Modelling breeding success in birds potentially exposed to treated seed

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Context

- Plant Protection Products, EU 1107/2009
- Dietary risk assessment for birds
  - Treated crop seed as a food source
- Spring crops may be drilled during breeding period
  - Potential reproductive risk to birds from spring drilled treated seed?

Current risk assessment

- High failure rate at Tier 1, and after refinement
- Assumes exposure during breeding
- Risk assessment conducted at individual level
- Protection goal: *"No long-term repercussions for abundance and diversity"*
- Can we improve risk assessments?
  - More realistic exposure estimates?
  - Population level effect measures?

Matrix model

- Two types of model developed by Joe Crocker
- 'Broods at risk' model
  - Information on drilling and breeding calendar
  - How many broods experience TERs <safety trigger?
  - Counts individual TERs
- 'Seasonal success' model
  - How many offspring successfully raised per season?
  - → Estimate *Population Growth Rate* (PGR)
  - Compare to control scenario
- Models focus on temporal exposure

Birds

Skylark, omnivorous, Red List, multiple broods

Linnet, granivorous, declining, multiple broods

Yellowhammer, omnivorous, Red List, multiple broods

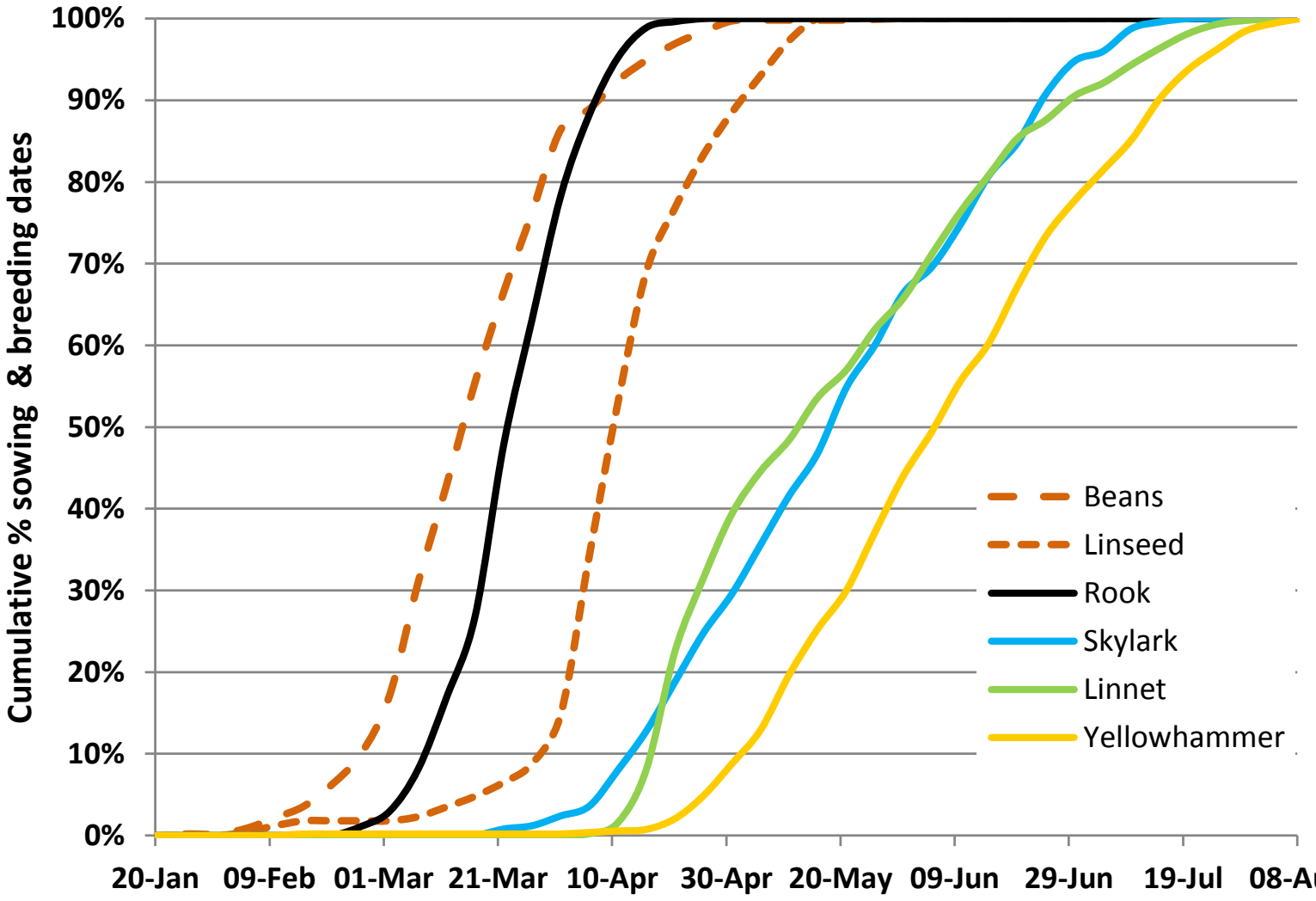
Rook, omnivorous, single broods

…Different life histories

Data

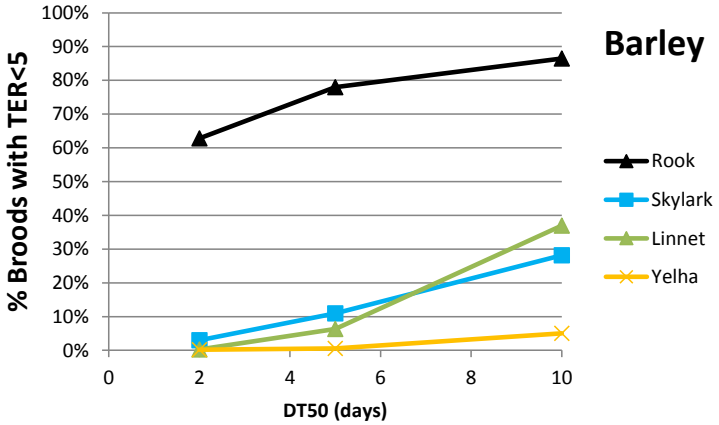
- British Trust for Ornithology (BTO)
  - Nest Records Scheme data, arable land, 2002-2011
  - First egg dates: Skylark, Yellowhammer, Linnet, Rook
  - Which first egg dates belong to first clutches? Developed population of birds → give rise to observed clutches
  - Duration of breeding phases, natural nest failure rates
- FERA Pesticide Usage Survey, ADAS data
  - Dates of spring crop drilling, 2000-2010
  - Wheat, barley, oats, OSR, beans, beets, peas, linseed

Calendars


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

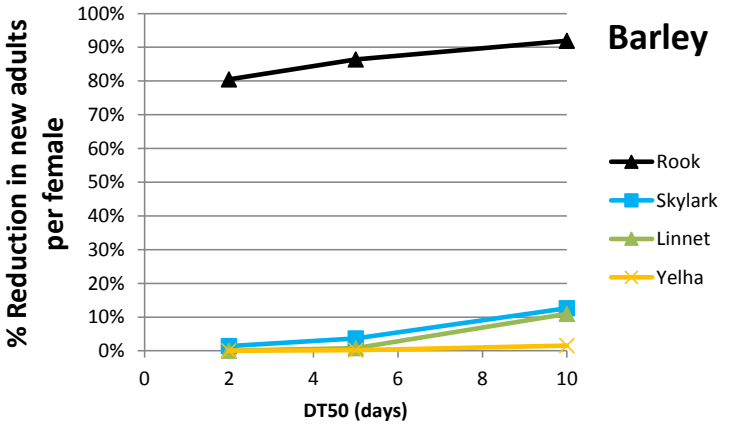
- Population of birds, transition matrix
  - Probability of progressing through each day of breeding, or failing due to natural causes
  - Daily TER calculated: drilling calendar, residue decay
  - Drilling data resampled; results median
  - DT_{50} 2d, 5d, 10d; 3-5d averaging period
  - NOAEL 5 mg/kg bw/d; 20 mg as/kg seed
  - If fail breeding, enter recuperation phase.. if time
  - Effects on different breeding phases captured
  - 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.

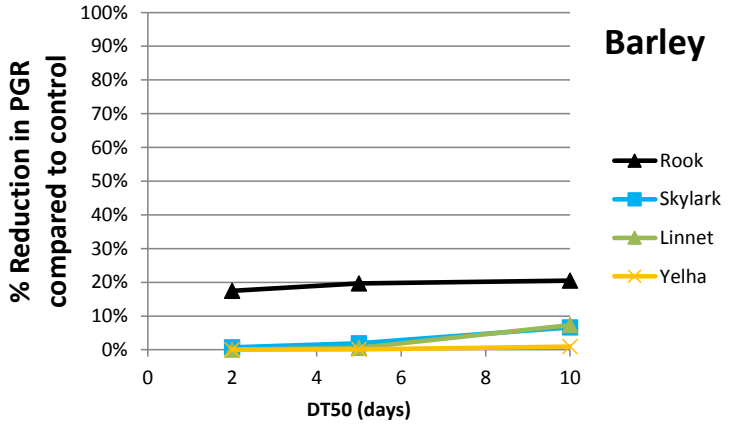
Results assume pesticide affects all phases of breeding *via* adult body weight



