flight ability decreased with increasing edge length (effect plots for 250m, level of significance and p-value: (\*\*\*) < 0.001, (\*\*) < 0.01, (\*) < 0.05, (.) < 0.1).

## Conclusions

- ▶ For Swiss lowland, with a small-scaled but intensive agriculture, landscape configuration and composition (edge length, field size, crop diversity) influences carabid communities more than the availability of natural areas and/or BPAs
- ▶ Field size and edge length are important factors to increase ecosystem services like weed seed consumption and pest predation
- ▶ Adapted cropland communities likely to be influenced by local management => need to be included in future studies