AgriLand: site selection and ground-truthing "the 4 axes"

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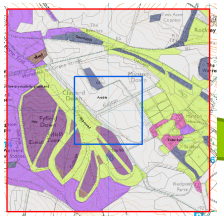
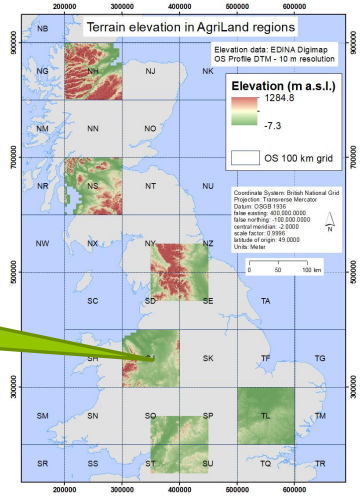
AgriLand part B: Assessing links between current land use and pollinator density/diversity

- **Site selection:** choosing a set of representative but contrasting sites to test landscape-scale effects on pollinators
- **Ground-truthing:** field assessment to see how well site properties can be predicted from national datasets.

Site selection: focus is on "**natural experiments**"

- Select 6 100km square "regions" that are representative of Britain



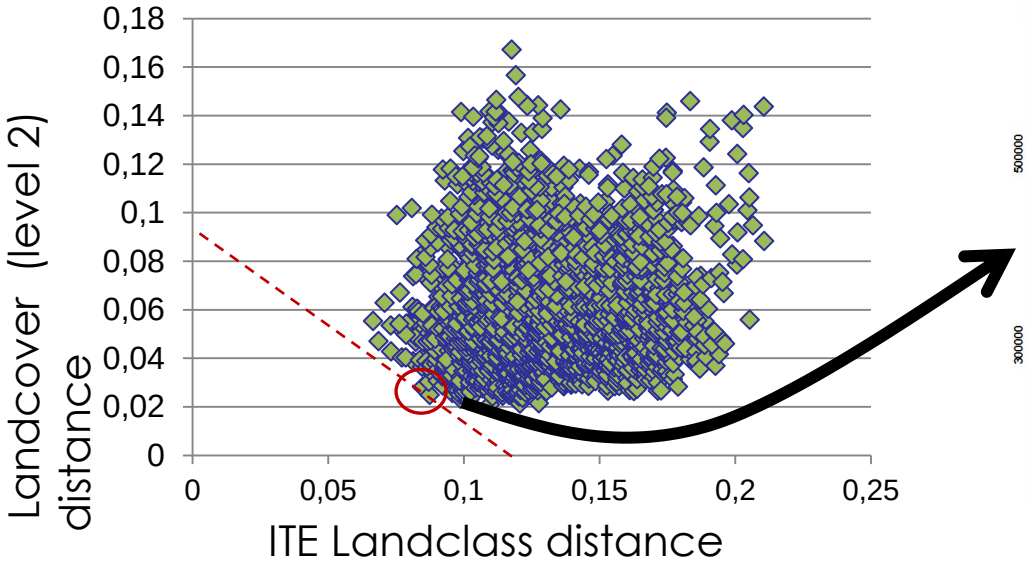


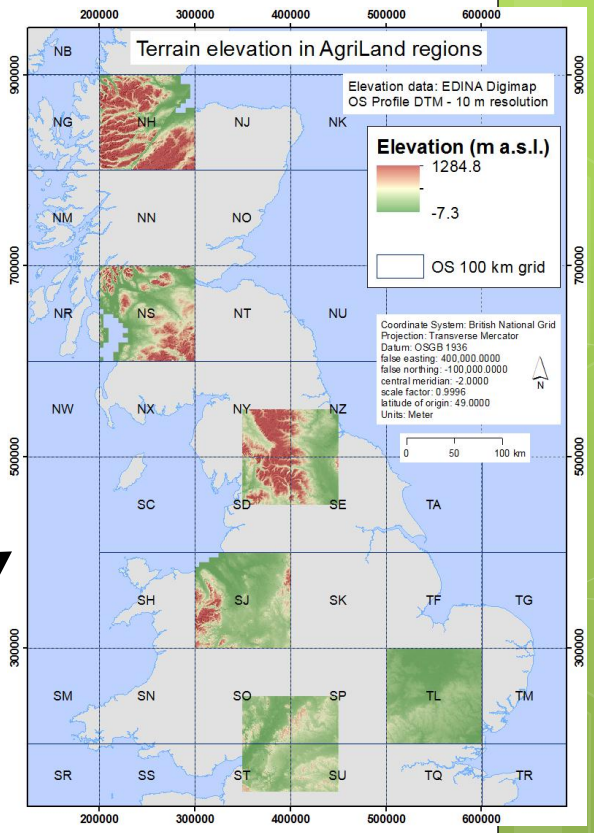
- Within each region select crossed combinations of potentially important "drivers" of wild pollinator decline:
  - **Habitat complexity**
  - **Floral resources**
  - **Pesticide (and other agrichemical) usage**
  - **Domestic honeybees**

- Levels of each driver reflect reality rather than being applied by researchers at start of study

Selecting a representative set of focal regions

- Six regions to best represent Britain
- Used ITE Landclass & Landcover Map 2007 to calculate British means
- Selected set of regions that was the closest fit





