

1. CONTEXT AND QUESTION

Can land be spared for nature without sacrificing food?

Agriculture occupies around half of the world's habitable land. Meeting the global 30-by-30 biodiversity target may therefore require taking some farmland out of production.

England's EU set-aside scheme provides a large-scale test. From 1993-2007, cereal farms were required to leave a share of arable land uncultivated and maintain green cover.

Set-aside may create habitat, but it may also reduce food output. Farmers can soften the trade-off by choosing marginal fields or raising yields on the land that remains.

What happened to bird biodiversity - and how much cereal production was lost?

1993-2007

mandatory policy period

5-15%

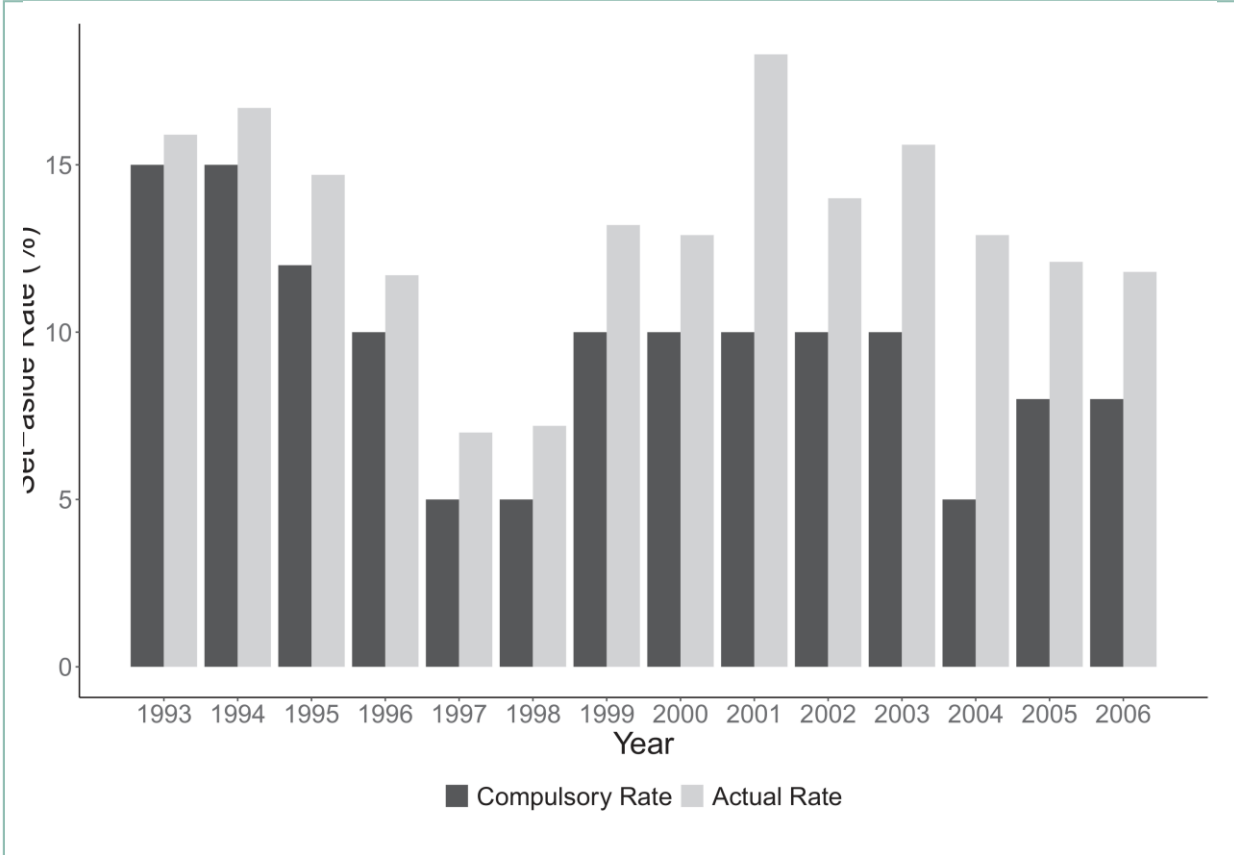
annual compulsory rate

GREEN COVER

no crop; near-zero fertiliser and pesticide use

2. POLICY, DATA AND IDENTIFICATION

A policy shock with two linked panels



Compulsory rates varied annually; actual rates were higher: farmers added voluntary set-aside.

