Reducing insect pest pressure and crop damage by spatiotemporal isolation of oilseed rape fields

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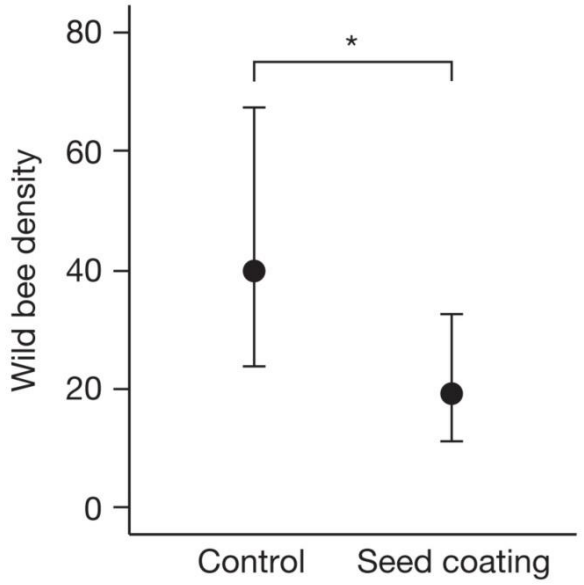
Background

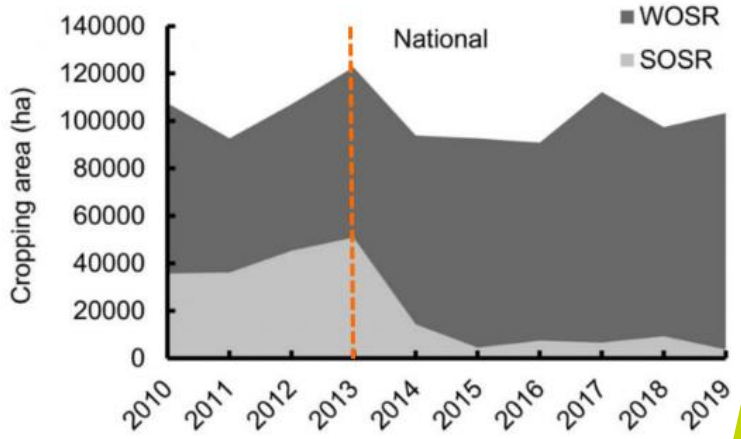
- Systemic neonicotinoid insecticide seed coatings against early season pests are detrimental to biodiversity, e.g. wild bees (Rundlöf et al. 2015 Nature)

- Neonicotinoid seed coatings were banned in the EU in 2013 / 2014, leaving some crops without sufficient protection (Kathage et al. 2018 Pest Manag Sci)

- In Sweden, spring oilseed rape (SOSR) was especially affected and became vulnerable to early season flea beetle pests (Lundin 2021 Pest Manag Sci)