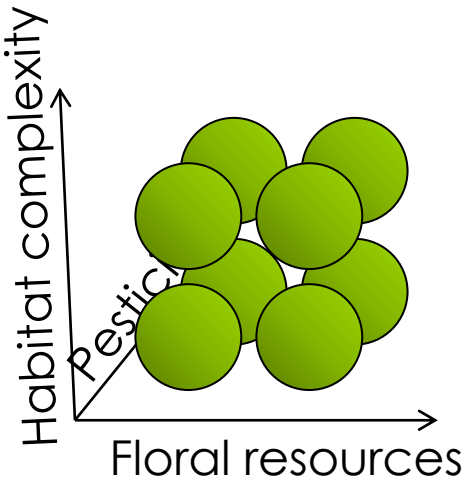
Selecting contrasting landscapes

Within each 100km square region: select 2x2km landscapes contrasting in 4 key variables:

- **Habitat complexity**
- **Floral resources**
- **Pesticide use**
- **Honeybee colony density**

High/Low values for each (relative to regional means) in all combinations:

2 x 2 x 2 x 2 = 16 landscapes



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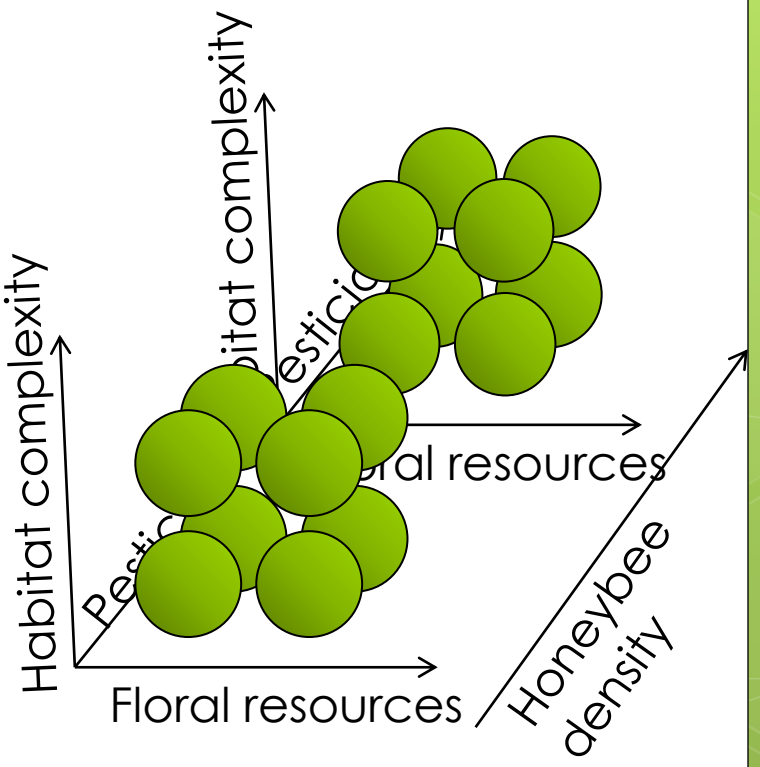
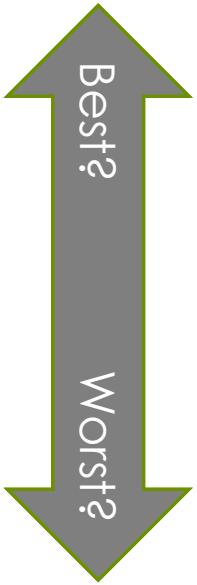


16 x 6 regions = 96 landscapes in total!

The 4 axes used in site selection

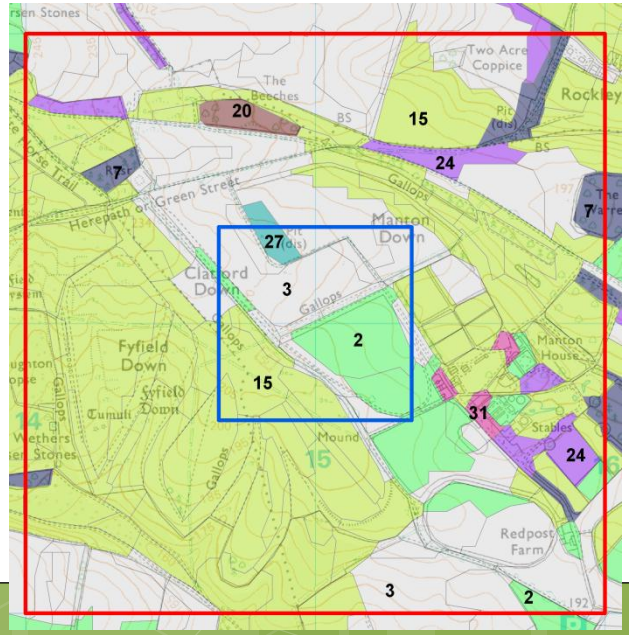
- Habitat diversity
- Honeybee forager density
- Pesticide load
- Floral resources