BIRDS

351 landscapes (10 km x 10 km), 1994-2007; BBS bird counts linked to June Survey land use (~4,300 grid-years).

FARMS

Farm Business Survey, 1981-2007; 13,960 observations on cereal area, output and yield.

DESIGN

Biodiversity: within-grid fixed effects plus a shift-share IV check. Food: event study plus RD-DID.

3. MEASURING BIODIVERSITY

Four measures answer different questions

ABUNDANCE

How many birds?

Total count. It can rise even when gains are concentrated in common species.

SPECIES RICHNESS

How many species?

Number of species present. It ignores evenness and evolutionary distance.

SHANNON-WIENER

How even is the community?

Richness plus evenness. No gain if a few common species dominate.

PHYLOGENETIC DISTINCTIVENESS (HAED)
How much evolutionary history?

Abundance weighted by evolutionary distinctiveness: how much evolutionary history is represented.

Five bird groups: all species (130) -> non-farmland (111) and farmland (19) -> generalists (7) and specialists (12).

4. MAIN BIODIVERSITY RESULTS

More birds and species - but not more biodiversity on every measure

ABUNDANCE

+1.3-2.1%

per +100 ha; positive for all, non-farm, farm and generalist groups.

SPECIES RICHNESS

+0.3 species

about +0.9%; almost entirely non-farmland species.

SHANNON-WIENER

NO
DETECTABLE
CHANGE

more birds, but no clear gain in community evenness.