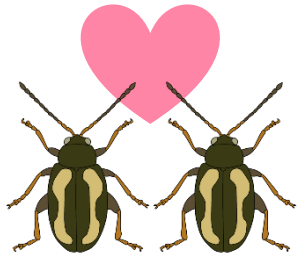


spring oilseed rape in Sweden



Background – flea beetles

summer

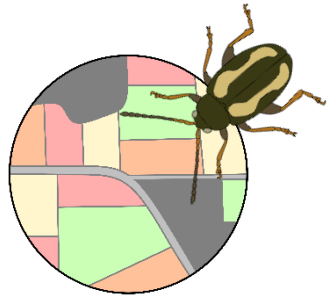


reproduction & development in the field

emergence & dispersal

autumn

overwintering in suitable habitats



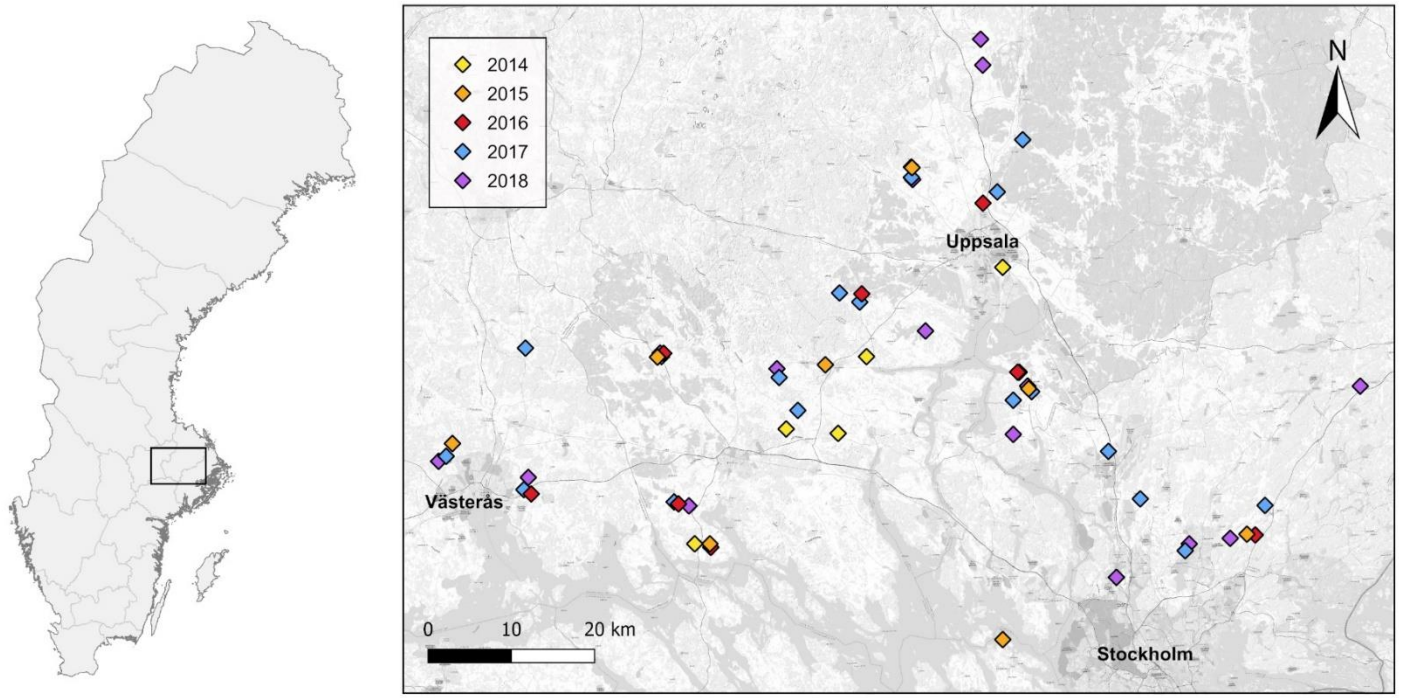
Where / from where?

