

LINKING AGRICULTURE & LAND USE CHANGE TO POLLINATOR POPULATIONS

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Late 2000's: Pollinators in crisis?

2006: CCD: Honeybee crash in USA

2006: evidence of Wild pollinator declines in NW Europe

2007: More evidence of Bumblebee declines globally

2008: even Dr Who is worried...

Fall Dwindle Disease: A preliminary report
December 15, 2006



"Fall-Dwindle Disease":
Investigations into the causes
of sudden and alarming colony
losses experienced by
beekeepers in the fall of 2006.

Preliminary Report:

Parallel Declines in Pollinators and Insect-Pollinated Plants in Britain and the Netherlands

J. C. Biesmeijer,^{1*} S. P. M. Roberts,² M. Reemer,³ R. Ohlemüller,⁴ M. Edwards,⁵ T. Peeters,^{3,6}
A. P. Schaffers,⁷ S. G. Potts,² R. Kleukers,³ C. D. Thomas,⁴ J. Settele,⁸ W. E. Kunin¹

Despite widespread concern about declines in pollinators, patterns of change in insect-pollinated plants have not been well documented.

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1980) in local bee
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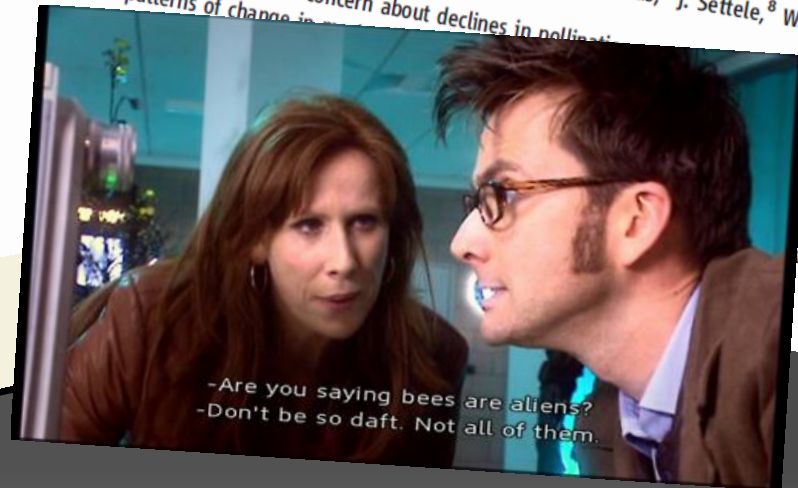
351

Decline and Conservation of Bumble Bees

D. Goulson, G.C. Lye, and B. Darvill

Annu. Rev. Entomol. 2008. 53:191-208

First published online as a Review in Advance on
September 5, 2007



-Are you saying bees are aliens?
-Don't be so daft. Not all of them.

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2009: Research councils + Defra + charities + Government request research proposals to address the issue



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2010: 9 projects funded – including this one: “**AgriLand**”

Linking agriculture and Land use change to pollinator populations



Insect Pollinator Initiative Projects

1. The impact of the mite *Varroa destructor* on the interaction between the honeybee and viruses
2. Modelling systems for managing bee disease: the epidemiology of European foulbrood
3. Impact and mitigation of emergent diseases on major UK insect pollinators
4. Impact of sublethal exposure to pesticides on the learning capacity and performance of bees
5. Can bees meet their nutritional needs in the current UK landscape?
6. Investigating the impact of habitat structure on queen and worker bumblebees in the field
7. Sustainable pollination services for UK crops
8. Urban pollinators: their ecology and conservation
9. Linking agriculture and land use change to pollinator populations