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



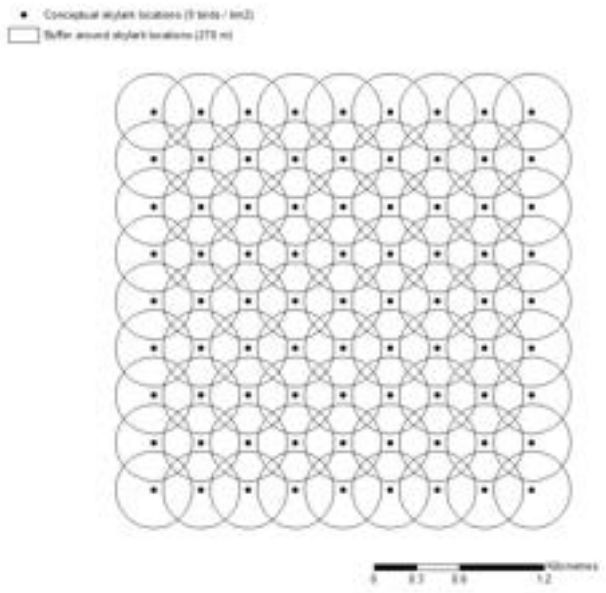
Population Growth Rate model

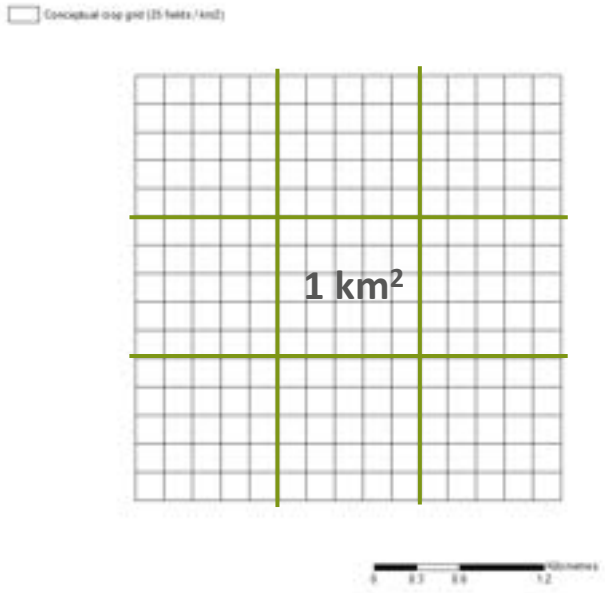
The higher annual survival rates of rook mitigates some of the impact on PGR. **Overall the effects on PGR are less severe than on the individual.**

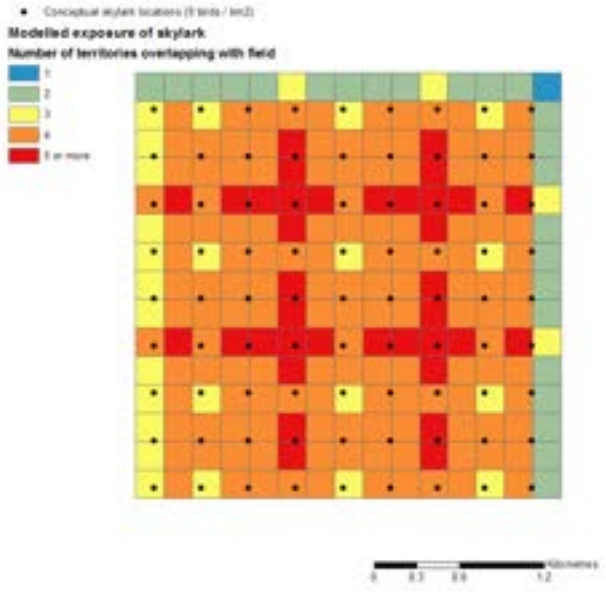
+ Effect of annual survival rate

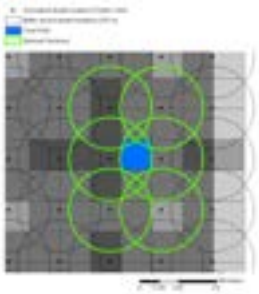
Spatial aspects

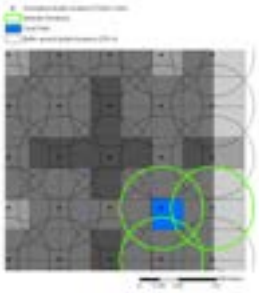
- We assume birds are exposed to the treated seed in the landscape during breeding period
  - What proportion of a population could encounter treated seed?
- Separate investigation to breeding success models











