

# Landscape composition outweighs trophic linkages and configuration in explaining farmland bird patterns

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## Background

- Biodiversity is declining. In Northern Europe, farmland dominates the landscape, making agricultural systems key for conservation
- Increasing **habitat diversity** promotes species diversity and ecosystem functioning
- Both **landscape composition** (area of semi-natural habitat) and **configuration** (edge density) shape biodiversity patterns
- Landscape features (permanent elements e.g. hedgerows, field margins, ponds) are particularly important in intensive farmland
- There is a growing need for **biodiversity indicators** to support EU restoration targets

## Aim

- To investigate how **landscape composition and configuration** influences farmland biodiversity
- To examine **trophic linkages** between:
  - Farmland birds
  - Flying insects
  - Flowering plants



This photo was AI-generated

## Methods

### Study area

- Five organic farms in Denmark with 78 survey points distributed across the five study regions.
- Land use quantified within a **9 ha square** around each observation point

### Variables included:

- Crop fields
- Permanent grassland
- Landscape features
- Forest

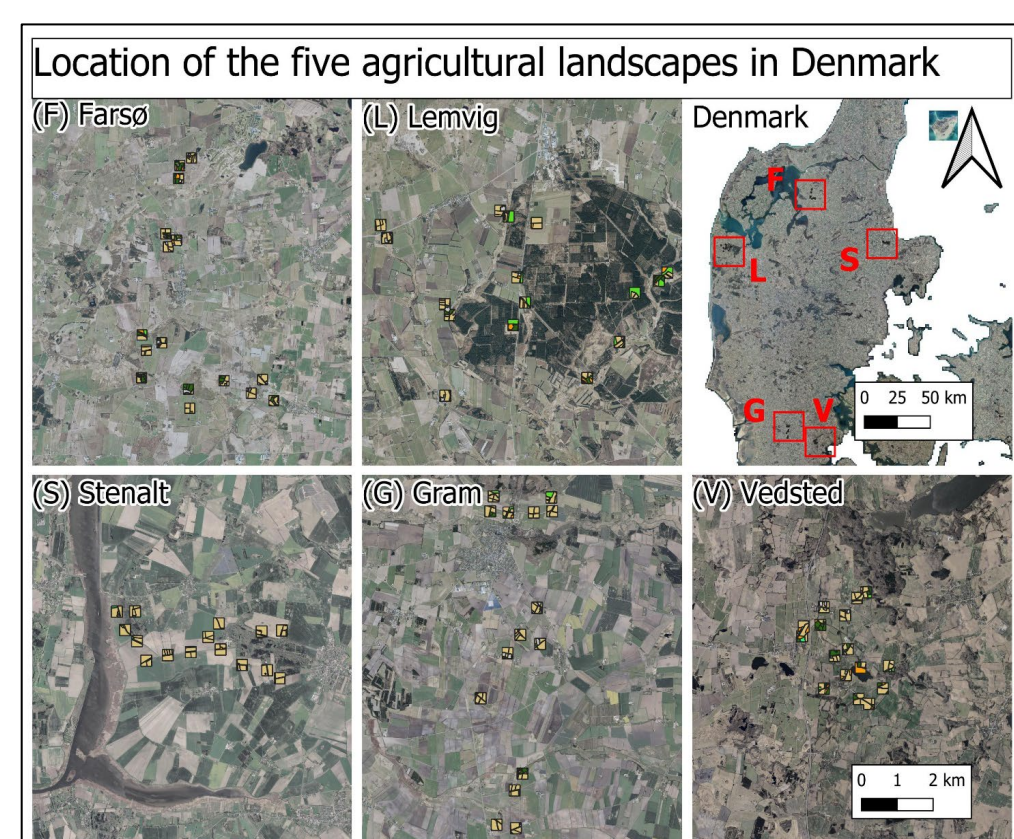


Figure 1 - The five agricultural landscapes and the spatial distribution of the survey points (yellowish squares) within and their location in Denmark (right upper corner).



A survey point with a 9-ha buffer used for landscape quantification

Data extracted using GIS (QGIS Field Ecospace Tool) (ICOEL)

Three study years: 2022, 2023, and 2024 (but for birds 2025 instead of 2024)

### Bird surveys

- Standardized 5-minute point counts
- Repeated 3 times per season (April–June)
- Four focal species:**
  - Skylark
  - Corn Bunting
  - Yellowhammer
  - Common Whitethroat
- Species richness and bird abundance of:**
  - All birds
  - 21 defined Danish farmland bird species

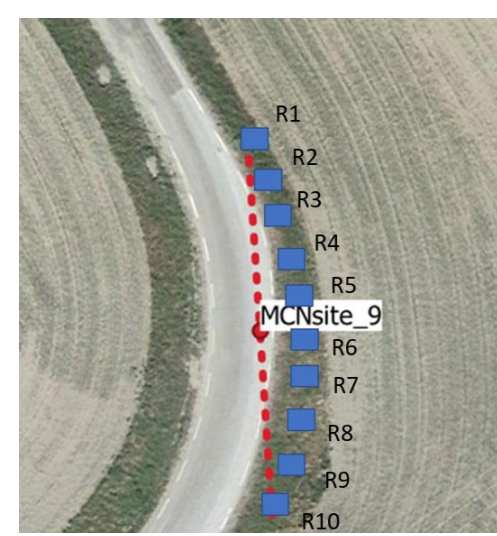
### Flying insect abundance

- assessed at survey points using pan traps targeting flying insects
- Repeated 3 times per season (spring, mid-summer and late-summer)



### Plant species richness

- A standard 50 m transect once per season (late June) at each point



### Data analysis

AICc-based model selection identified the best predictors of bird responses; insect and plant variables were excluded due to no effect.