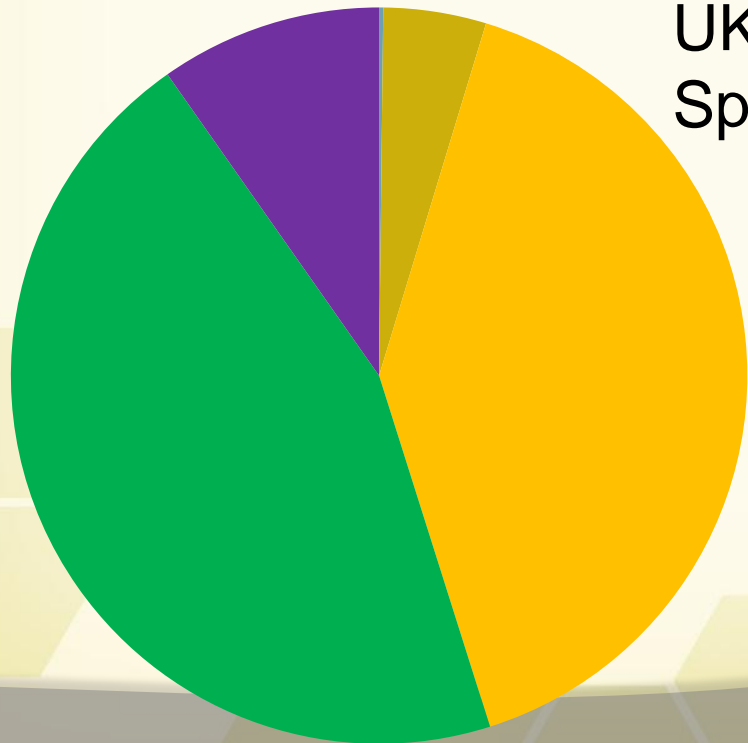
Honey bees	Bumble bees	Other groups
✓		
✓		
✓	✓	
✓	✓	
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✓	✓	✓
✓	✓	✓
✓	✓	✓

Pollinators come in many forms

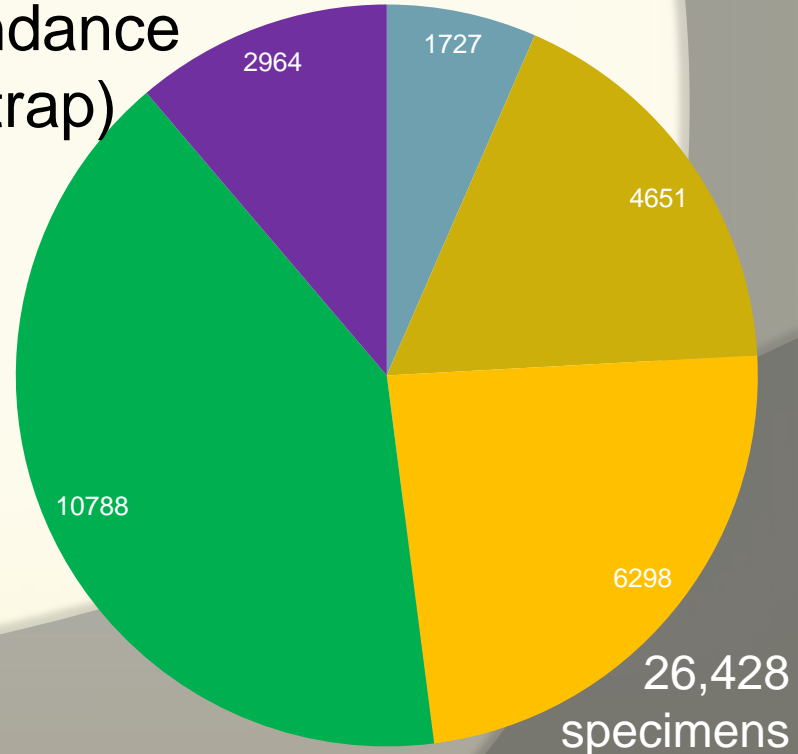


UK
Species

Abundance
(pantrap)



