Evidence of Indirect Effects of Pesticides on Birds

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Assessing the Indirect Effects of Pesticides on Birds

work funded by:

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Selection of Study Species

	yellowhammer	barn swallow	skylark
Remains abundant -allows collection of sufficient data	✓	✓	✓
Believed to be declining on farmland	✓	✓	✓
Field study on the species ongoing/recently completed	✓	✓	✓
Comparative demographic data from organic farms	✓	✓	
Nests in arable crops			✓
Feeds on taxa known to be affected by pesticides	✓	✓	✓
Known to frequently forage in/over arable crops	✓	✓	✓

Yellowhammer

- **the most complete data to fill the framework for detecting IEPs**
- **strong indications of IEPs**

Do pesticides reduce abundance of invertebrate chick-food?

variable	variable type	all invertebrates in diet	invertebrates important in diet	invertebrates ≥5mm	invertebrate biomass
date	continuous	P = 0.044 +			P = 0.016 +
# fungicides	continuous	P = 0.006 -			
# herbicides	continuous			P = 0.012 ∩	
insecticide timing	factor 3: 1 = no spray in the crop year; 2 = winter only spray; 3 = summer spray	P < 0.001 2>>>1>>>3	P < 0.001 2>1>>>3	P < 0.001 2>1>>>3	P < 0.001 2>1>>>3

Table 5. Effect of pesticides on yellowhammer chick-food. Significance and direction of the relationship for variables retained in the yellowhammer chick-food MAMs. + = positive effect; - = negative effect; ∩ = curvilinear effect (slight initial positive effect with strongly negative tail). Differences between factor levels for insecticide use are ranked of greatest to least abundance. '>' signifies the order of ranking and '>>>' represents significant differences between adjacent ranks at $P < 0.01$.

Do pesticides reduce abundance of invertebrate chick-food?

- **use of insecticides in summer ⇨ consistently low abundance of invertebrate chick-food**
- **caveat: insecticide use and site are largely confounded, making it difficult to decouple effects**
- **less robust evidence for effects of fungicides and herbicides**

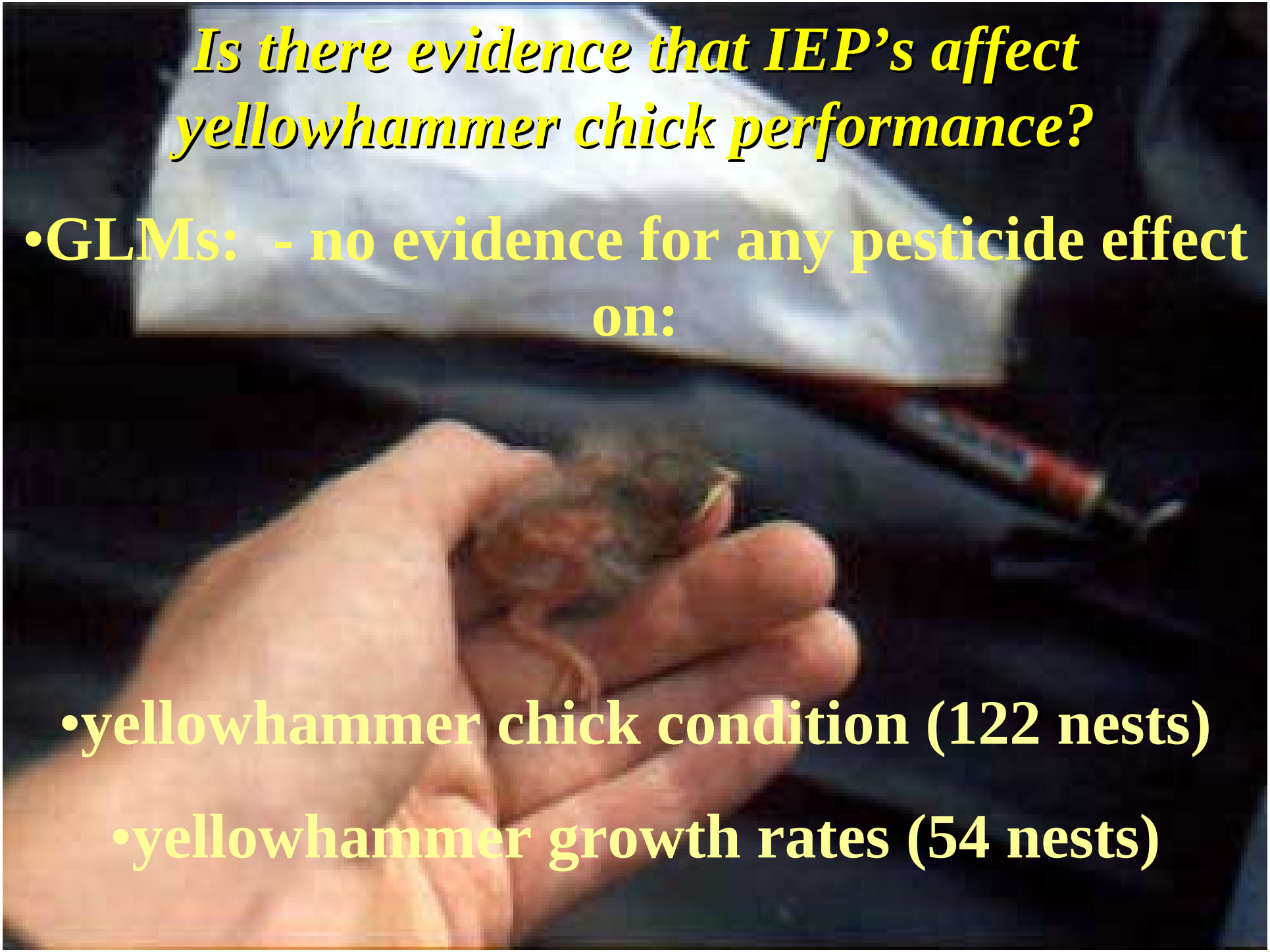
Do IEPs affect Yellowhammer behaviour?

