# Breeding success of birds exposed to treated seed PS2373

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# Reproductive risk assessment: birds exposed to treated seed

- Assessments often indicate potential for concern
  - At tier 1
  - And after refinement (e.g. residues, diet)
- Assumes
  - One field
  - Exposure during sensitive life stage, i.e. breeding coincides with drilling
- Aim to add realism
- Modelling approach

# Objectives

1. a. Develop population growth rate estimates for Skylark potentially exposed to treated seed.

   b. Develop population growth rate estimates for Rook potentially exposed to treated seed.

2. Screen Linnet and Yellowhammer for likelihood of exposure during breeding for key spring crops, for which data of sufficient resolution exist.

3. Explore the mechanisms by which land cover can be used to estimate exposure of bird populations to treated seed.

4. Notify industry & MS.

5. Discuss the potential use of population growth rate (PGR) in regulatory risk assessments.

# Objective 1 & 2
# Breeding success/PGR estimates

- Builds on previous work by Joe Crocker
  - PS2346, for insecticide sprays
- Two approaches were developed:
  1. Broods at Risk model

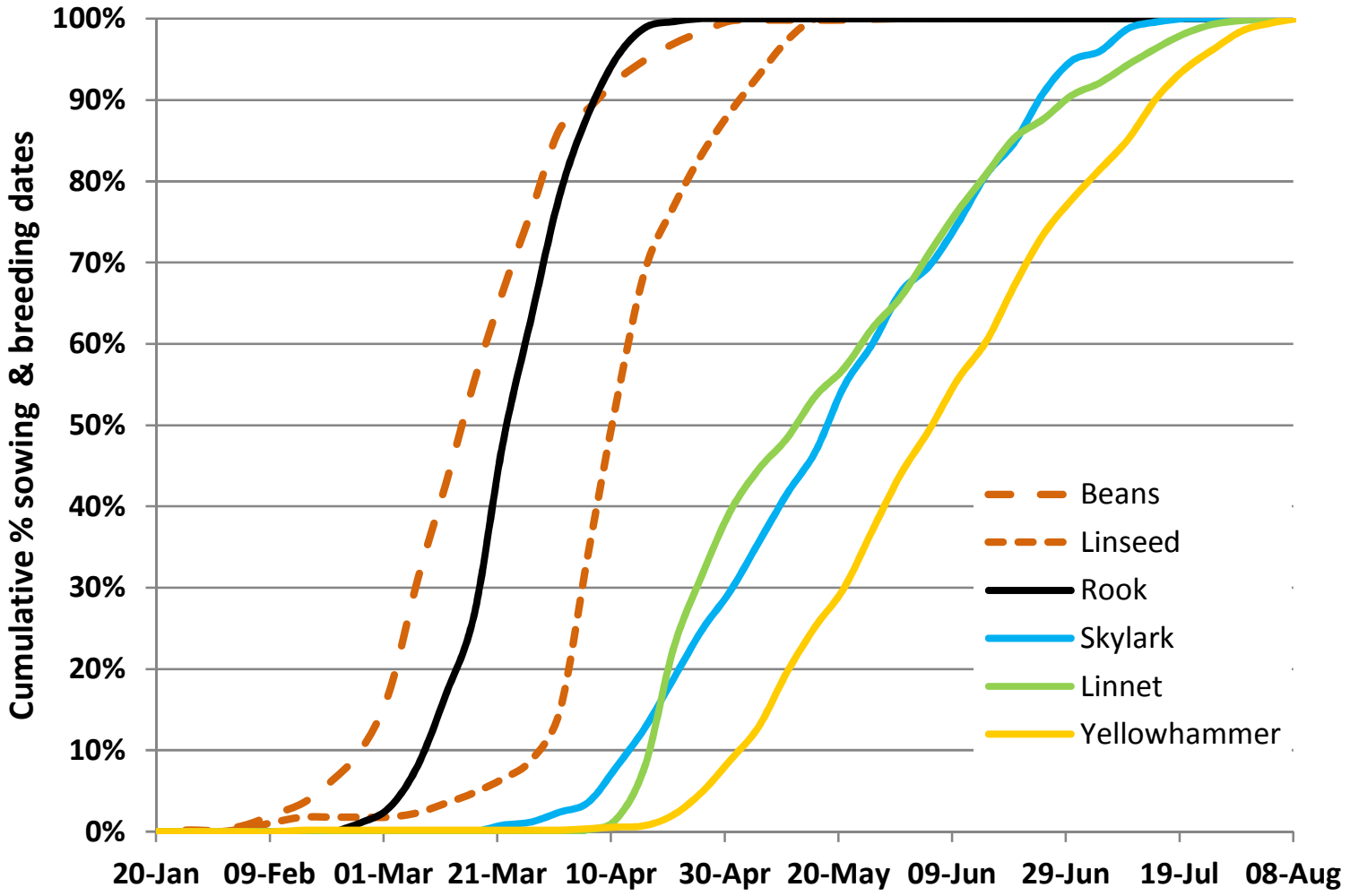
     How many broods are around at a particular application date?
     How many experience Toxicity Exposure Ratio (TER) <5?
  2. Seasonal Success model