- Honeybees
- Bumblebees
- Solitary bees
- Hoverflies
- Butterflies

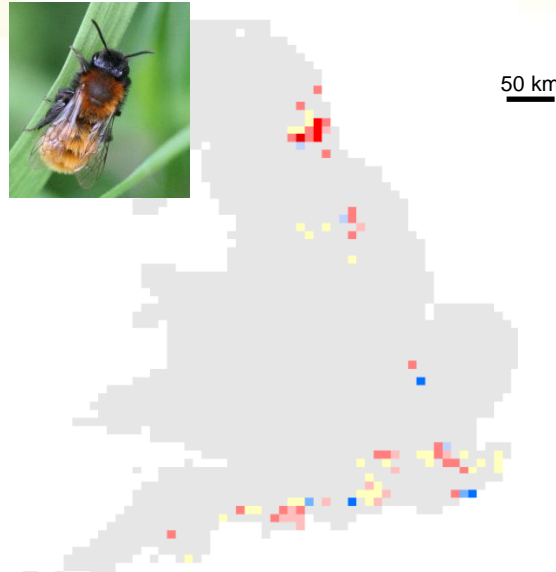


26,428
specimens

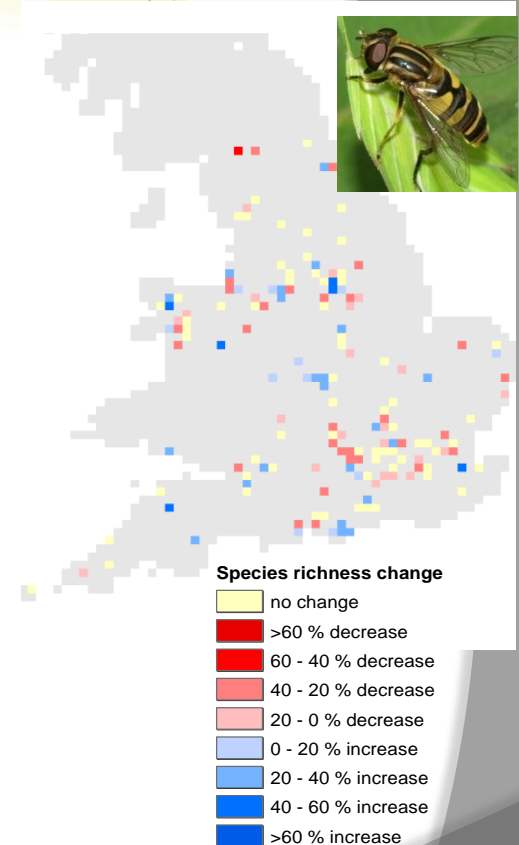
Pollinator declines: different trends

- No standardised pollinator surveys: must use indirect methods...
- Suggest bee diversity has **decreased significantly** in most areas
- Hoverflies less consistent: winners & losers

Britain bees



Britain syrphids

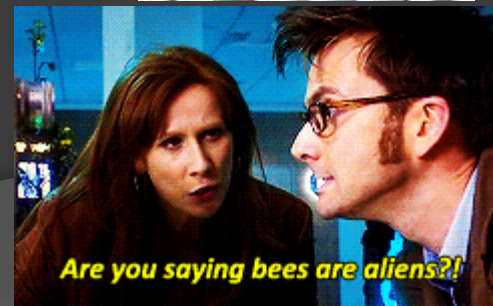
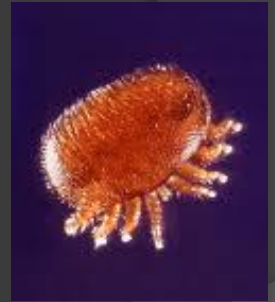


More recent work: different groups have different histories of decline

UK	1940s-1960s	1960s-1980s	1980s-2000s
Bumblebees	Decline	Decline	Decline
Other bees	Decline	Stable +	Increase
Hoverflies	?	Stable +	Stable
Butterflies	?	Decline	Decline

What is causing wild pollinator declines?

- Loss & simplification of habitats?
- Loss of floral resources?
- Increased pesticide use?
- Competition with honeybees?
- Novel diseases and parasites?
- Mobile phones??
- The end of days???
- Recall to home planet???



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A matter of SCALE...

- Easy to demonstrate (for example) that individual bees fed pesticides in the lab are affected...
- But that doesn't prove that populations of bees in landscapes with some sprayed fields are in jeopardy
- ...or that if bees decline, it is pesticides that are to blame.
- Bees forage over multiple km² – need landscape-scale multi-factor tests



Source: <http://ucsdnews.ucsd.edu/pressrelease/>

Landscape-scale experiments?

