FARMING PRACTICE
LANDSCAPE FEATURES

IMPACT: PESTS AND DISEASES

Reference 27

Shackelford, G; Steward, PR; Benton, TG; Kunin, WE; Potts, SG; Biesmeijer, JC; Sait, SM 2013 Comparison of pollinators and natural enemies. A meta-analysis of landscape and local effects on abundance and richness in crops BIOLOGICAL REVIEWS, 88(4), 1002-1021. 10.1111/brv.12040

Background and objective

To manage agroecosystems for multiple ecosystem services, there is a need to know whether the management of one service has positive, negative, or no effects on other services. The objective of this study was to analyse the effects of local and landscape complexity on the abundance and richness of pollinators of crops and natural enemies of crop pests, sampled in fields, orchards, and vineyards of food crops.

Search strategy and selection criteria

The authors limited their search of the ISI Web of Knowledge database to the following terms: Topic=bee OR bees OR pollinator* OR ((beetle* OR "hover fl" *OR hoverfl* OR parasitoid* OR spider* OR wasp*) AND ("biological control" OR "pestcontrol" OR "natural enem")) AND Topic="ecosystem service" *OR ((crop OR crops OR field*) AND (border OR borders OR boundar* OR edge* OR margin OR margins OR perimeter* OR (landscape* AND scale) *OR ("natural habitat"* AND (area* OR distance* OR isolation OR percent*)))) AND Topic=abundance OR abundant OR rich OR richness OR visits OR visitation AND Year Published=2001–2010. In July of 2011; this search resulted in 350 studies (with 'lemmatization' off). 1) The study had to be published; 2) the study had to report abundance or richness of in situ 'ecosystem service providers' (ESPs) (bees; predatory beetles; hover flies; spiders; or parasitic wasps); sampled in fields; orchards; or vineyards of food crops (not in the margins); as an effect of local complexity (proximity to; or diversity of; field margins) or landscape complexity (proximity to; diversity of; or proportion of natural or non-crop habitats; or similar metrics from ordinations of landscape variables); 3) the experiment had to be replicated; 4) studies that sampled arthropods in meadows or pastures; rather than fields of food crops; were not included; 5) studies of small-scale experimental plots were not included if authors considered treatments and controls to have been spatially confounded (i.e. if they were separated by <10 m) and if no spatial statistics were reported; 6) only measurements of richness that were standardized by sampling effort were included.

Data and analysis

Authors modelled effect sizes (Fisher's Z-transformed r (Zr)); weighted by inverse variance; by using mixed-effects models. To account for the non-independence of data reported in the same study (e.g. abundance and richness), authors used study as a random effect in all models. The authors started with maximal mixed-effects models that used effect size as the response variable and metric; scale; crop habit; taxon; and their interactions as predictor variables; and then used backwards stepwise deletion to select minimum adequate models. The authors examined funnel plots and conducted correlation tests for funnel-plot asymmetry to study publication bias. When funnel-plot was not symetric; a fail safe N test was performed to check if likely to be an artifact of publication bias. The authors used chi-squared tests to compare the number of studies in different categories (e.g. studies on pollinators versus studies on natural enemies).

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
46	Fields, orchards, and vineyards of food crops	High compositional complexity (landscape complexity: proximity or proportion of non-crop or natural habitats in the landscapes surrounding food crops; or local complexity: proximity or diversity of non-crop plants in margins of food crops)	Low compositional complexity	Metric: Abundance and richness of crop pest natural enemies; Effect size: Fisher's Z-transformed r	81.25

Results

- The effects of complexity were positive and significantly different from zero for natural enemies (P =0.0024, Zr =0.1868).
- The different effect sizes between abundance and richness were larger and more significant in the models of natural enemies only (P =0.0169, Zr =0.2044) and spiders only (P =0.0112, Zr =0.2659)

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

Some pollinators and natural enemies seem to have compatible responses to complexity, and it might be possible to manage agroecosystems for the benefit of both.