     How many chicks are successfully raised in a season?

     Multiple broods.

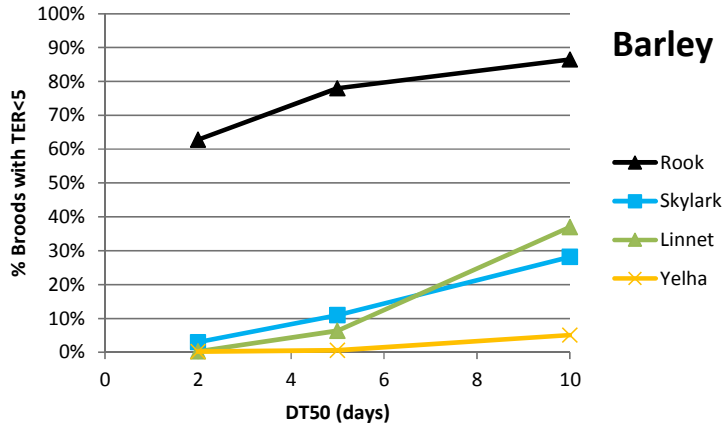
     What consequences for Population Growth Rate (PGR)?
- Included all four birds in each

# Data


Cumulative % sowing & breeding dates
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
20-Jan
09-Feb
01-Mar
21-Mar
10-Apr
30-Apr
20-May
09-Jun
29-Jun
19-Jul
08-Aug
Beans
Linseed
Rook
Skylark
Linnet
Yellowhammer

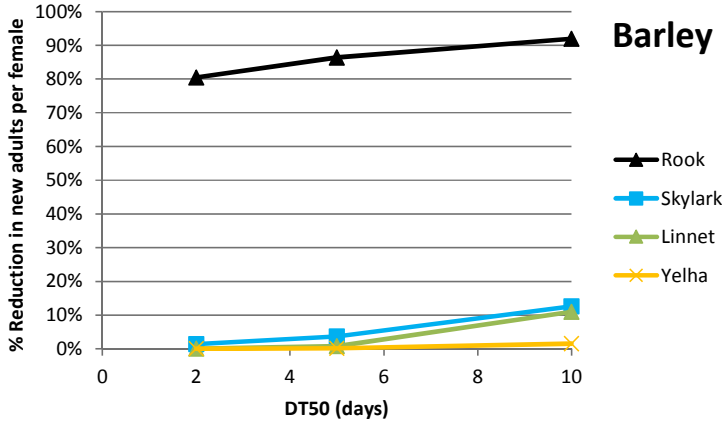
# Seasonal Success model: How it works

- Population of birds, transition matrix
  - Probability of progressing through each day of breeding, or failing due to natural causes.
  - Daily TER calculated: drilling calendar, residue decay.
  - Drilling data resampled, Monte Carlo; results median
  - $DT_{50}$ 2d, 5d, 10d; 1-5d averaging period.
  - If fail breeding, enter recuperation phase.. if time.
  - No competition, no resource limitation, no density dependence; no feeding preferences. Not an Individual Based Model!