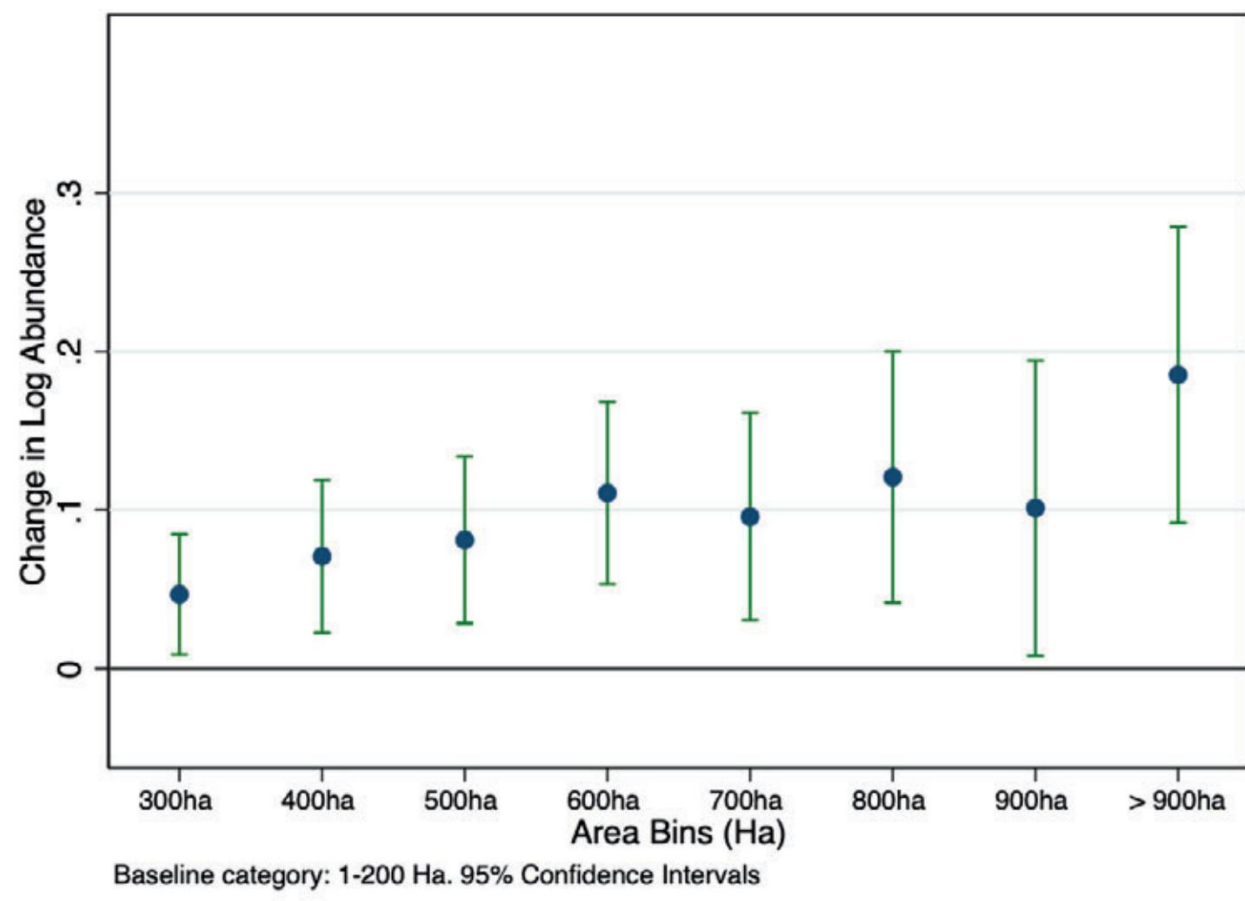
PHYLOGENETIC DISTINCTIVENESS

-0.03
Not significant

non-farmland birds; weaker after multiple-testing correction.

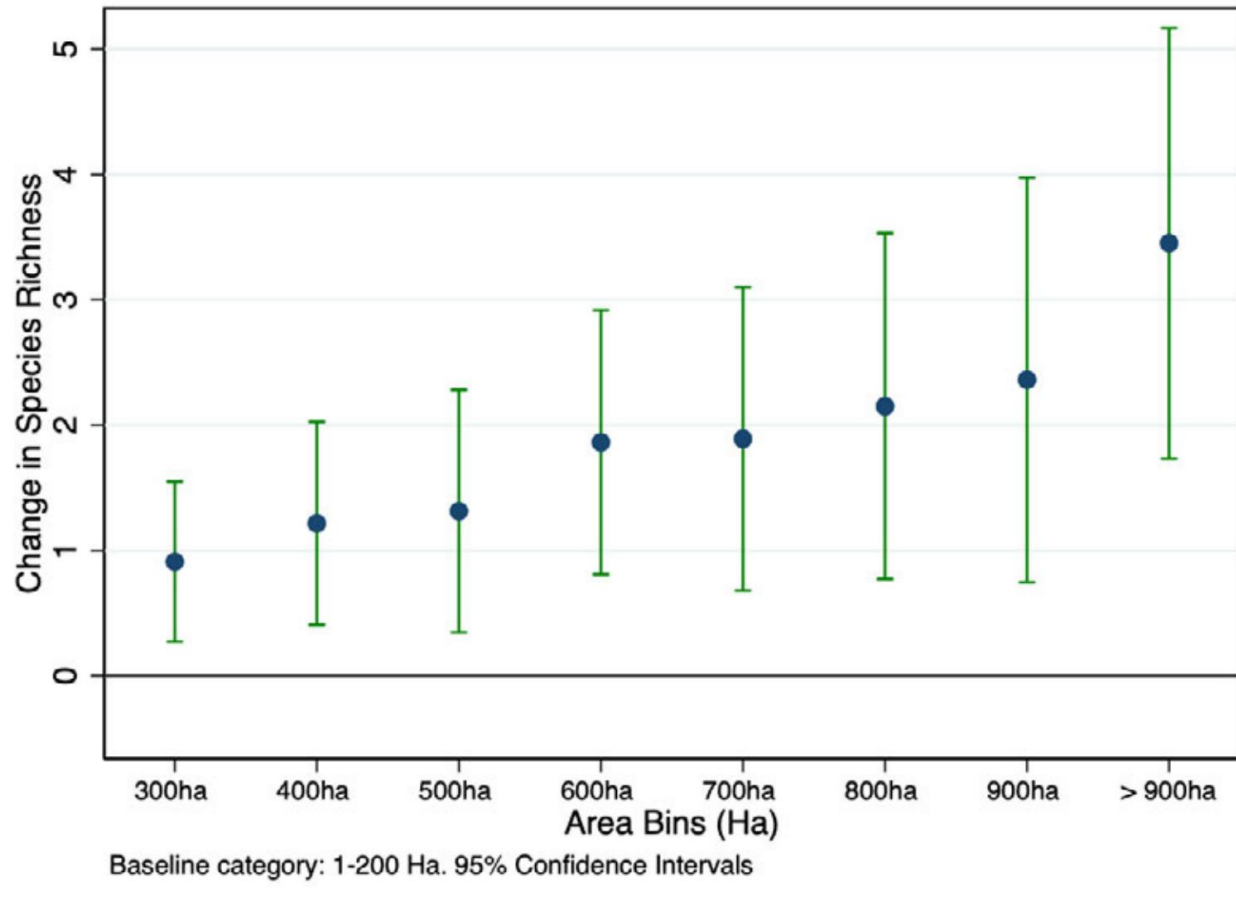
Scale matters: effects first materialise beyond about 200 ha, with a marked jump above 900 ha.

