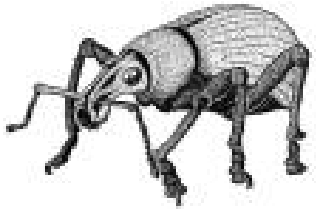
Are the severity and drivers of decline in UK butterflies representative of other insects?



Jeremy Thomas

SCI meeting: Insect decline

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

Department of Zoology

New College

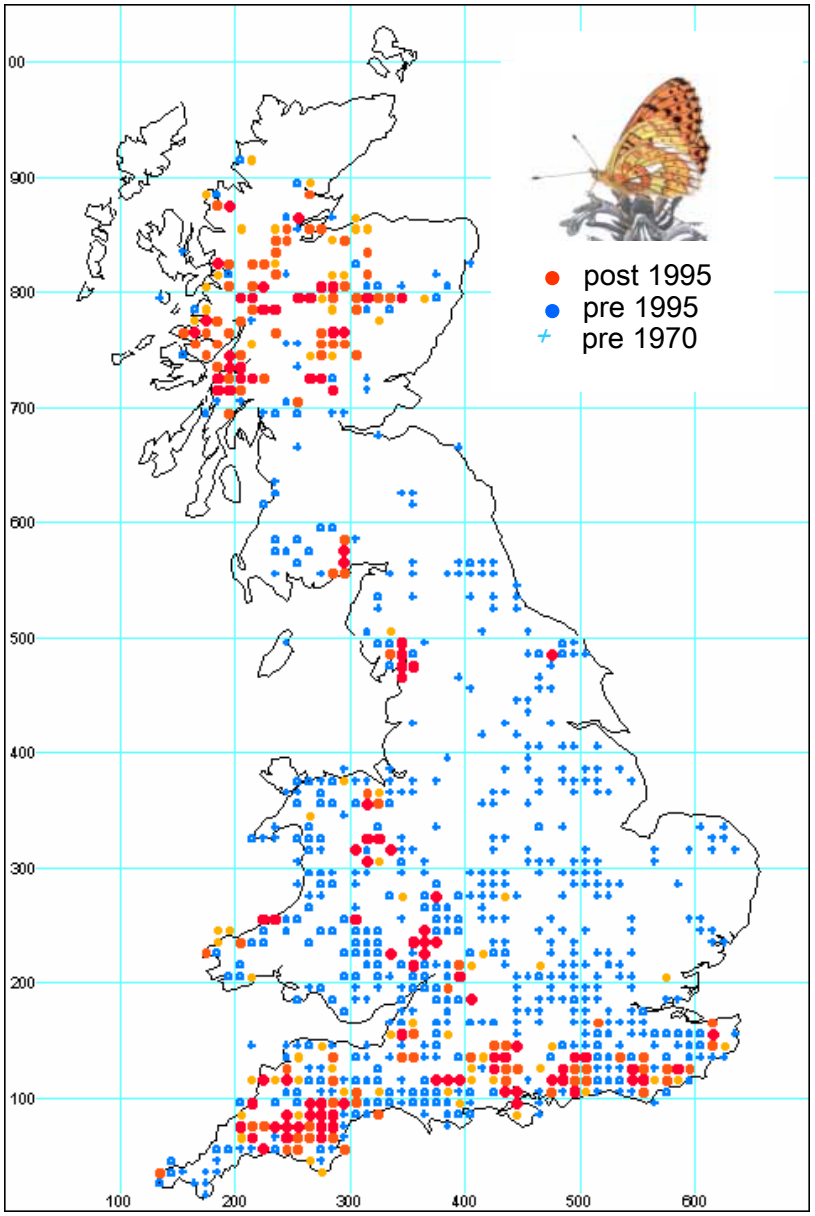
Butterfly Conservation

Two methods of measuring change make UK butterflies the most rigorously assessed insect taxon in the world

