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Let me tell you ’bout the flowers and the bees…

Can sown flower-rich fields enhance pollination in the agricultural landscape?

Introduction

Agricultural intensification has led to a massive decrease of biodiversity and loss of semi-natural habitats in agricultural landscapes. As a result, biodiversity-dependent ecosystem services like crop pollination are at risk!
Agri-environmental schemes (AES) aim to restore part of the biodiversity by providing suitable habitats and key resources. Sown flower-rich fields provide nectar, pollen and nesting sites to insects and are assumed to partly compensate for the lack of perennial semi-natural habitats (SNH). But the optimal composition, management and distribution of flowering fields to maximize ecosystem services is still being discussed.

To address this issue, we assessed visitation rate in oilseed rape fields (OSR) as a measure of pollinator spillover from different adjacent AES flowering fields and control fields along a gradient in landscape complexity.

Results

Pollinator visits in the OSR fields were the same next to the Refreshed AES and Continuous AES, as well as the calcareous grassland and the crop field. The New AES had a significantly lower amount of pollinator spillover than the other treatments (Fig.1).
High amounts of SNH in the surrounding landscape led to shallower visitation decline in OSR fields and helped to maintain a high visitation rate even at larger distances from the field edge (Fig.2).
All functional pollinator group visits to OSR flowers declined with growing distance to the field edge. Honey bees had the highest visitation rate, followed by flies and Solitary bees. Bumblebees and Hoverflies only accounted for a small amount of overall visits (Fig.3).

Type of adjacent AES field

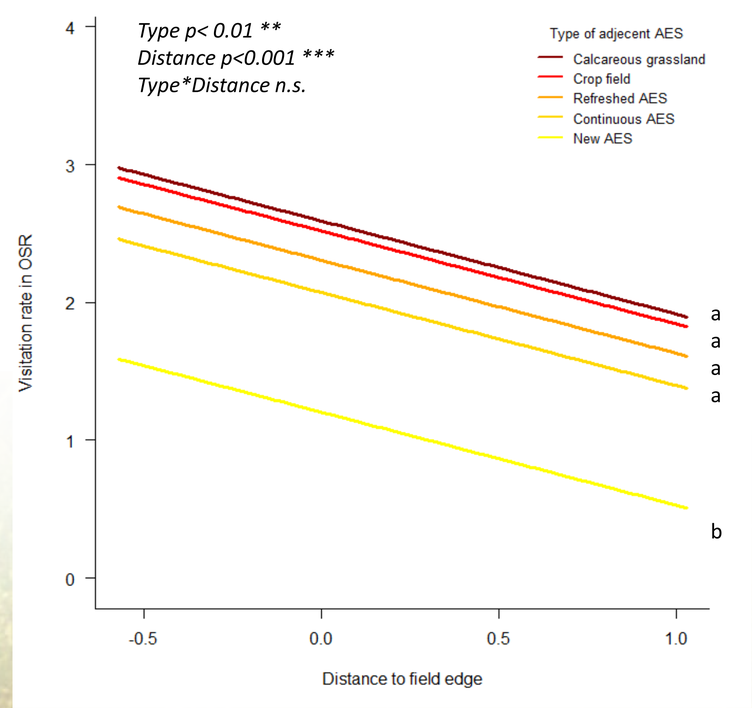

Fig.1 Distance decay functions of flower visitation rates in oilseed rape fields for different adjacent AES types and control treatments.

SNH

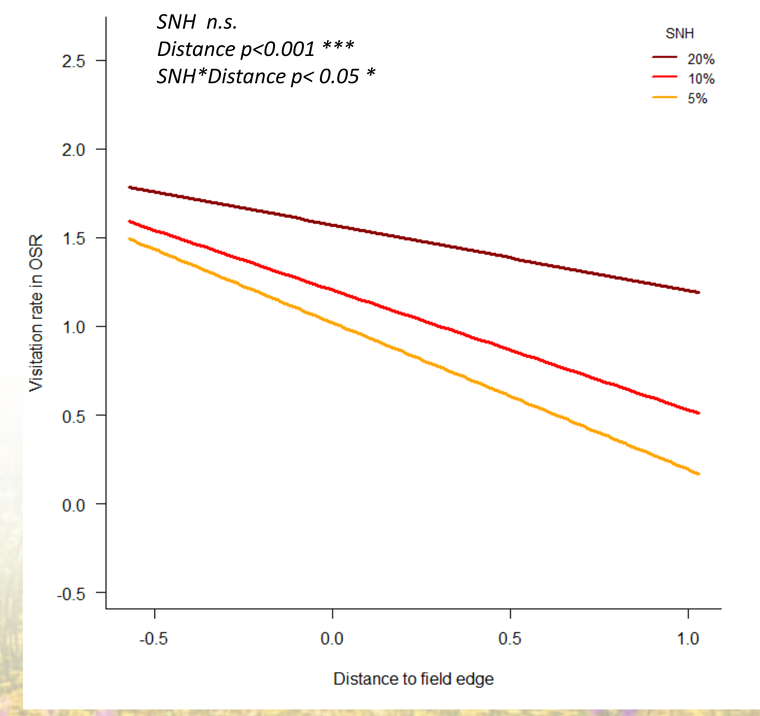

Fig.2 Distance decay functions of flower visitation rates in oilseed rape fields for different SNH proportions in 1km radius.