Conceptual approach:

- Forage range of birds, skylark and rook
- Crop area
- Overlap of foraging ranges with treated area
- Varied % treated area
- Informed by real crop density & field size data
- Analyses by Hester Lyons

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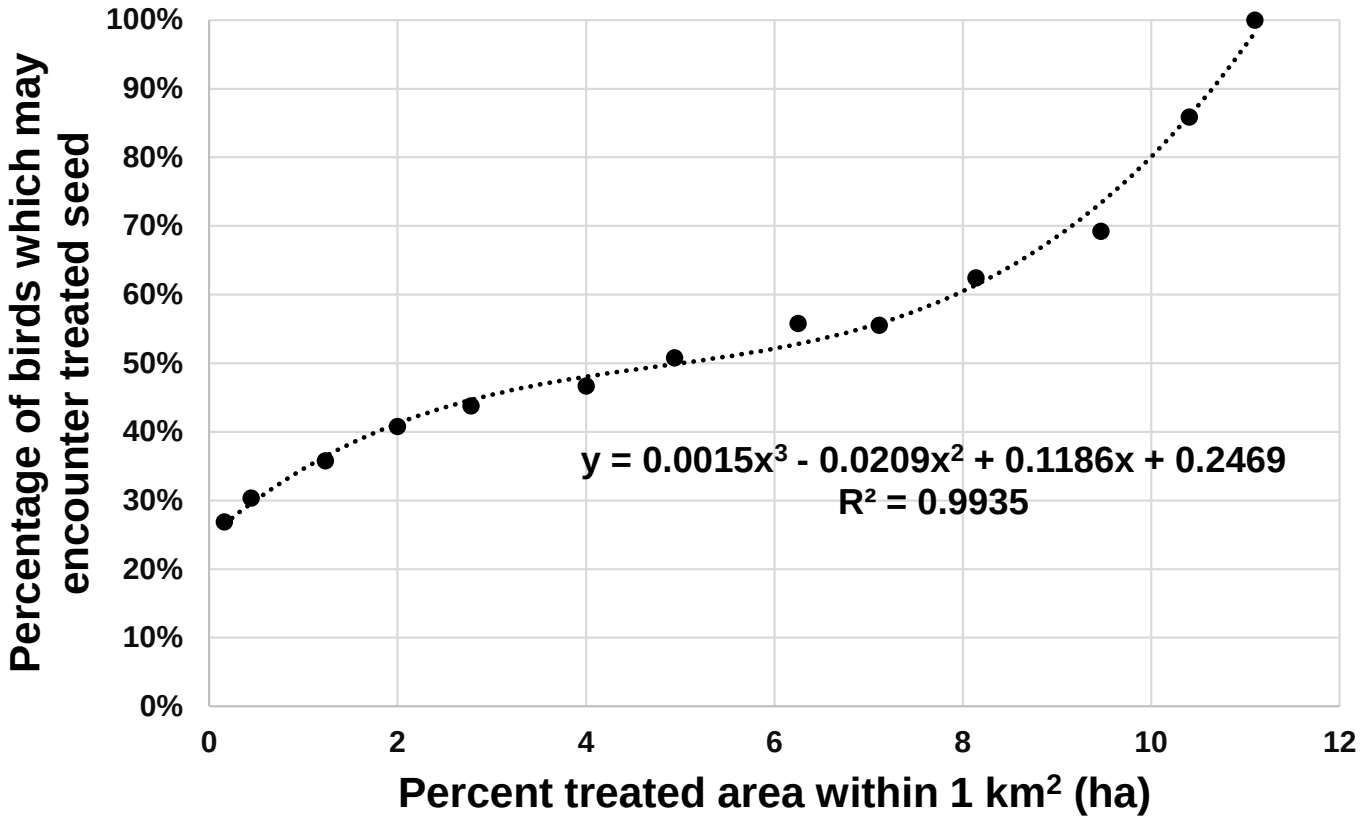
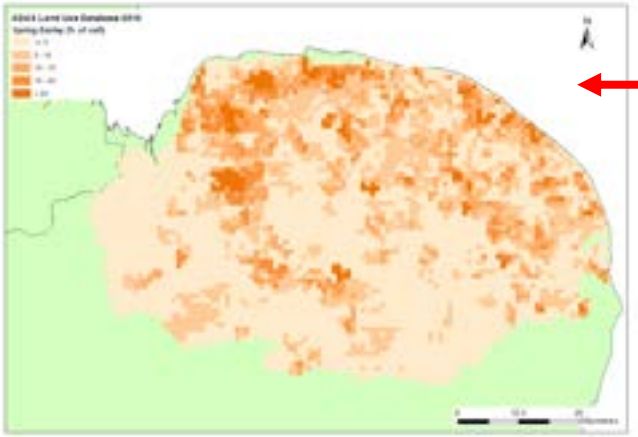
Skylark