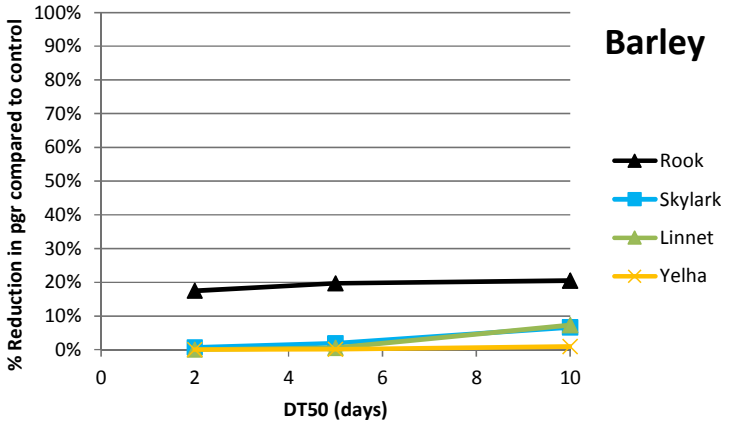

***Broods at Risk model***
For rook, nearly 90% of broods with TER <5. For skylark and linnet, 30-40%. Effect of earlier breeding in rook.

**Results assume pesticide affects all phases of breeding *via* adult body weight**




***Seasonal Success model***
Allowing for multiple broods, the impact on skylark and linnet is reduced, but not for rook which breeds only once.

***Mitigation: effect of multiple broods***




***Population Growth Rate model***
The higher annual survival rates of rook mitigates some of the impact on PGR. Overall the effects are less severe when considered at the population growth rate level.