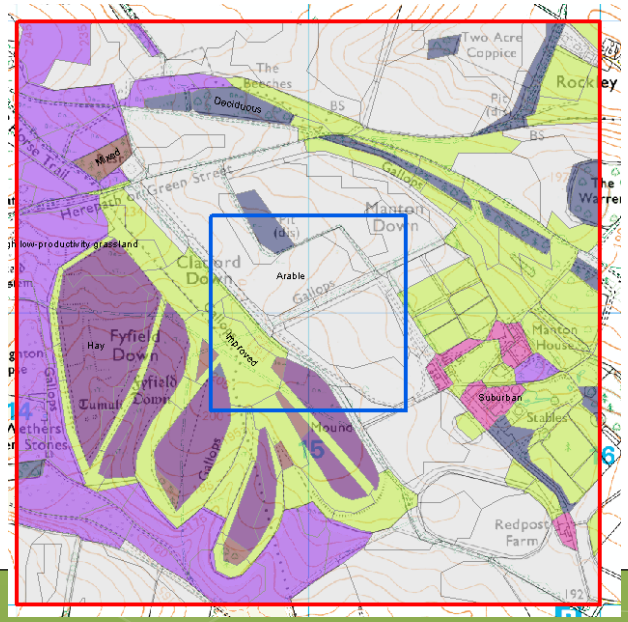


Ground-truthing: can we predict these factors across British landscapes?

1. Habitat diversity

- Based on LCM2007: Shannon index of habitat fractions
- However: observed habitats in some landscapes did not correspond closely to those on map





1. Habitat diversity

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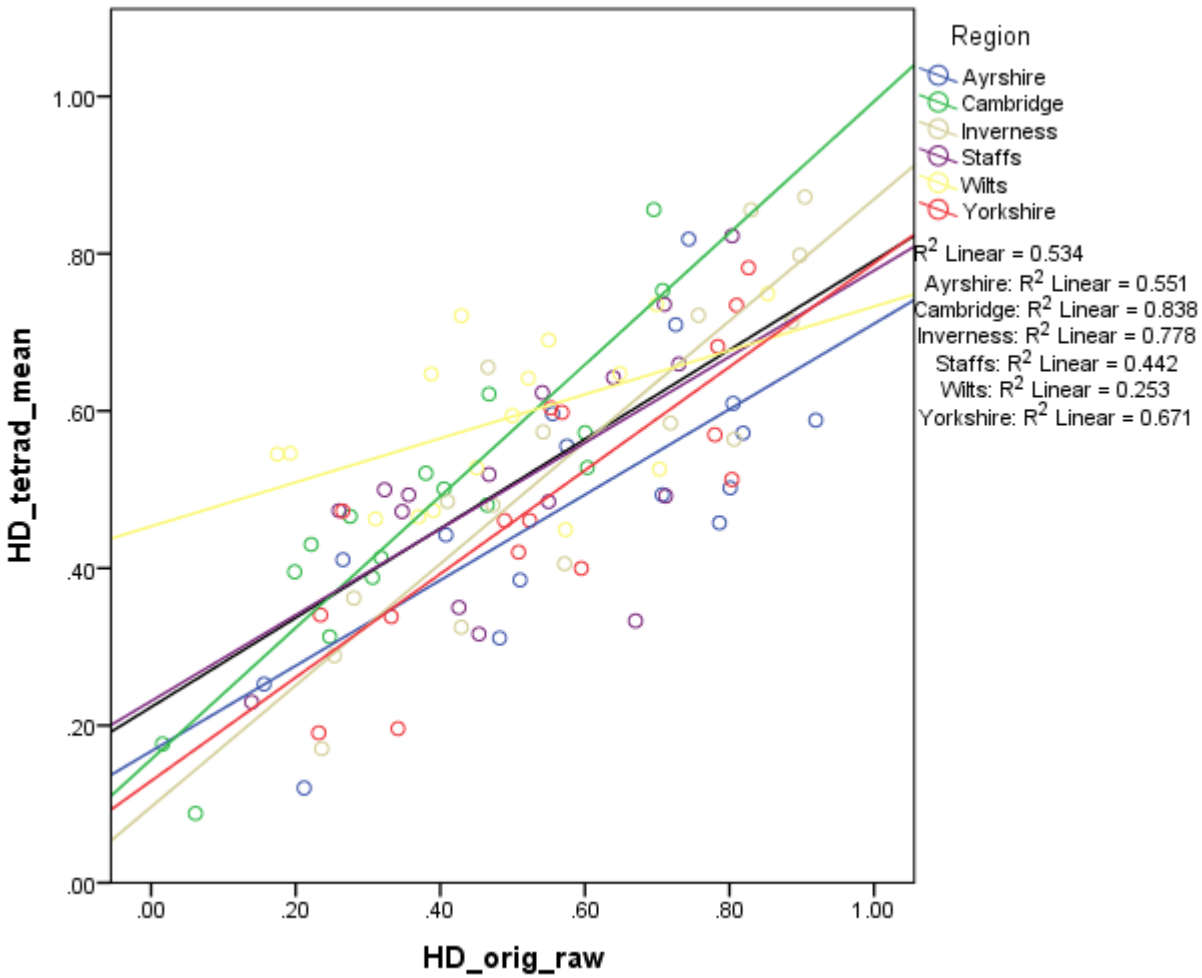
- However: observed habitats in some landscapes did not correspond closely to those on map
- Field tested by mapping broad habitats of focal landscapes: including linear features
- Arable divided into "Mass flowering" vs other crops, due to resource diffs