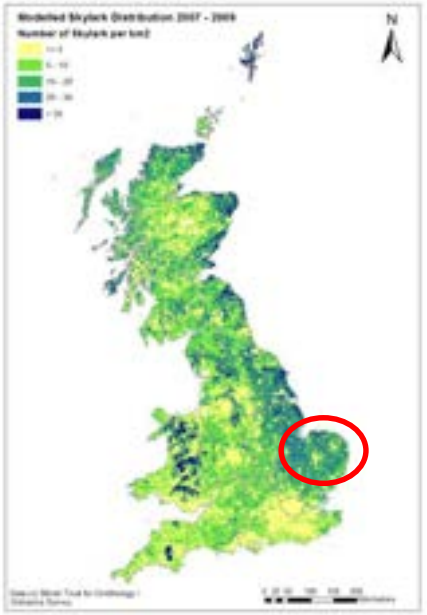


Applied to 1 km² grid cells data for crops and birds

Results, political boundary

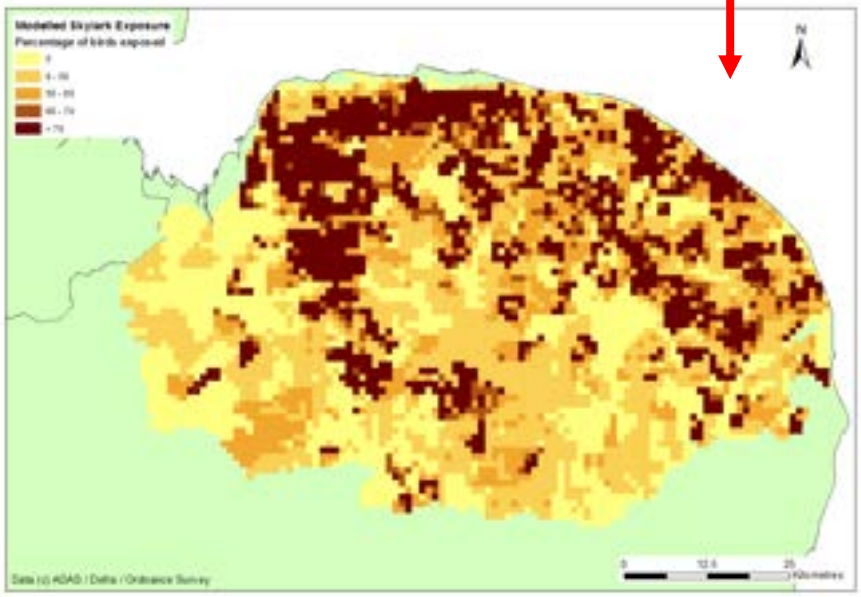


Spring barley in Norfolk 10%

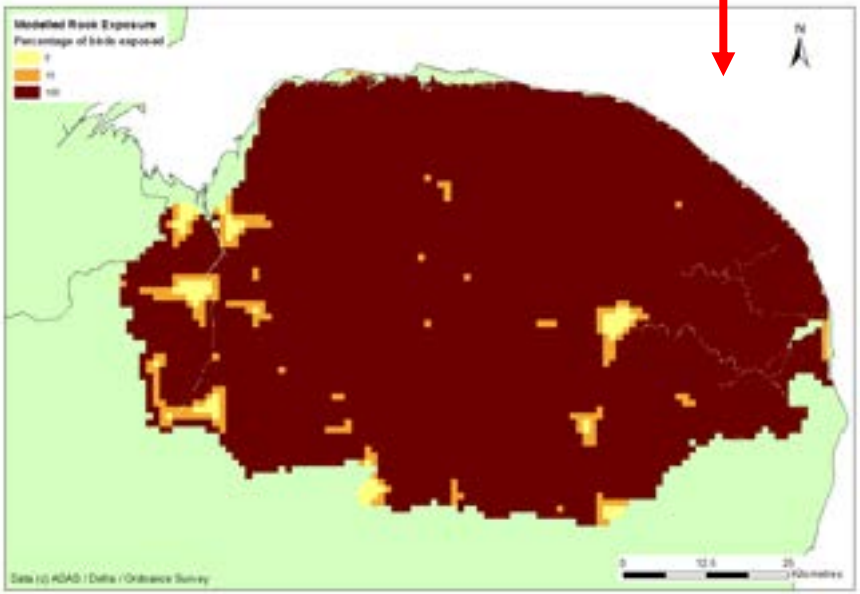


Skylark 1 km^2 distribution data

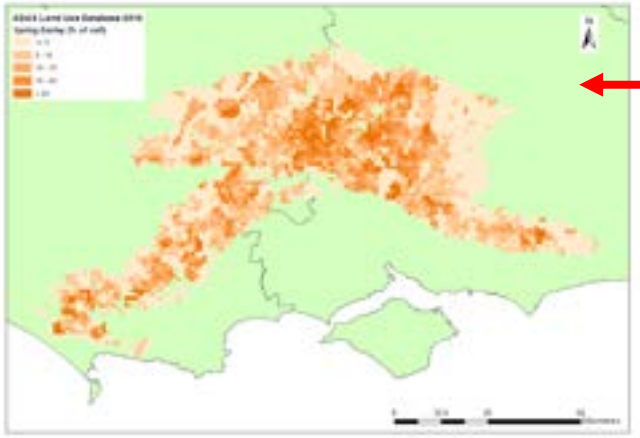
51% of skylark may encounter crop



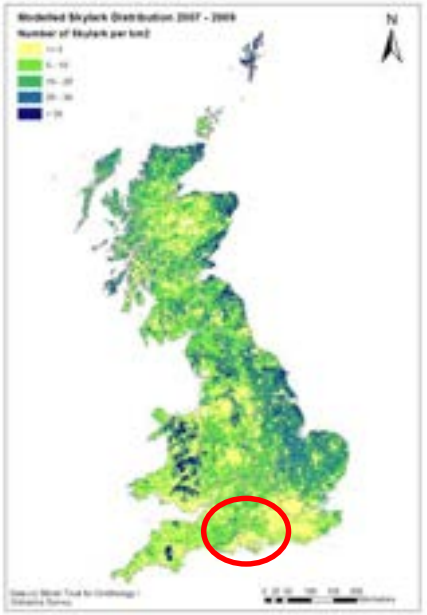
96% of rook may encounter crop



Results, geological boundary

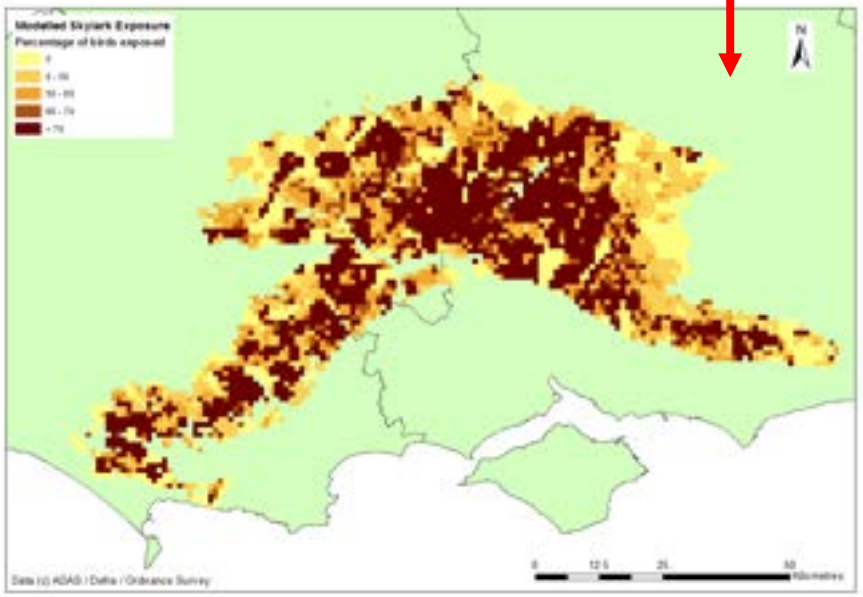


Spring barley in focal area 18%