Functional group

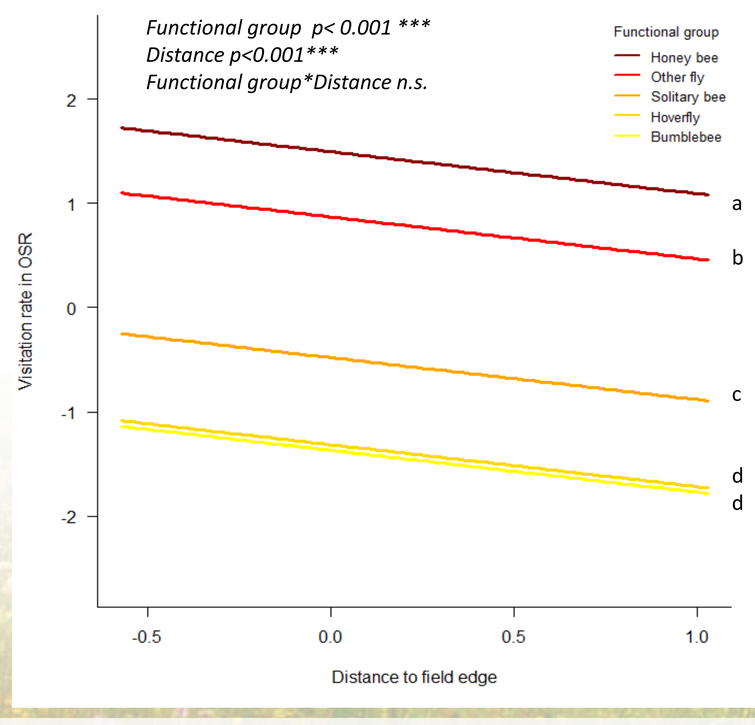

Fig.3 Distance decay functions of flower visitation rates in oilseed rape fields for different functional pollinator groups.

Conclusion

Our results (1) indicate that old AES fields maintain higher numbers of pollinator spillover than newly established flower areas, (2) show the importance of landscape context for the effectiveness of AES and (3) reveal differences between functional pollinator groups.
However, and in contrast to our hypotheses, crop field controls showed patterns that were not significantly different from most AES schemes and calcareous grasslands, underpinning the importance of negative controls for the sound evaluation of AES schemes. Our quantitative distance decay functions for visitation rates provide the basis for targeted management of the spatial arrangement of AES in agricultural landscapes.

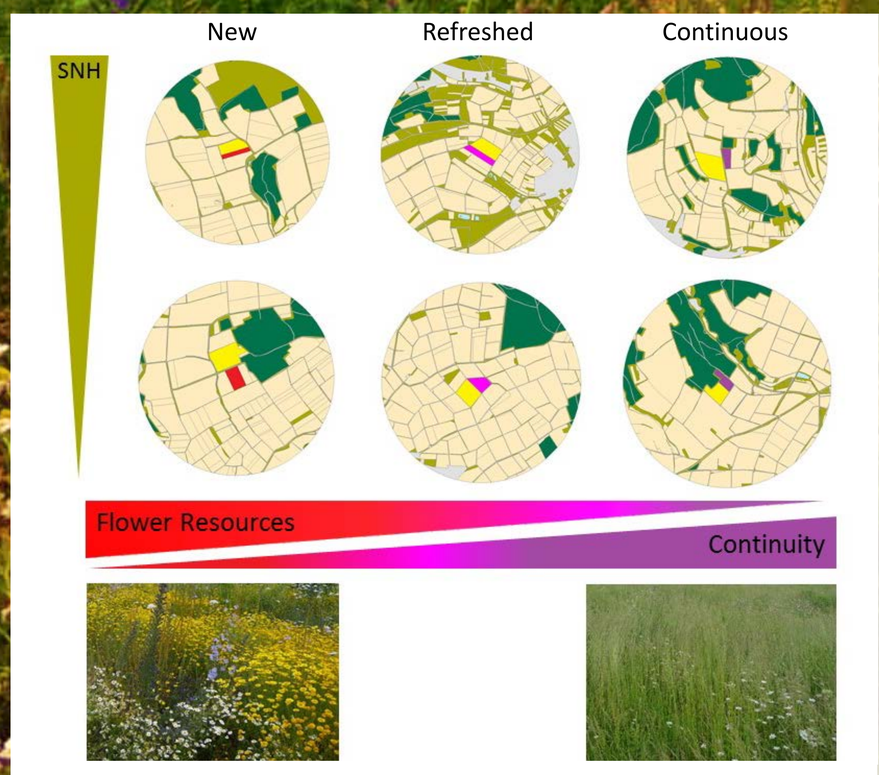

Fig.4: Study design.

Material & Methods

Experiments were carried out on 31 flowering OSR fields with adjacent flower-rich fields which differed in age/continuity and management or with adjacent control fields in April/May 2016. Fields were located in landscapes with 1km radius along a semi-natural habitat gradient (3.6-32.5%) in lower Franconia, Germany. In the OSR, four observation plots in various distances (0-125m) leading away from the flowering fields were established to examine distance decay of pollinator spillover from the AES or the respective control. Plots were observed for 5 minutes and pollinator visits and abundance were noted for each functional group (Honey bee, Bumblebee, Solitary bee, Hoverfly and other Fly). Data was analyzed using generalized linear mixed effect models with ‘lme4’ and ‘glmmADMB’ packages in R version 3.3.3 (R Development Core Team).

AES	New	Refreshed	Continuous
Established	2015	2009-2010, re-established 2015	2009-2010
Managed	Ploughed & sown, no further management	Ploughed & resown , no further management	Mulched every year

Table 1. Different types of AES flower-rich fields used in this study.

Part of the Project **ECODEAL**
Enhancing biodiversity-based ecosystem services to crops through optimized densities of green infrastructure in agricultural landscapes

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