Variable	Significance value 'cereal unavailable' model			Significance value 'cereal available' model		
	Wald	df	p	Wald	df	p
Distance of field from nest	28.61	1	< 0.001	18.46	1	<0.001
	coefficient: -0.02003			coefficient: -0.01070		
Timing of insecticide applications	4.63	1	0.031	0.16	1	0.685
	predicted means: no-summer 0.5495 summer -0.7957			predicted means: no-summer 0.5135 summer 0.3984		

Table 4 Significance and direction of the relationship for variables retained in the MAMs for yellowhammer foraging habitat selection. Values given in tables of effects/ predicted means are on a log scale.

Do IEPs affect Yellowhammer behaviour?

- **when chicks reliant on invert food – fields with summer insecticide foraged in far less than fields with no summer insecticide**
- **no effect of pesticides once grain available as alternative food source**



Is there evidence that IEP's affect yellowhammer chick performance?

- **GLMs: - no evidence for any pesticide effect on:**
  - **yellowhammer chick condition (122 nests)**
  - **yellowhammer growth rates (54 nests)**

Is there evidence that IEP's affect yellowhammer chick survival?

- **GLMs: yellowhammer chick starvation is +ve related to application of herbicide in summer (130 nests; $P = 0.035$)**
- **herbicides likely to act indirectly by reducing invertebrate numbers via the removal of their host plants**
- **GLMMs: non-significant +ve trend**
- **result should be treated with caution, although suggests a +ve trend worthy of further investigation**

Skylark

Is there evidence that IEP's affect skylark chick performance?

- **Sample sizes of biometric data from arable fields too small to draw firm conclusions on effects on chick performance**