1. Habitat diversity

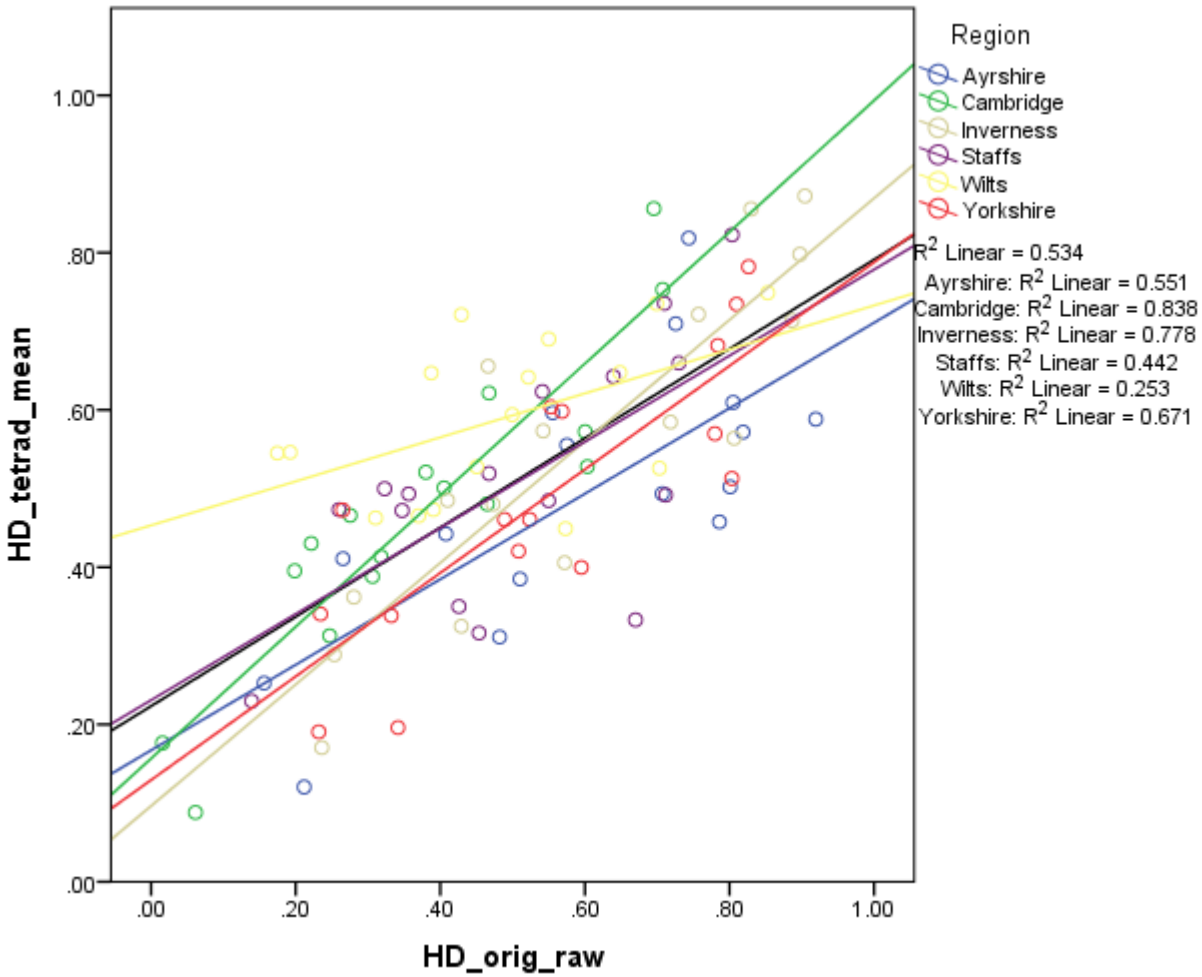
- Overall R^2 = 0.534
- Consistent + correlation overall, and within each region
- Now includes MFC & linear features…



1. Habitat diversity

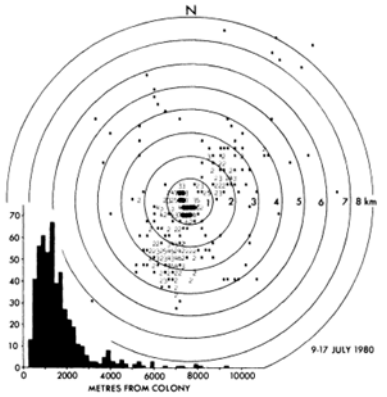
Verdict:

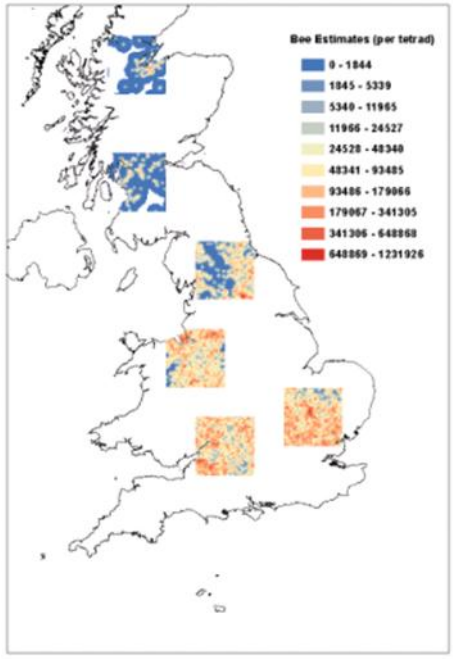
- Original assessment pretty good
- Ground-truthed data more accurate and nuanced (e.g. linears, MFCs)
- Therefore use ground-truthed