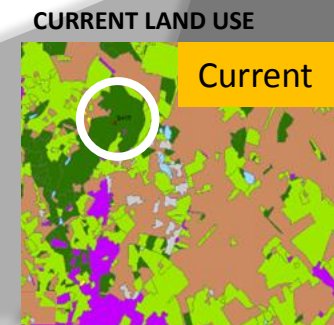
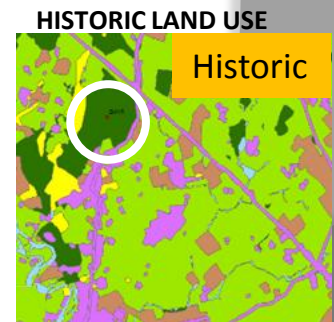
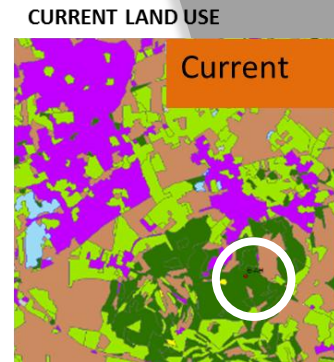
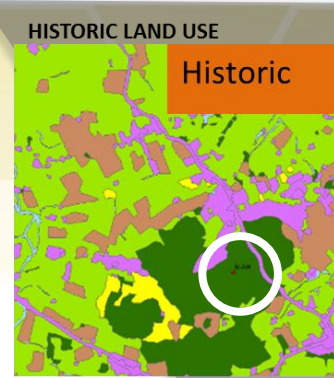
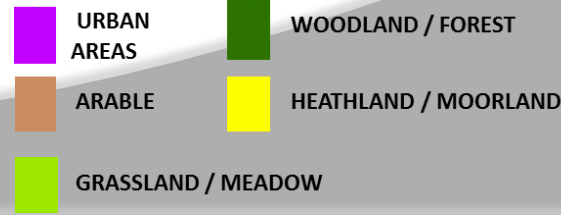
- ⦿ Impossible to run properly controlled multi-factor experiments at landscape scales
- ⦿ Instead, must rely on “accidental experiments”
 - look for examples of similar landscapes that have been managed differently:
 - Do past **CHANGES** in land use predict changes in pollinator communities (over time)?
 - Does **CURRENT** land use predict current pollinator communities (across space)?

Our main goals:

- Test how past changes in land use have affected pollinators;
- Select current landscapes differing in some of the main potential drivers;
- Test how honeybees, wild bees and flowers perform in these landscapes;
- Look for novel ways to mitigate the effects of adverse land management on pollinators and pollination.

Testing for pollinator change by re-surveying landscapes

- Re-surveying pollinators in sites that were well studied in the early 20th century
- Provide direct evidence of shifts in pollinator diversity and species composition
- Contrasting landscapes: Are shifts tied to historical changes in land use:
 - IN the sites
 - AROUND the sites