### Response variables (dependent):

- Bird abundance
- Bird species richness
- Four focal species

### Explanatory variables (independent):

- Landscape composition
- Trophic variables
  - Flying insect abundance
  - Plant species richness

## Results and discussion

- No effects from insect- and plant-variables.
- Excluding insect and plant variables revealed clearer responses to landscape factors.
  - Species-specific responses** varied, but only with skylark and corn bunting showing consistent patterns: positive associations with crop rotation area and strong negative associations with forest and permanent grassland.
  - Whitethroat and yellowhammer showed weaker and less consistent responses:
  - At **community level** abundance and species richness of all birds followed similar patterns: Negative effects of crop fields and forest
  - For farmland birds there was a strong and consistent negative association with forest

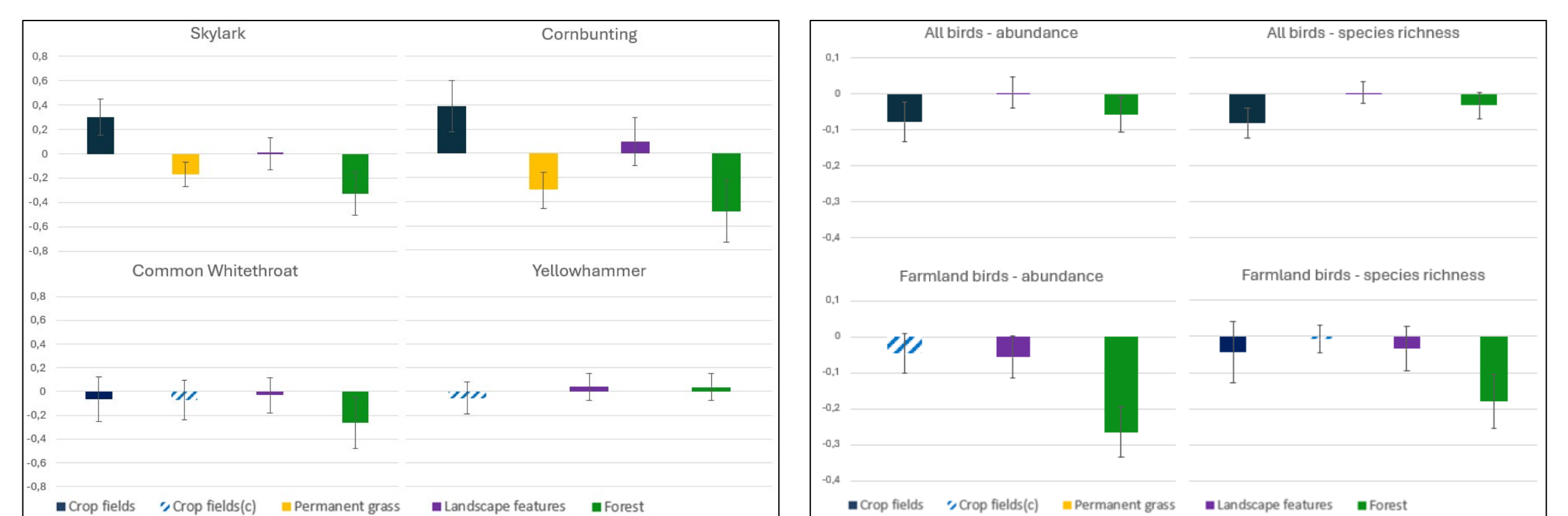


Figure 7 and 8 - Relationships between bird variables ((to the left) corn bunting, skylark, common whitethroat and yellowhammer and (to the right) all birds - abundance, all birds - richness, farmland birds - abundance, and farmland birds - richness) and the response variables (crop fields and crop fields (c), permanent grass, landscape features and forest). The results shown are extracted from the models that best describe each relationship.

- Configuration showed no clear positive effects, despite expectations
- No effect of landscape features → quality may matter more than quantity
- No clear links between birds, insects, and plants, possibly due to:
  - Weak/complex trophic interactions
  - Standard insect surveys not reflecting bird food resources
- Simple indicators may not capture biodiversity patterns effectively
  - Species respond differently → Aggregating species can mask important variation
  - Variation in landscape feature quality should be taken into account

## Conclusions

- Trophic linkages are complex and difficult to detect at this scale
- Complex biodiversity responses cannot be captured by single indicators, as species respond differently and aggregation masks variation.
- Biodiversity-friendly management requires multiple, nuanced approaches

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Key reference: MARTIN, E. A., DAINESE, M., CLOUGH, Y., BALDI, A., BOMMARCO, R., GAGIC, V. & GARRATT, M. P. D. 2019. The interplay of landscape composition and configuration: new pathways to manage functional biodiversity and agroecosystem services across Europe. *Ecology Letters*, 22, 1083-1094.  
 EU 2024. Regulation (EU) 2024/1991 of the European Parliament and of the Council of 24 June 2024 on nature restoration and amending Regulation (EU) 2022/869.