2. Honeybees

- Based on known apiary sites (from NBU's BeeBase)
- Approx number of hives per apiary based on industry norms
- Foraging kernal based on distribution of waggle-dance wiggles – indicates distance
- Summed foraging kernals to estimate forager densities





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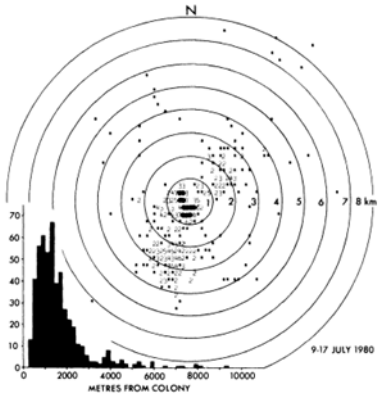
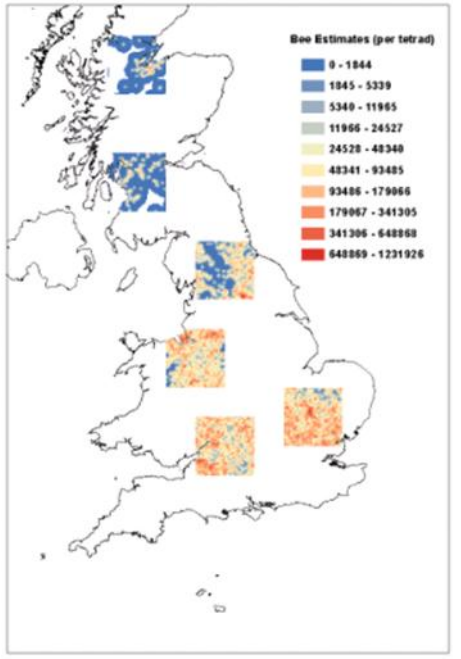
- **<u>Field tested</u> by examining HBs in pantraps & transect "walk-backs"** (but: poor catch rate)
- **2013: introduced HB baits** (but: messy)