***+ Effect of annual survival rate***

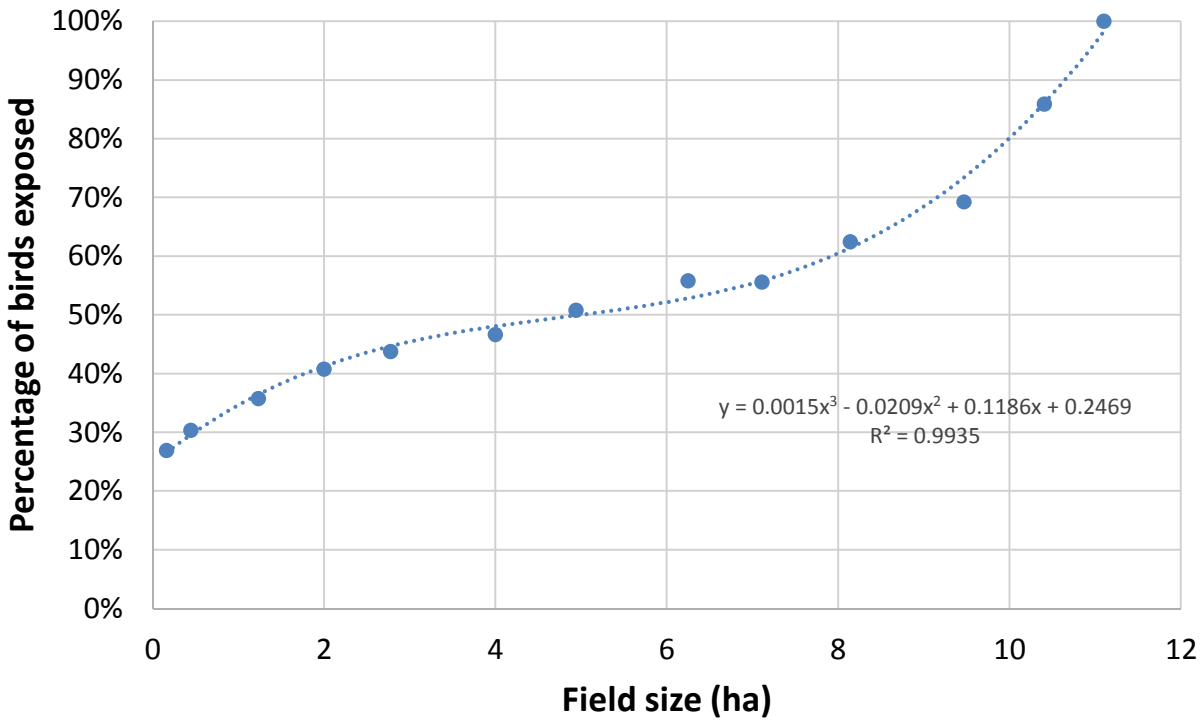
# Objective 3
# Spatial elements

- Do foraging ecology and landscape interact to further inform exposure?
- Two main elements
  - Foraging flight distance i.e. area foraged
    - Skylark, forage flight ~270 m during breeding
    - Rook, up to 3 km
  - Amount of drilled seed in landscape vs. bird density
    - ADAS cropping data 1 $km^2$; BTO BBS data 1 $km^2$

- What is chance of birds encountering treated seed in a real landscape?

# Local level
# Skylark

Does presence of bird + crop in 1 km$^2$ cell = exposure?

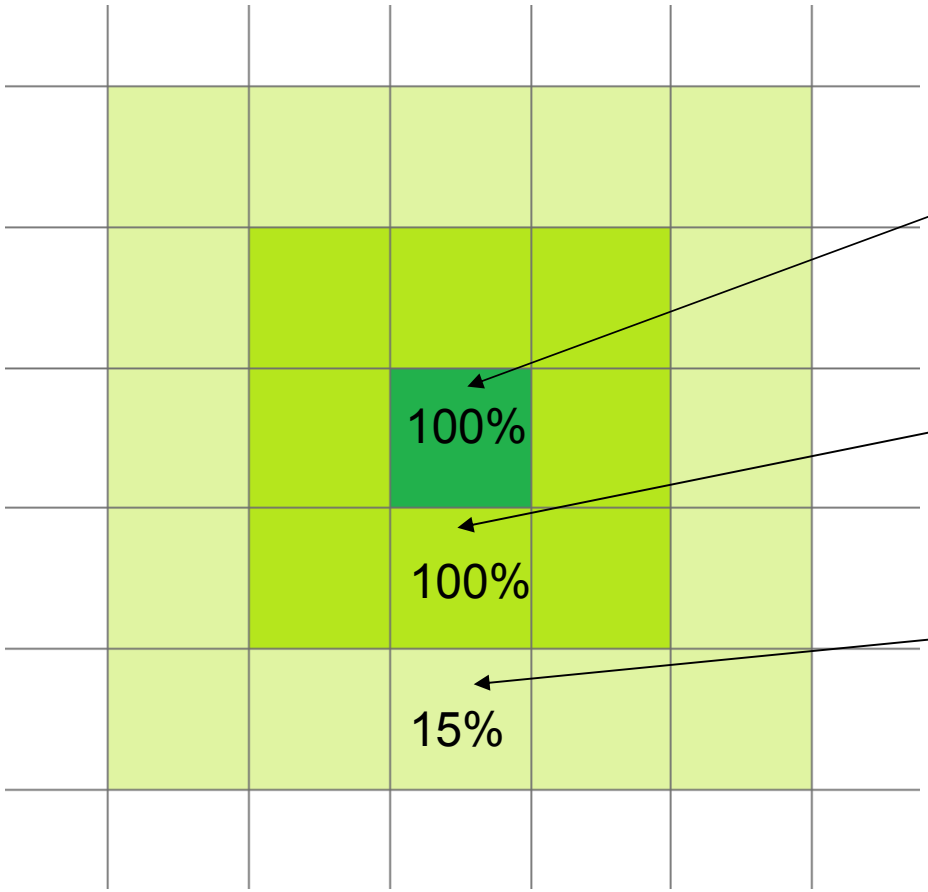



Forage flight 270 m

Can skylark always find treated seed in 1 km$^2$ cell?