Measuring floral resources at landscape scale



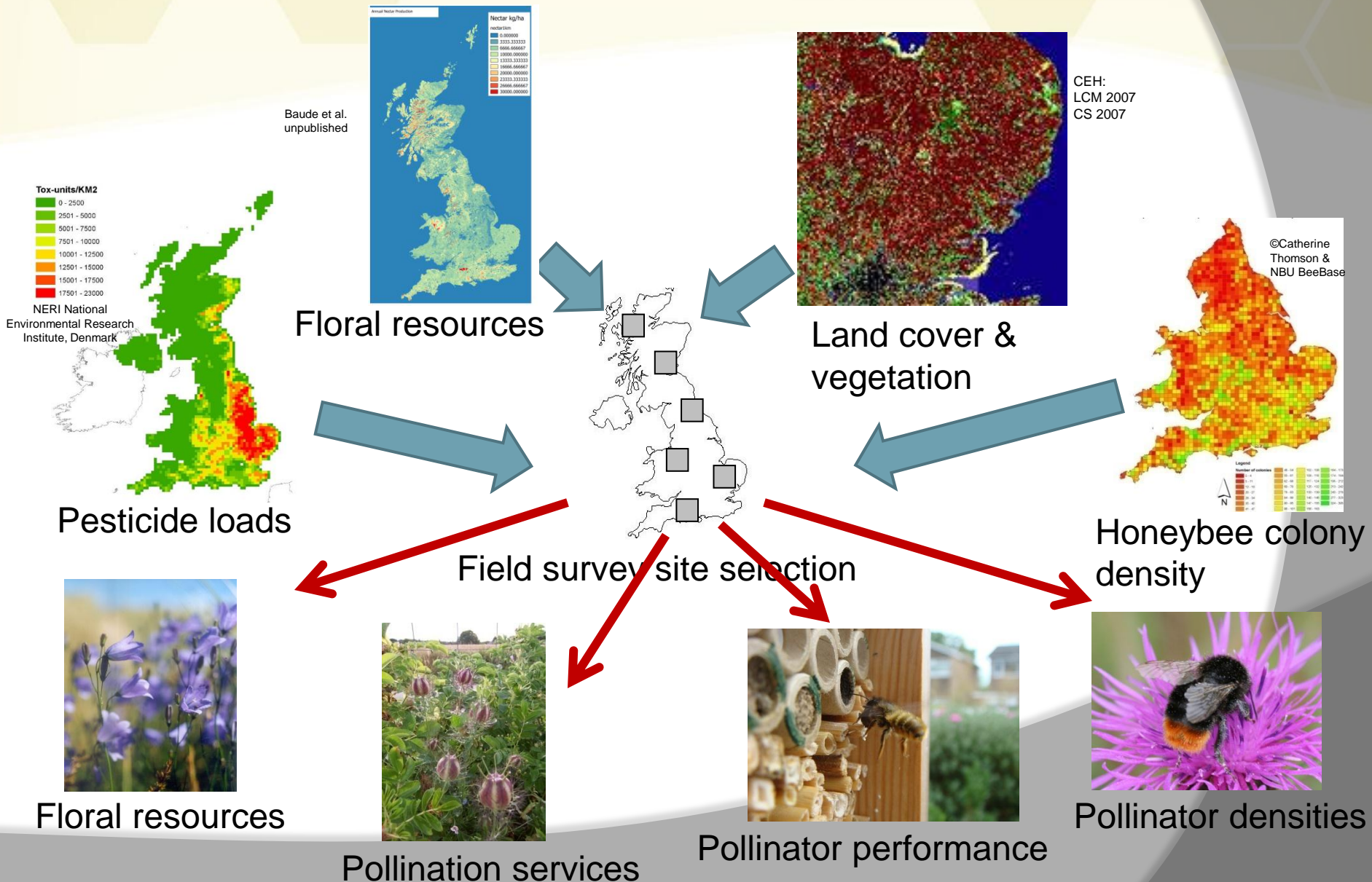
- (Relatively) easy to survey wildflowers...
- But how to sum them up? Like adding apples & oranges -- need a common currency!
- Establishing a British floral resource database
(in cooperation with IPI Bee nutrition, Newcastle):
 - nectar (sugar) & pollen (protein) per flower, per inflorescence, per unit area...