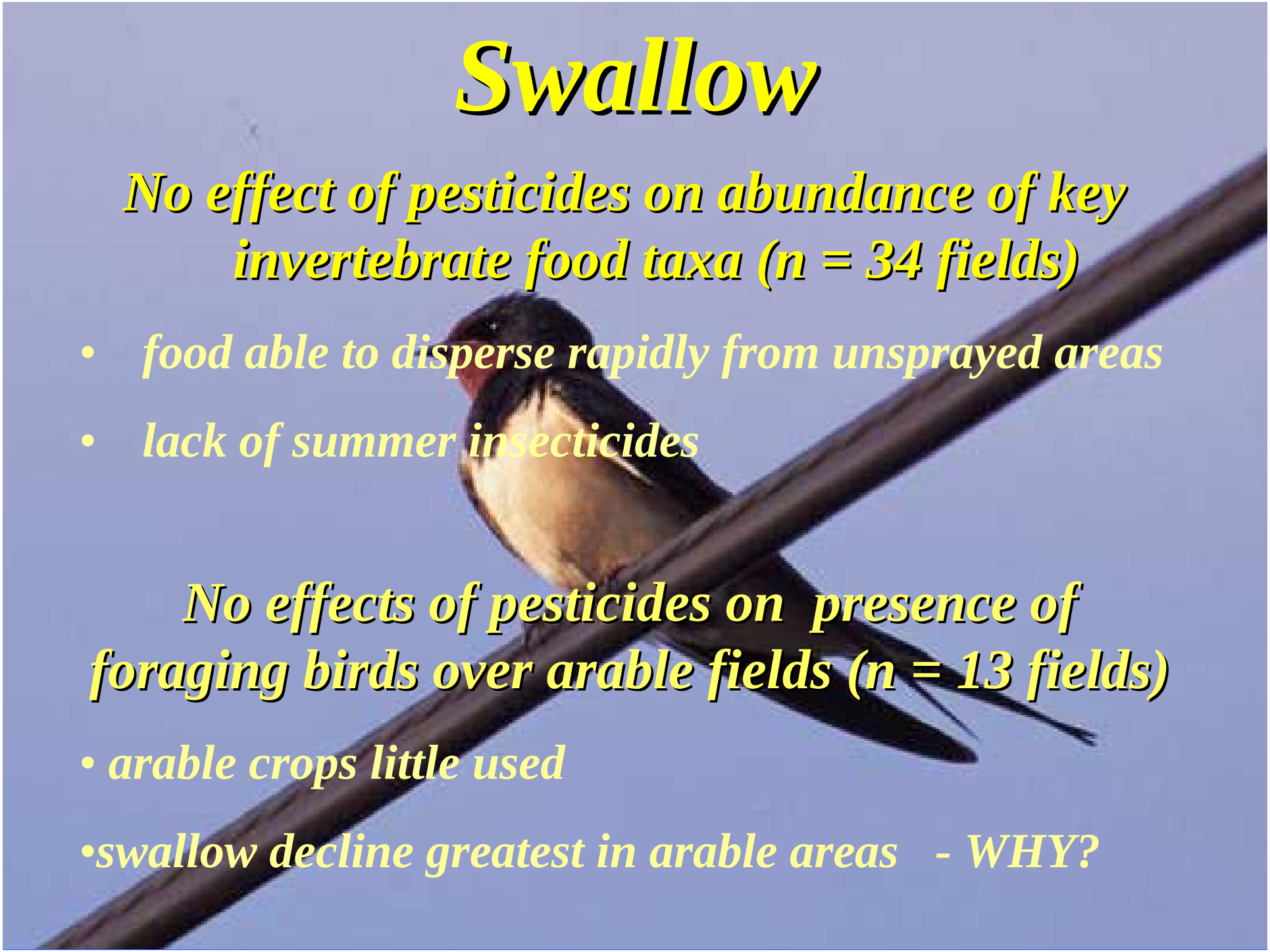
Evidence for IEP's on skylark chick survival

- **GLMs: skylark chick starvation is positively related to summer applications of insecticide in the field where the nest was situated (n=55 fields of which 25 arable crops; $P = 0.025$)**

- **GLMMs: no indication of such a relationship –**

- **result may arise from high mortality on a single summer-sprayed field**

- **treat result with caution: more arable data needed**



Swallow

No effect of pesticides on abundance of key invertebrate food taxa (n = 34 fields)

- *food able to disperse rapidly from unsprayed areas*
- *lack of summer insecticides*

No effects of pesticides on presence of foraging birds over arable fields (n = 13 fields)

- *arable crops little used*
- *swallow decline greatest in arable areas - WHY?*

IEPs: Further Evidence?

1. evidence of effects on further species: notably yellowhammer & to a lesser extent skylark
2. mainly insecticide implicated in impacts on behaviour (& survival?)
3. most of the evidence points to timing of applications being more important than cumulative effects
4. strong & consistent insecticide effects on important yellowhammer chick-food

IEPs: Further Evidence?

1. Caution; can't detect relationships in some species e.g. swallow
2. Caution; some sample sizes small or data auto correlated
3. Caution; IEP only one of many agricultural changes affecting birds

Indirect effects of pesticides on birds

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