spring

colonisation & feeding on oilseed rape cotyledons

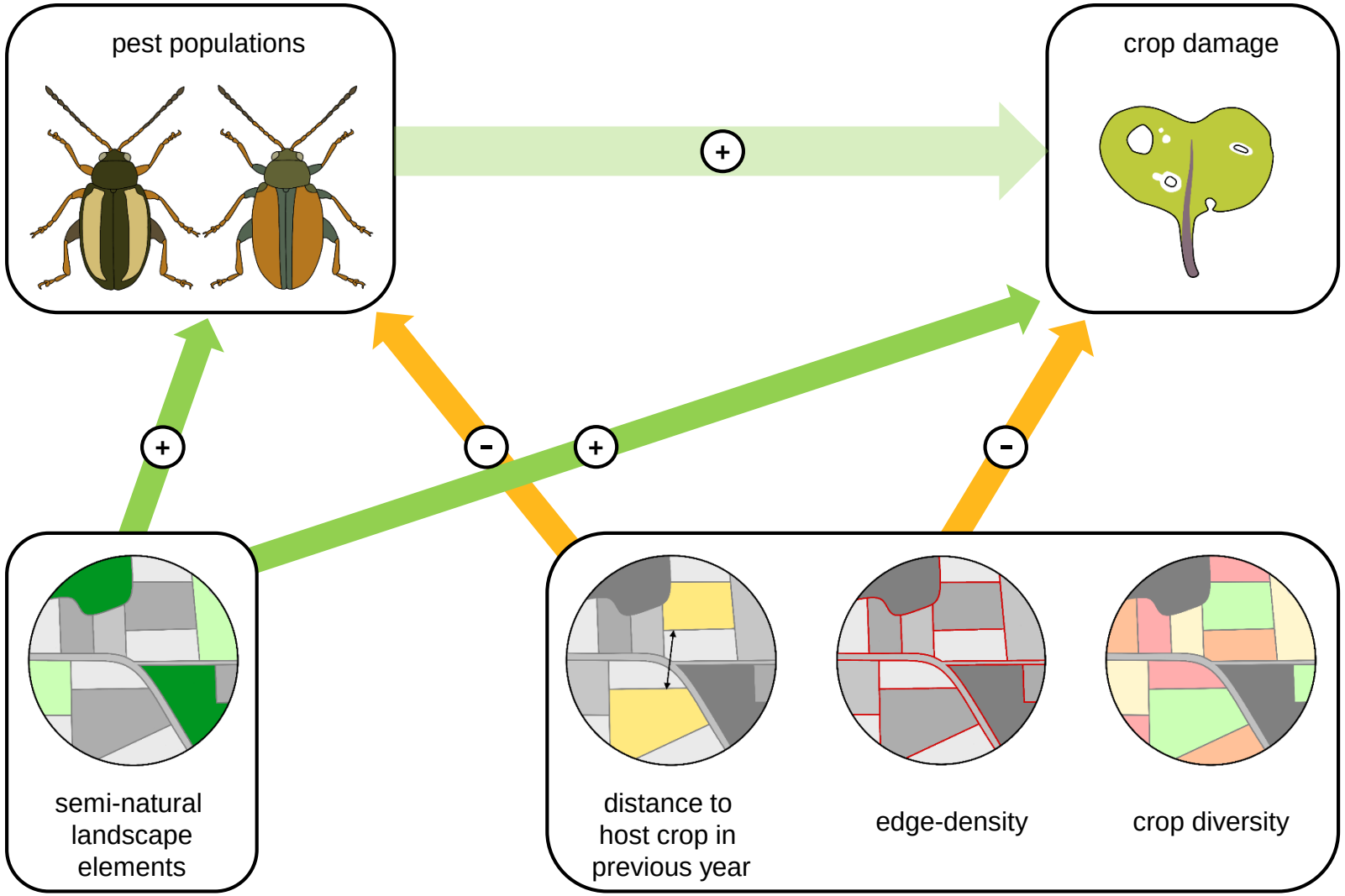
Study design

Aim: Identify landscape-level solutions for sustainable pest regulation



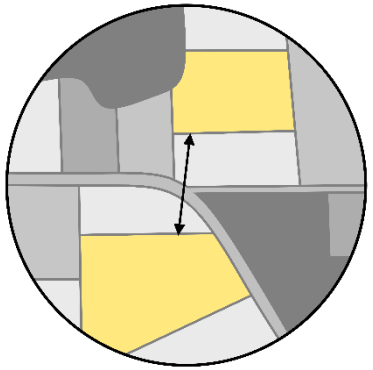
Data from 56 spring oilseed rape fields (and surrounding landscapes) across 5 years and 67,547 flea beetle individuals

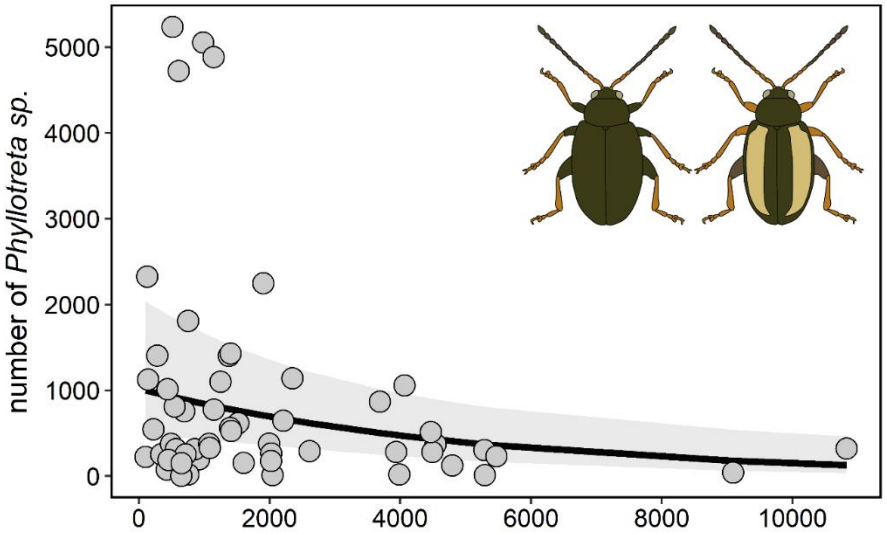
Does surrounding landscape affect pest pressure?