Abundance by set-aside area



(a) All Species.

Species richness by set-aside area

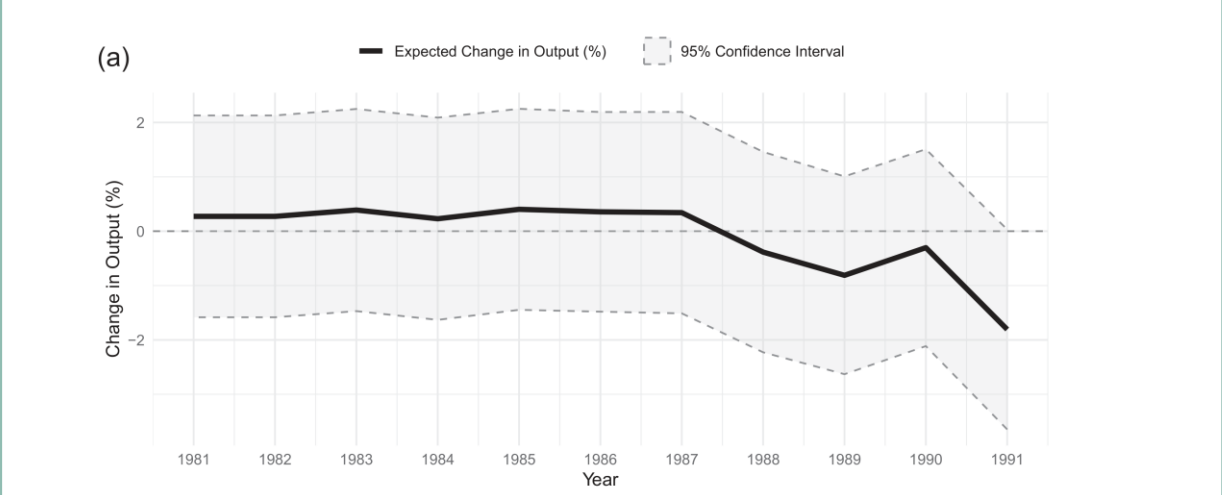


(a) All Species

Selected all-species panels from Figures 2 and 3; bars show 95% confidence intervals relative to the 1-200 ha baseline.

5. FOOD PRODUCTION

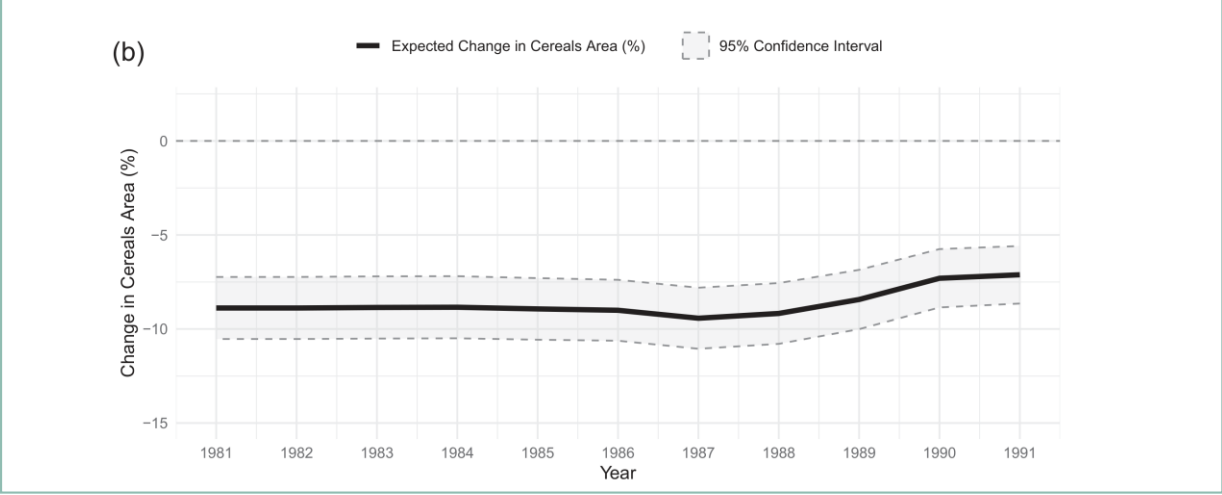
Much less cereal land - only a small output loss