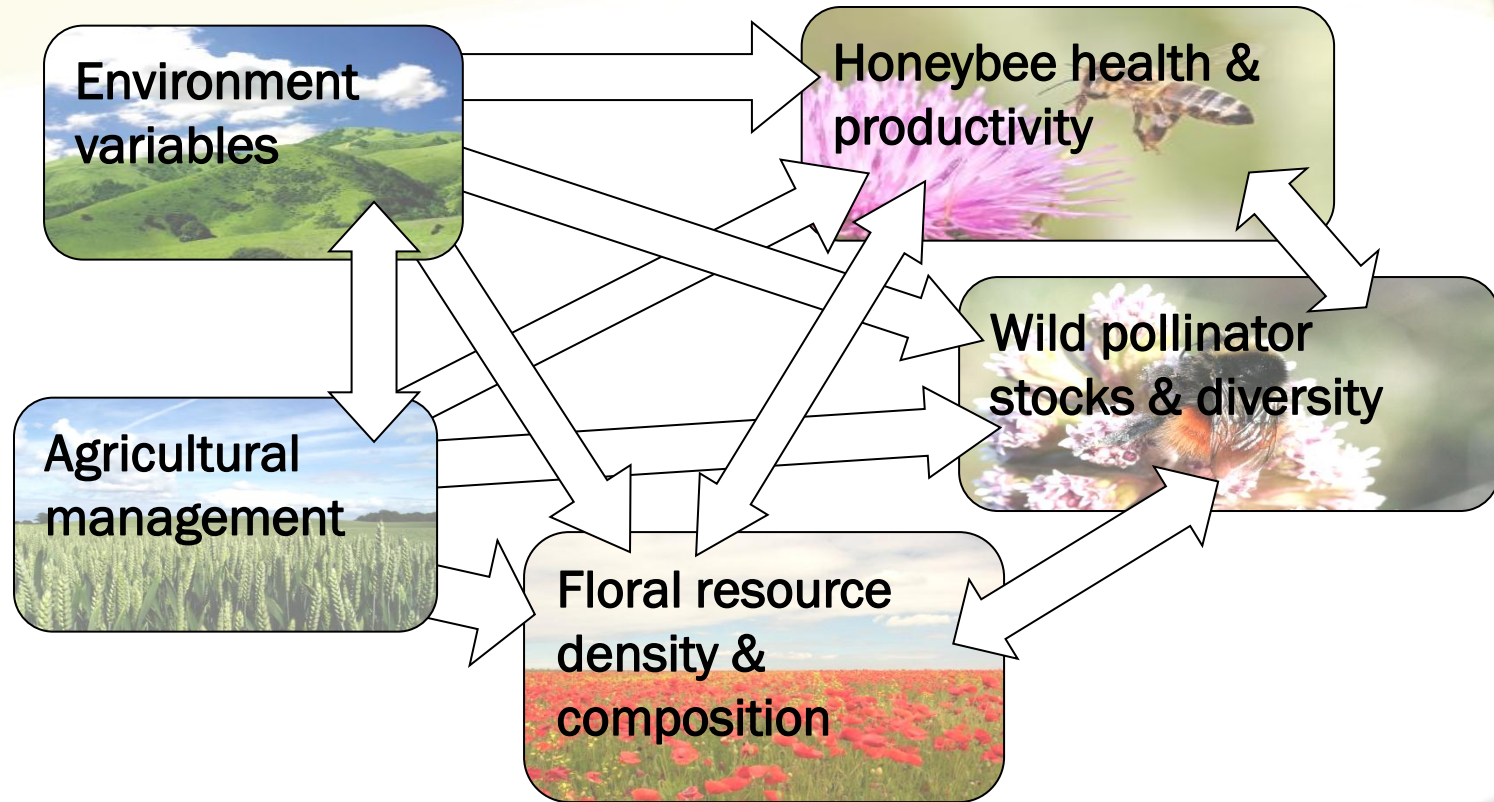
Source:

http://www.deviantart.com/photography/humour/?q=apples+and+oranges#/art/Apples-aint-Oranges-60760597?_sid=75a2aa1c

Untangling the causes: current landscapes



Untangling the causes



- Modern statistical approaches to disentangle the different causal pathways

Outline of talks:

- ⦿ **Impact of historic land-use change on shifts in pollinator communities** (Dr. Deepa Senapathi, Univ. Reading)
- ⦿ **Quantifying nectar resources from floral to national scale** (Prof. Jane Memmott, Univ. Bristol)
- ⦿ **Current land use and pollinator populations:**
 - **1. Site selection and ground-truthing** (Dr. Simon Smart, CEH Lancaster)
 - **2. Field assessments and their impact** (Dr. Mark Gillespie, Univ. Leeds)
 - **3. Experimental honeybee hives and Agri-environment schemes** (Dr. Nigel Boatman, Fera)

Thanks for your attention (&
support!)



Additional photo credits:

Alan Kelly (bees)

Robsplants.com (syrphid)

Doreen Gabriel (poppy field)

Louise_in_Northumberland (Osmia)

Webshots (Nigella fruits)