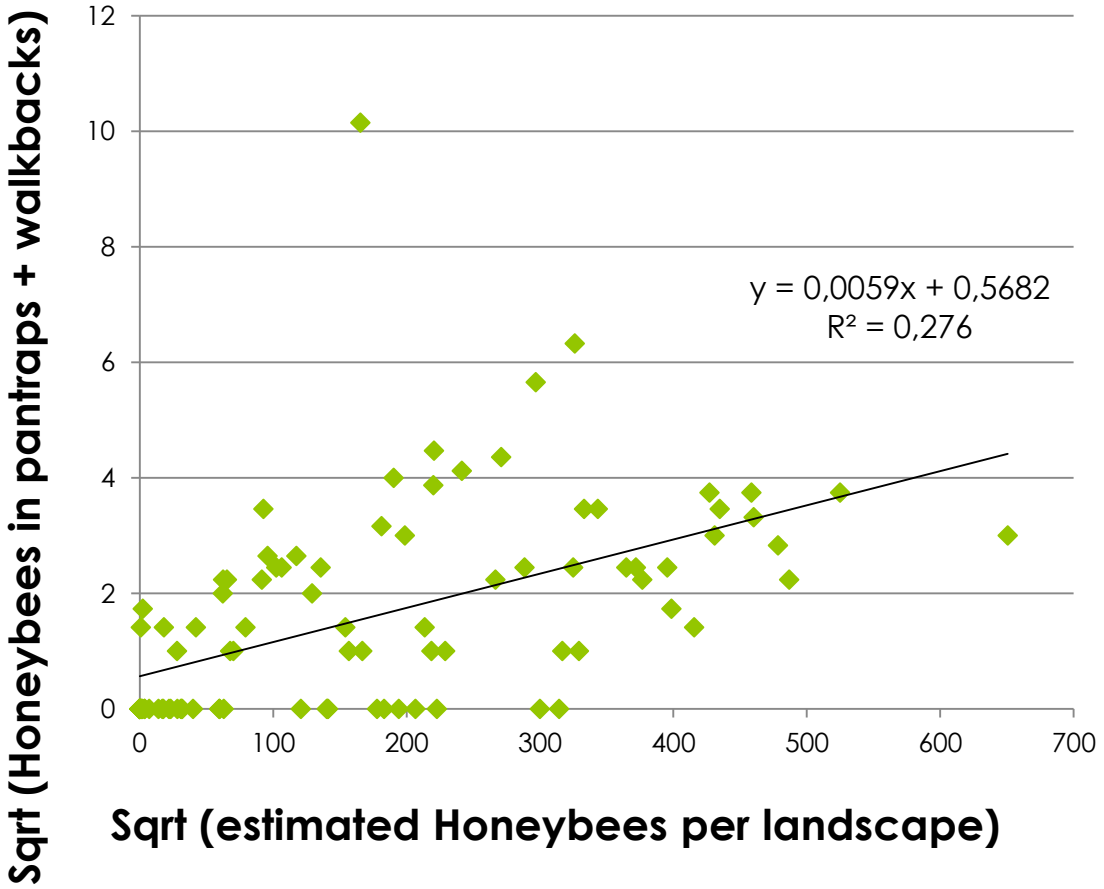




2. Honeybees

Here: pan-traps + transects for both years surveys – bait station data add noise

Reasonably strong relationship – but note: still quite a few "0"s



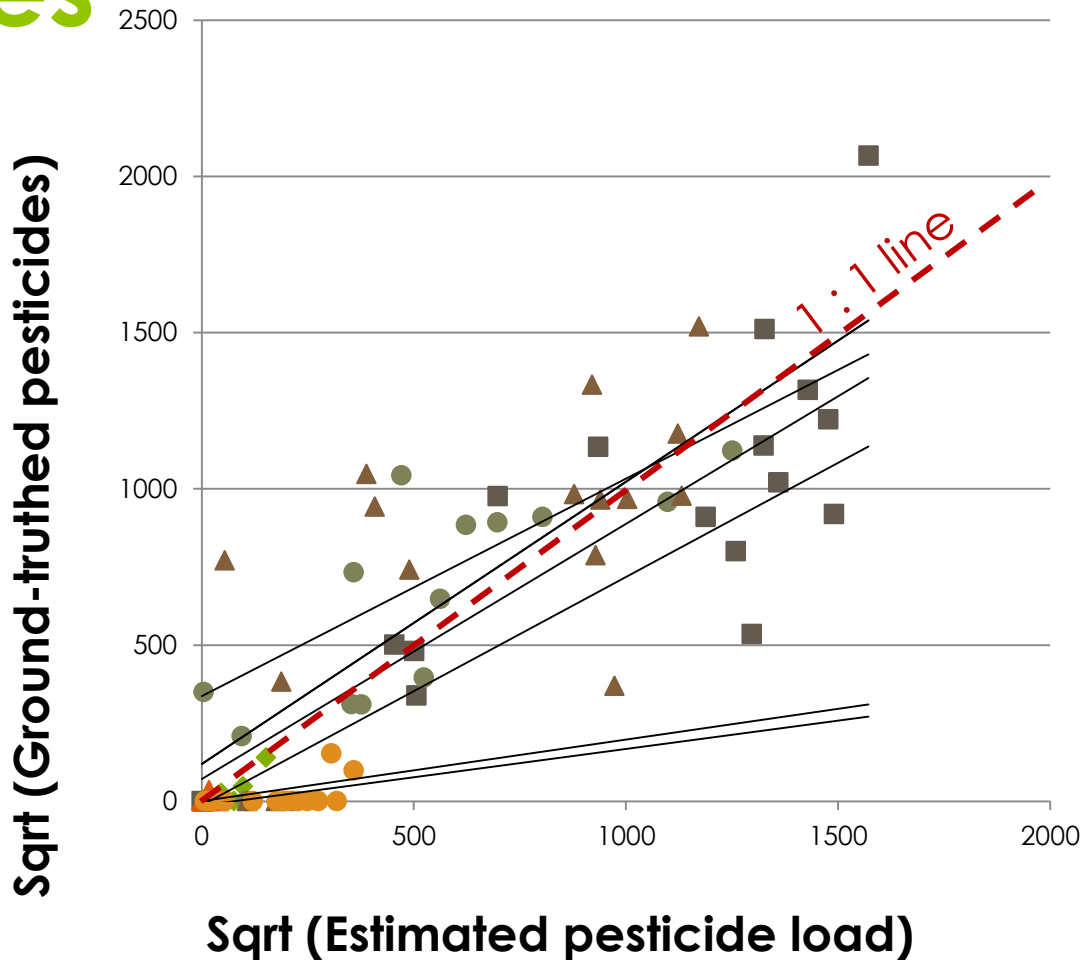
Verdict: confirms original model. Indeed, field data so "noisy" that original estimate is probably better than measured value!

3. Pesticides

- Estimated using [distribution of crops (from Agricultural Census) – areas in organic] x recommended pesticide uses
- Field tested by surveying focal landscape farmers concerning agri-chemical usage
- But note: only about half of land-owners provided the needed data – representing about <50% of our focal land

3. Pesticides

- Good fit between predicted and observed
- However: some northern regions had virtually NO pesticide usage!



Verdict: models were impressively accurate.
But pesticides may be of little relevance in North.

4. Floral resources

Original estimates very indirect:

- Mix of habitats (LCM 2007)
- Regional plant abundances in those habitats (Countryside Survey 2007)
- Floral resources per unit cover (values for some spp from lit; modelled for all)
- Additional resources from agri-envt schemes