At 11% cover, all birds potentially exposed

# Local level
# Rook




Forage flight 3 km

Focus grid cell – 100% of birds nesting here may also forage here

100% of birds nesting in central cell may forage in first zone of cells

15% of birds nesting in central cell may forage in second zone of cells

# Data: Spring barley, skylark, rook

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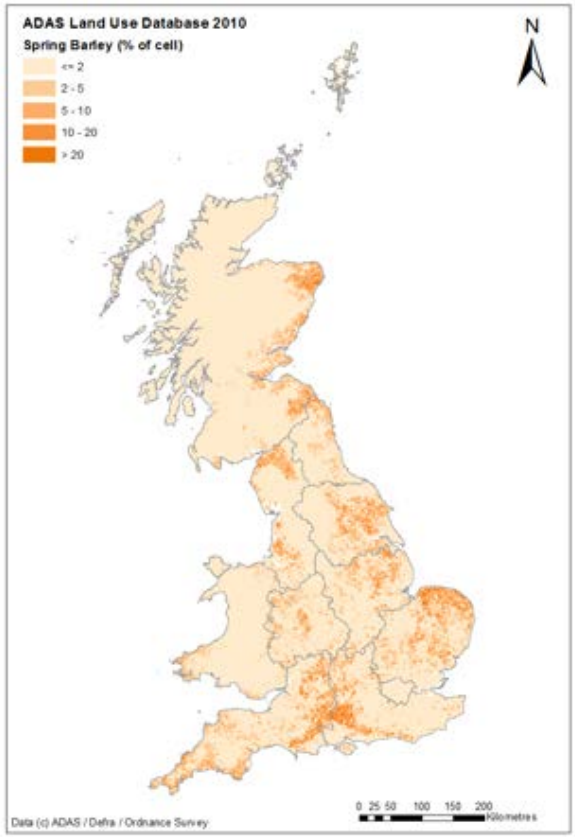
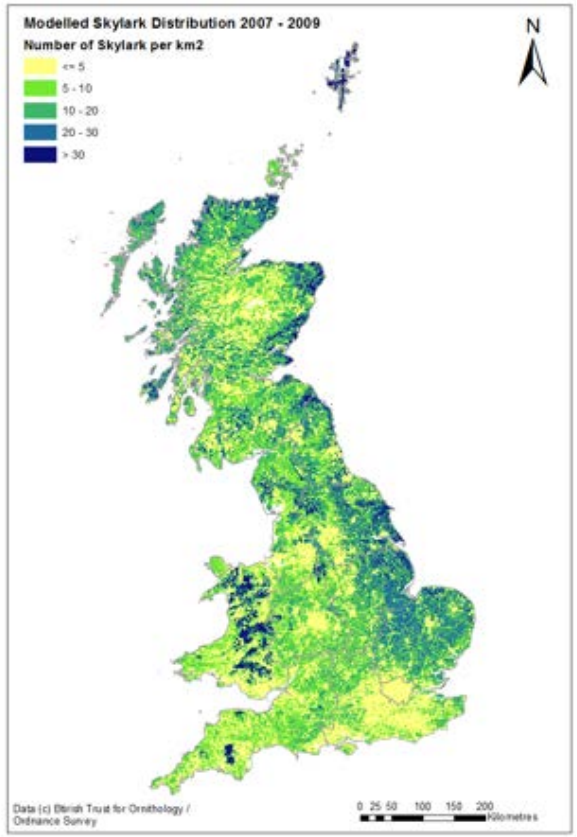
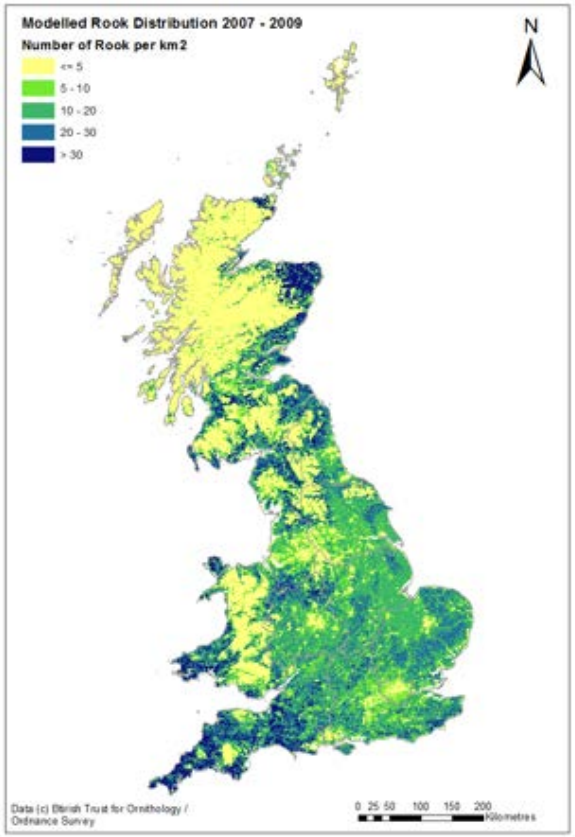
Spring barley density