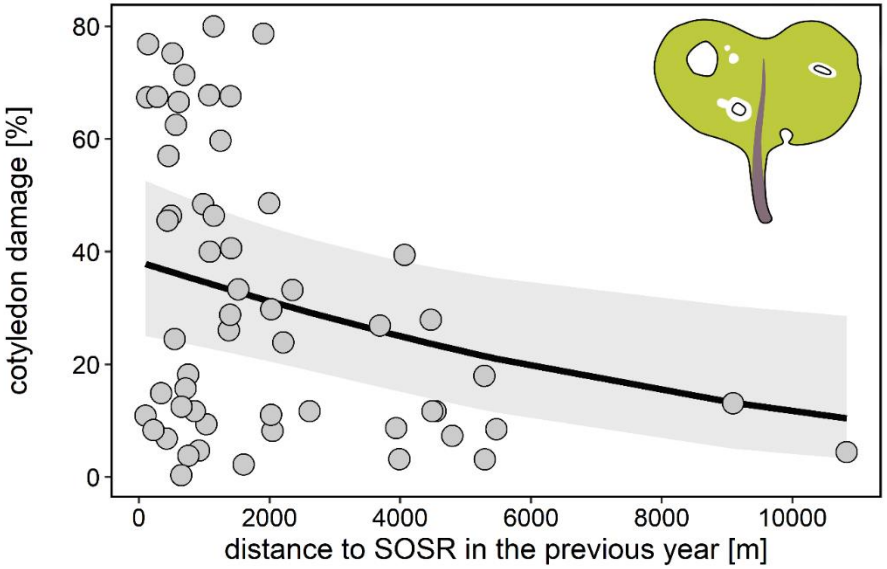


Main results

Spatiotemporal isolation of SOSR fields was the **most important predictor for pest pressure and crop damage** across species and years

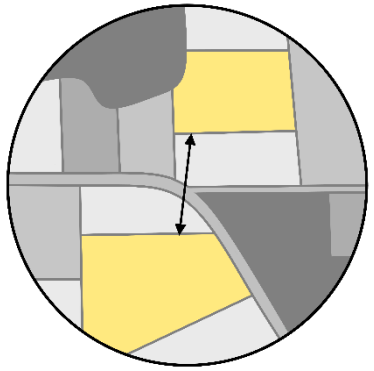






Implications for pest control

- Strategic planning of host crop fields across years holds great potential to disrupt pest life-cycles in agricultural landscapes:
  - → Limits pest populations and pressure which leads to a reduced overall need for insecticide use



- Likely works best for specialised and dispersal limited pests with spatiotemporal distancing based on the dispersal abilities of the pests

Co-authors and funding

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RESEARCH ARTICLE

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Spatiotemporal isolation of oilseed rape fields reduces insect pest pressure and crop damage

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Abstract

1. Pest management is essential to maintain agricultural production, but recent shifts in policies and the development of insecticide resistance have restricted the availability of insecticides for pest suppression. Identifying the landscape-level resource requirements of pests to complete their life cycles might unveil new sustainable solutions to regulate their populations and prevent crop damage.
2. We assessed the effects of landscape composition and configuration at different spatial scales on flea beetle densities and crop damage in 56 spring oilseed rape fields sampled over 5 years in Sweden. We considered the cover of non-crop habitats as an aspect of landscape composition and the distances to the host crop and an alternative host crop in the previous year, edge density and crop diversity as aspects of landscape configuration.
3. The distance from spring oilseed rape in the previous year reduced flea beetle densities and crop damage across most species and spatial scales. Edge density reduced the densities of two flea beetle species, predominantly at the 500 m radius landscape scale. The cover of forests and permanent pastures as well as crop diversity in the previous year increased the densities of different species at several, mostly larger (1000–2000 m) spatial scales. Increasing permanent pasture cover at the 500 m scale also increased crop damage.
4. *Synthesis and applications*: We find that there is no one fits all approach in designing landscapes for flea beetle regulation as habitat use and scales of effect are species-specific for these pests. However, increasing the spatiotemporal isolation of host crop fields is a promising and potentially more general means of disrupting pest populations and reducing crop damage. Considering the ecological traits of the pest species is a possible next step to optimise landscape-based pest management.

KEYWORDS
Brassica napus, flea beetles, insect pest management, landscape structure, legacy effect, neonicotinoid ban, Phyllotreta, semi-natural habitat

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