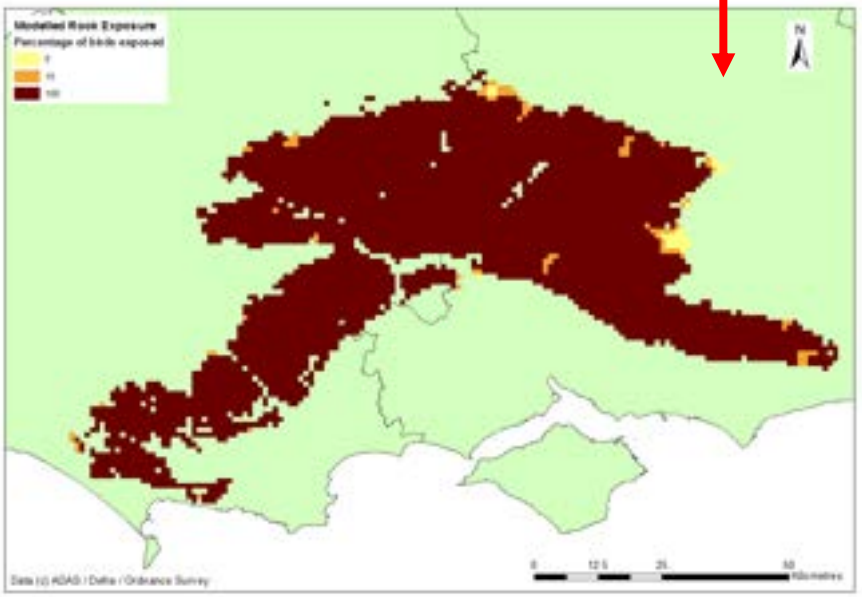


Skylark 1 km^2 distribution data

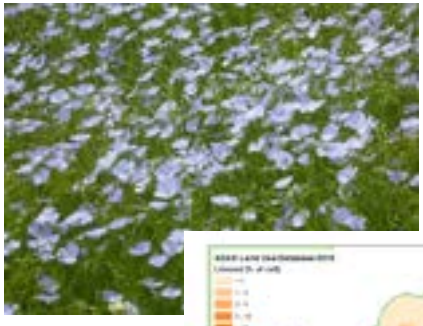
65% of skylark may encounter crop



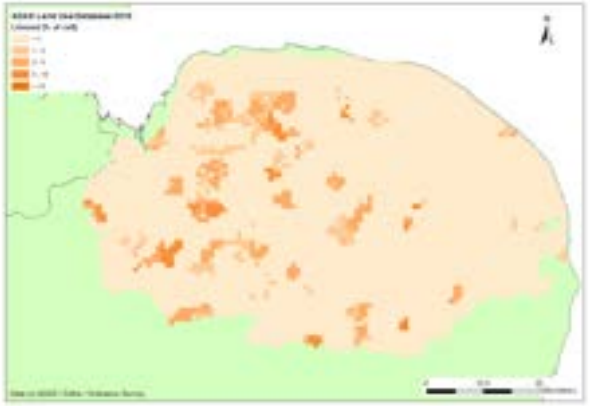
98% of rook may encounter crop

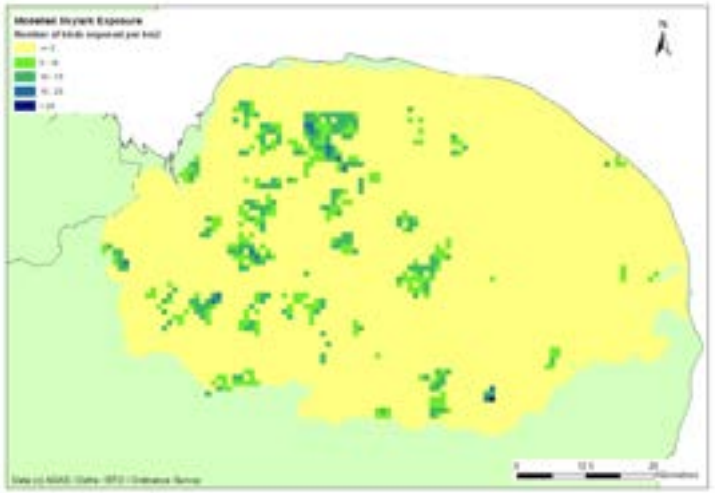


Minor crop



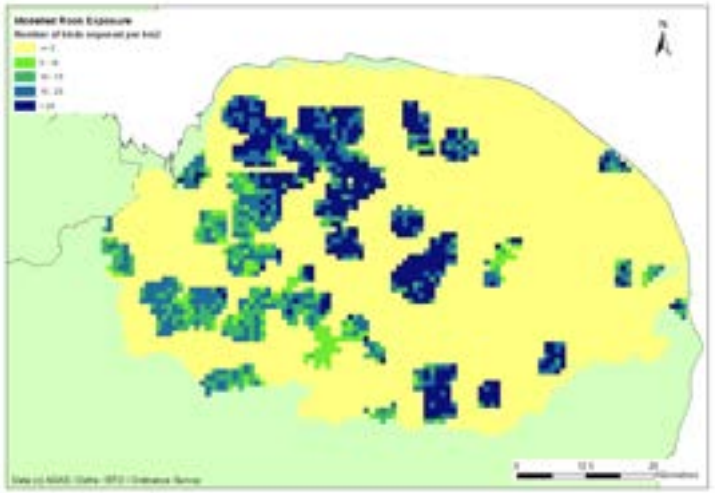
Spring linseed
0.6% land area





5.7% skylark could encounter crop

From one-field risk assessment to landscape scale... Exposure to multiple products on multiple crops? A major challenge for landscape RA



30% rook could encounter crop