Skylark density




Rook density

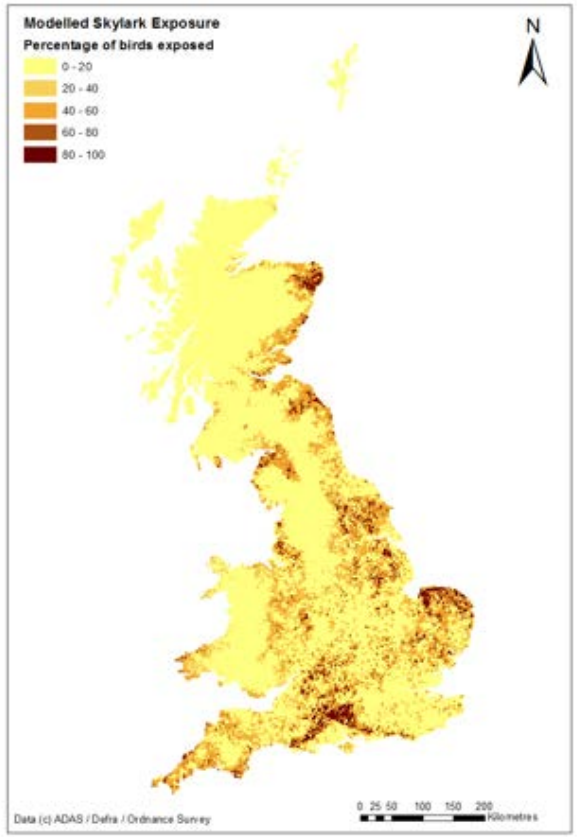


# Results: Spring barley, skylark, rook… National

Percent birds potentially exposed: data overlay, also foraging distance effects

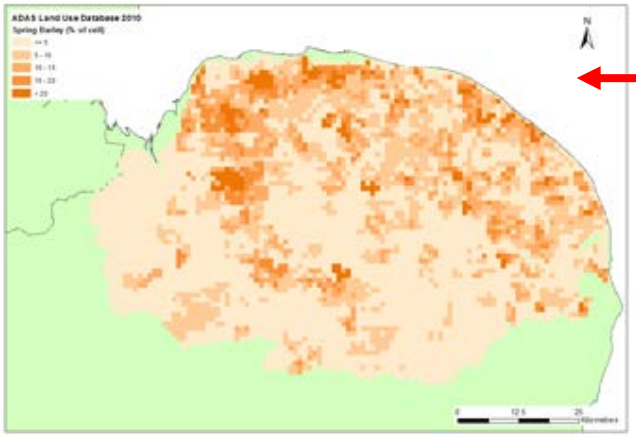
Less landscape mitigation for rook

Skylark: 10% potentially exposed



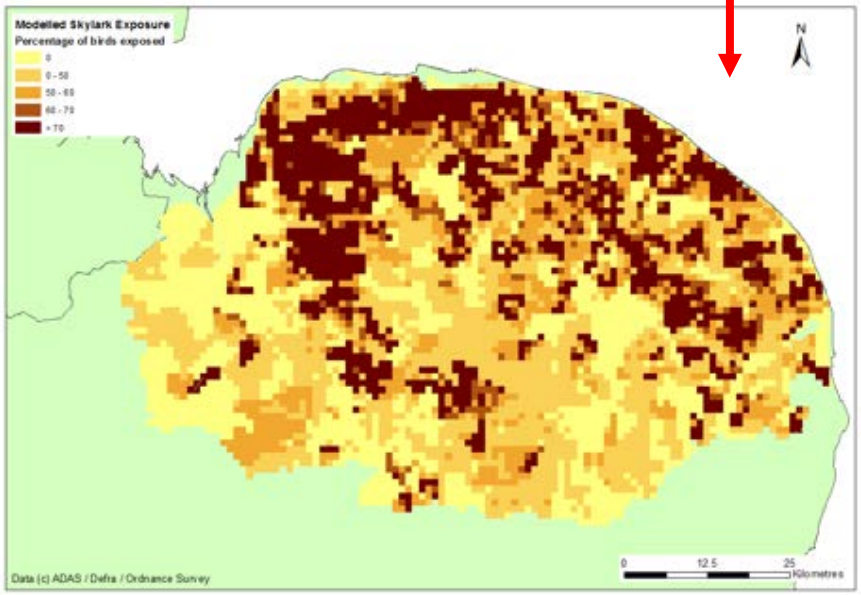

Rook: 81% potentially exposed

# Results: Spring barley, skylark, rook… Norfolk

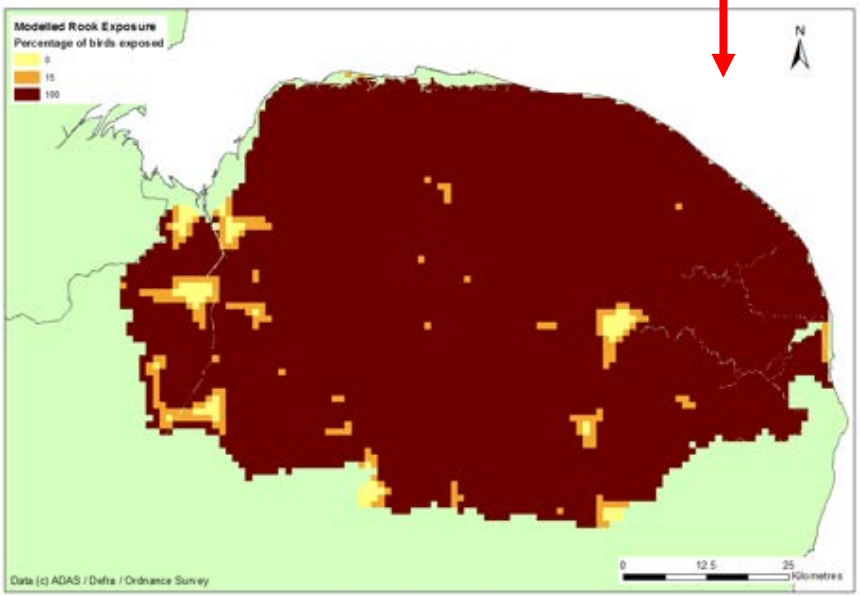


Spring barley in Norfolk 6%

Skylark 51% potentially exposed




Rook 96% potentially exposed



# Summary

- Breeding success
  - Reveals ecological factors that may drive exposure
  - Rook: breeds early, only once, at risk?
  - Skylark: multiple broods may mitigate effects at pop. level
  - Conservative (TER <5 = brood failure, uses shorter TWAs)
- Landscape
  - One possible approach presented here
  - Strong effect of forage flight distance
  - Offers mitigation to skylark; little to rook

# Application, outlook

- Adds realism and context to risk assessments
- Prioritise scenarios for higher tier work
- Inputs can be changed
  - Is worst-case ($DT_{50}$, PD, PT; TER 5)
- Integrate breeding models with landscape results?
- Discussion of PGR in risk assessments to follow
  - Requires wider debate
- Report due – not yet reviewed by CRD/DEFRA

Thanks for your attention

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