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- Mix of habitats (LCM 2007)
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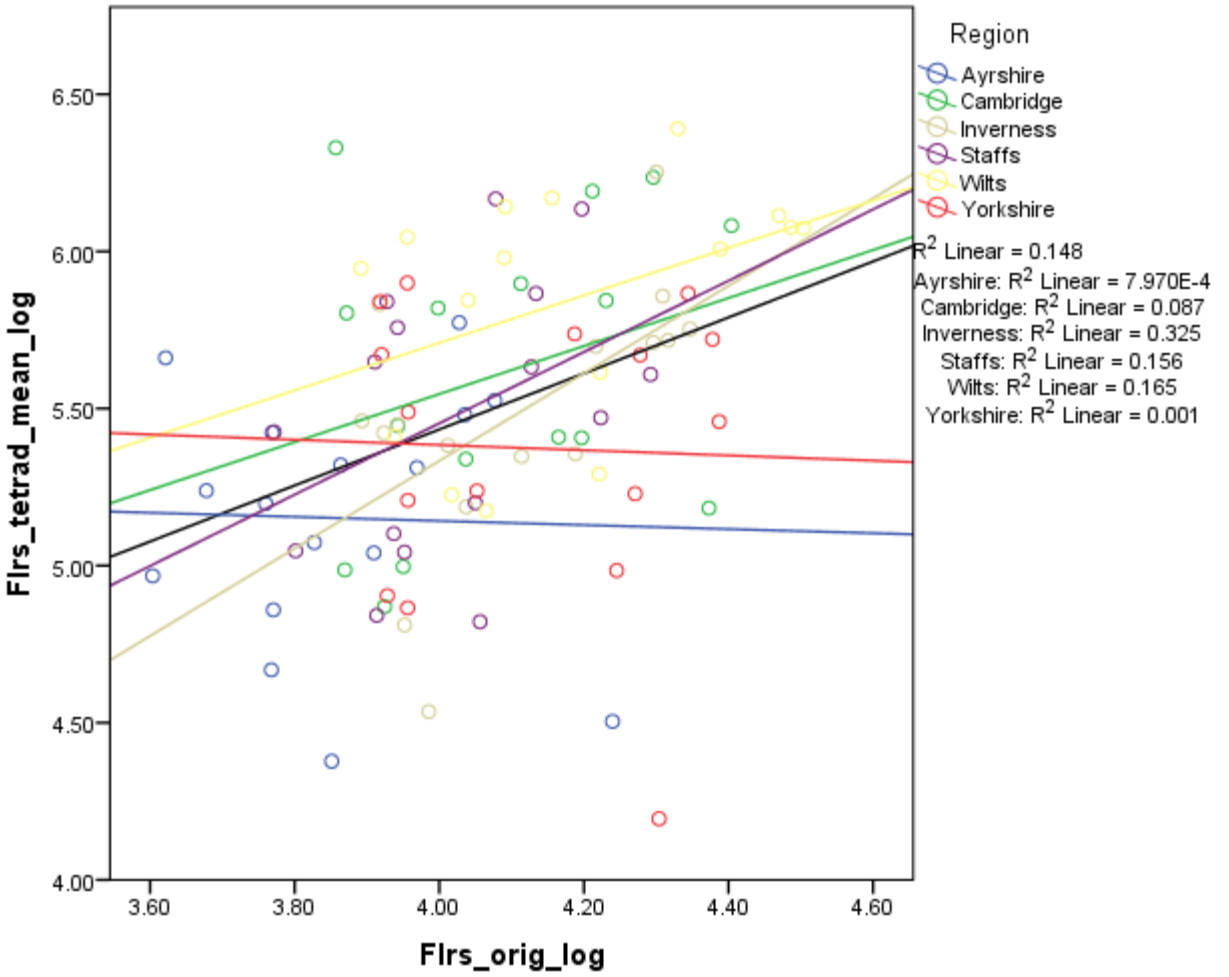
- Floral resources per unit cover (values for some spp from lit; modelled for all)
- Additional resources from agri-envt schemes
- **Field-tested by surveying flowers on random transects 3 times per year, over 2 years.**
- **Floral resources per flower measured, and per unit area**

4. Floral resources

- Overall: significant positive relationship between predicted & observed resources.
- Repeated in both years (with independent samples)
- Mean of 2 years less noisy
- Even so: weak & noisy relationships within some regions