OUTPUT

0 to -2%

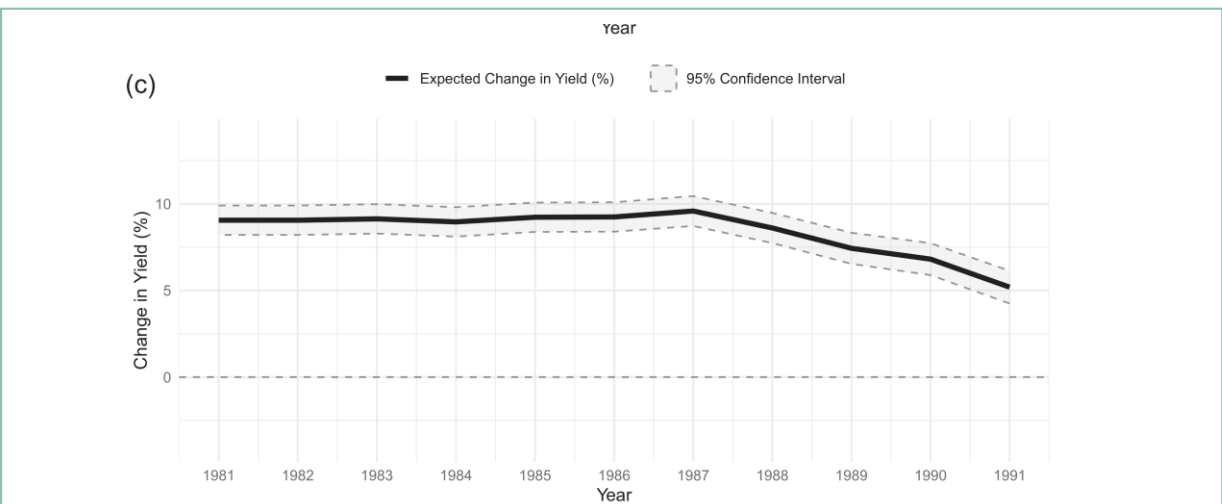
Usually not different from zero.



CEREAL AREA

-7.1 to -9.4%

The policy removed land from cereals.



YIELD

+5.2 to +9.6%

Higher yields protected output.

Interpretation: farmers mostly set aside marginal land, while higher yields on remaining cereal land cushioned the fall in output.

6. SCALE, TIME AND CREDIBILITY

Why the average effect is only part of the story

1 SCALE

Effects are near zero below about 200 ha; abundance and richness jump above 900 ha.

2 TIME

Biodiversity adjusts gradually. The long-run richness effect is about 29% larger than the short-run estimate.

3 SPECIES

Only generalists and farm generalist species of birds are affected positively

Persistent, coordinated habitat may matter more than short-lived, scattered set-aside.

7. POLICY IMPLICATIONS

Target the biodiversity outcome - not just hectares

1 DEFINE THE GOAL

Abundance, richness, evenness and evolutionary distinctiveness give different answers. Choose the target first.

2 TARGET SCALE AND LOCATION

Create sufficiently large, connected habitat rather than isolated fragments.

3 PROTECT FOOD SUPPLY

England mostly spared marginal land. Stronger targeting may include productive land and raise food costs.

4 USE WHERE INTENSIFICATION IS FEASIBLE

Trade-offs are smaller where remaining land can raise yields without large environmental costs.

LAND SPARING CAN WORK - BUT METRICS, SCALE AND PERSISTENCE MATTER.

England's scheme raised bird abundance and richness with little cereal-output loss, but it did not improve every measure of biodiversity.