So what?

- Breeding success models
  - Life history is important; crop calendar
  - Individual level effects do not always translate to the population level. Sometimes TER_{LT} <5 → PGR 0% effect
- Spatial elements
  - Contrast between species; rook fares worst again?
  - Effect of crop density
  - Challenges of including landscape in risk assessment
- Utility
  - Higher tier option; place RA into context at pop. level?

Conclusions

- Debate on population level effect measures
  - A better comparison to protection goals at higher tiers?
- Balancing act
  - Protect the environment
  - Are theoretical risks real?
  - Spring crops are good for biodiversity!!*
  - Food production
  - Great example is UK RSPB's 'Hope Farm' - biodiversity can increase under profitable conventional farming

*Spring cropping report; DEFRA IFO130

Acknowledgements

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- *No endorsement by HSE/CRD is implied!*

Thanks!

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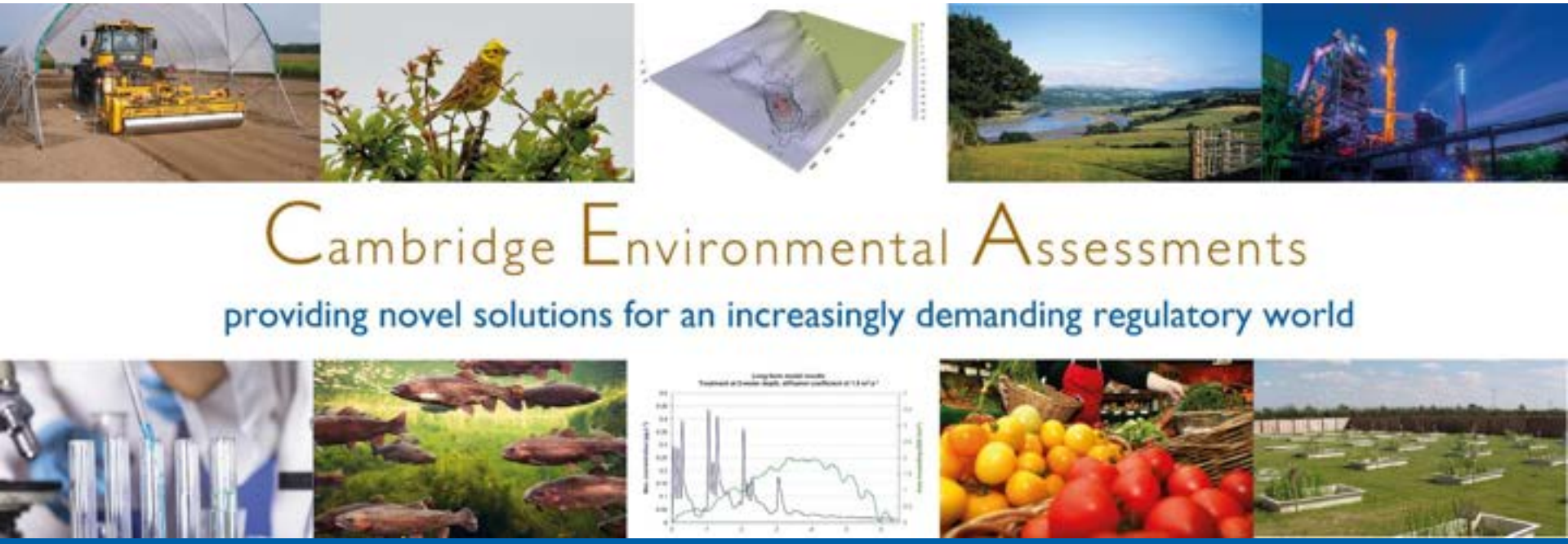
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