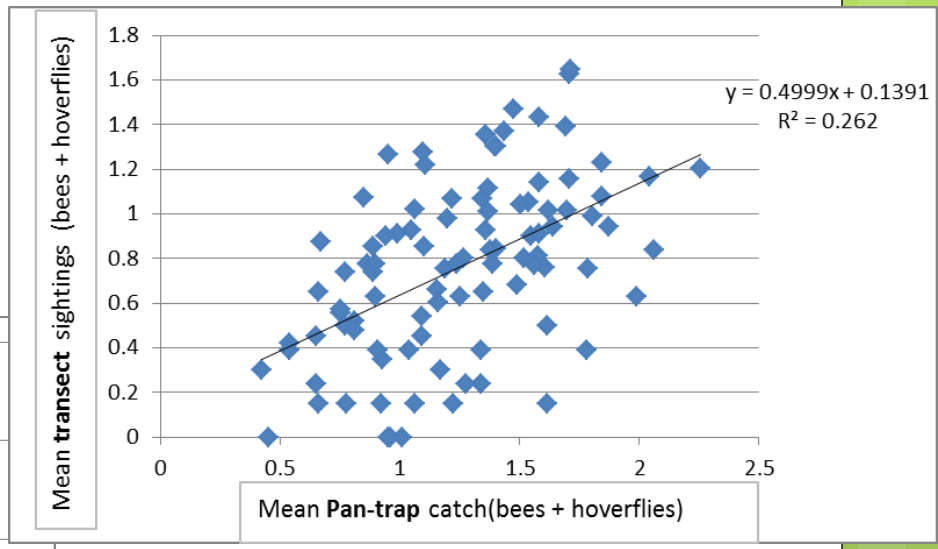
4. Floral resources

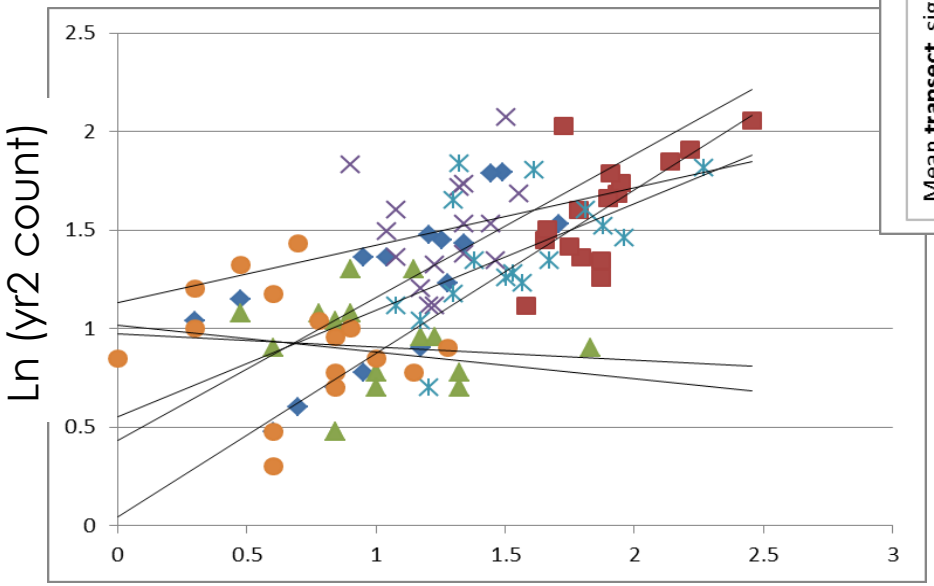
Verdict:

- Despite "error propagation", the original estimate had SOME predictive value
- Note: Our field assays are a TINY fraction of the resource (ca. 1/4000 of area, on only 3 days/yr)

Pollinator surveying

- Pollinators surveyed using "Pan-traps" to assess numbers, diversity
- Catch is well-correlated to observational transects – suggests results are robust.
- Pan-trap results look "repeatable" across years

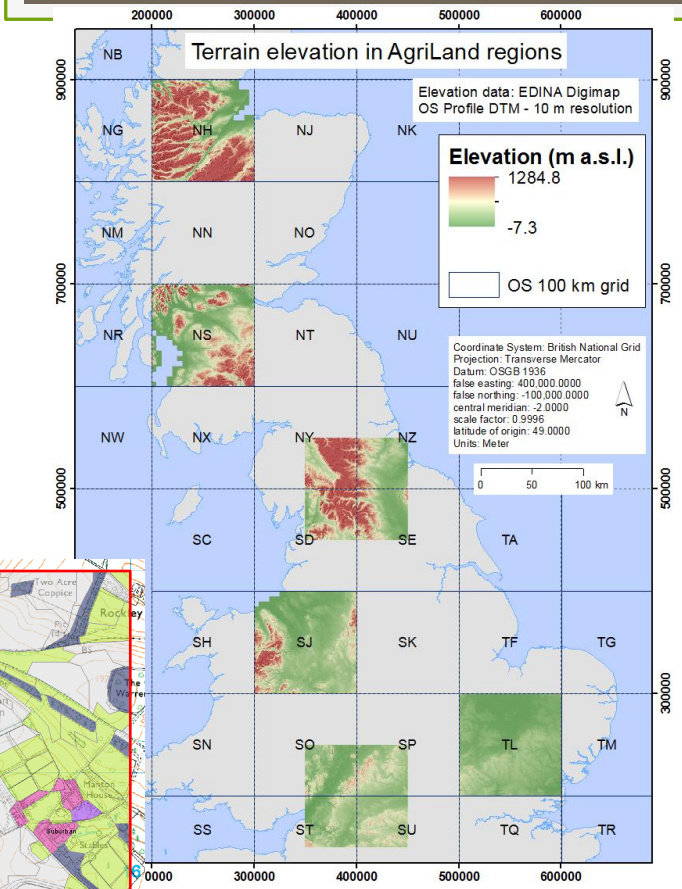




In summary:

- Appear to have done surprisingly well in modelling the 4 axes
- In most cases, sensible to use the measured values rather than those modelled… but model may be a decent option where measurements uncertain or incomplete (e.g. honeybee densities)
- Pollinator numbers and diversity can also be measured reliably in these landscapes
- Thus we should be able work out the relationship between pollinators and some of the most important potential drivers of decline.

Thank you


Terrain elevation in AgriLand regions
Elevation data: EDINA Digimap
OS Profile DTM - 10 m resolution
Elevation (m a.s.l.)
1284.8
-7.3
OS 100 km grid
Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
false easting: 400,000.0000
false northing: -100,000.0000
central meridian: -2.0000
scale factor: 0.9996
latitude of origin: 49.0000
Units: Meter
0 50 100 km
N
200000 300000 400000 500000 600000
900000 700000 500000 300000
NB NG NH NJ NK NM NN NO NR NS NT NU NW NX NY NZ SC SD SE TA SH SJ SK TF TG SN SO SP TL TM SS ST SU TQ TR