(1) *Mapping*

>10,000 people record 1.6 million butterfly locations every 5 years

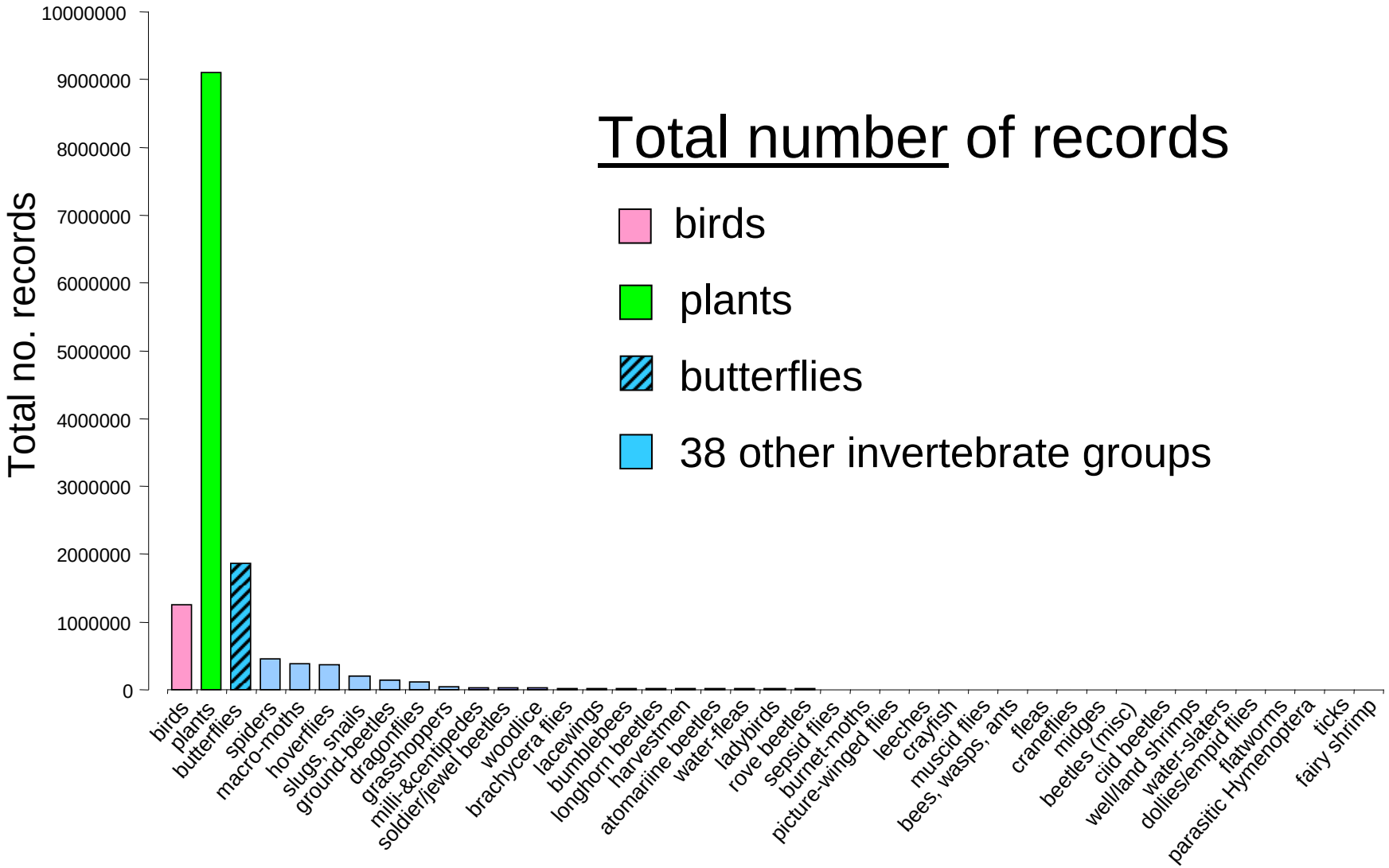
Provides more-or-less complete record of distributions since 1960s



Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

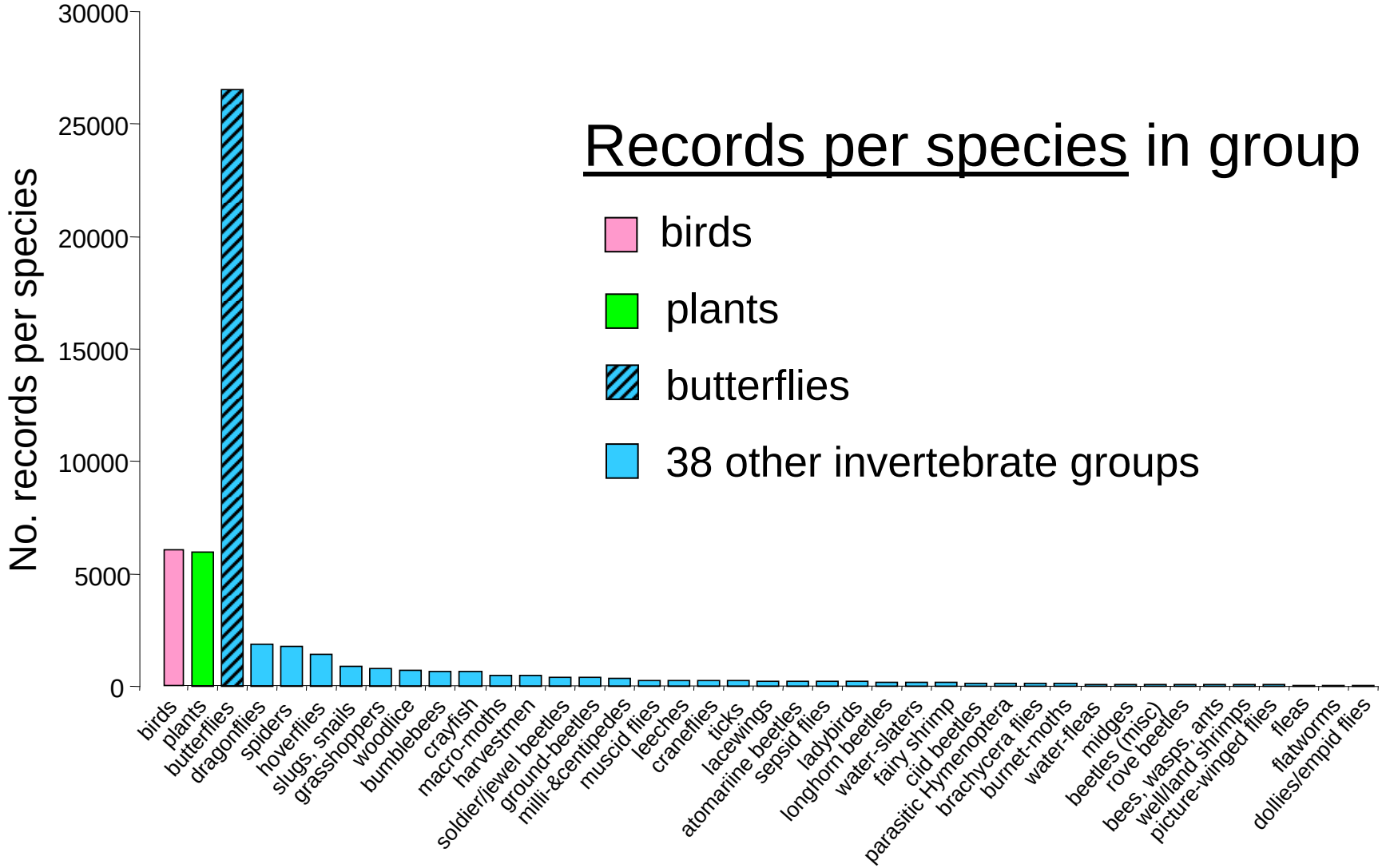
Butterfly Conservation

UK mapping records for plants, butterflies & breeding birds far exceed those for all other invertebrate groups



Thomas, JA 2005 *Phil Trans R Soc* **360**, 339-357

UK mapping records for plants, butterflies & breeding birds far exceed those for all other invertebrate groups

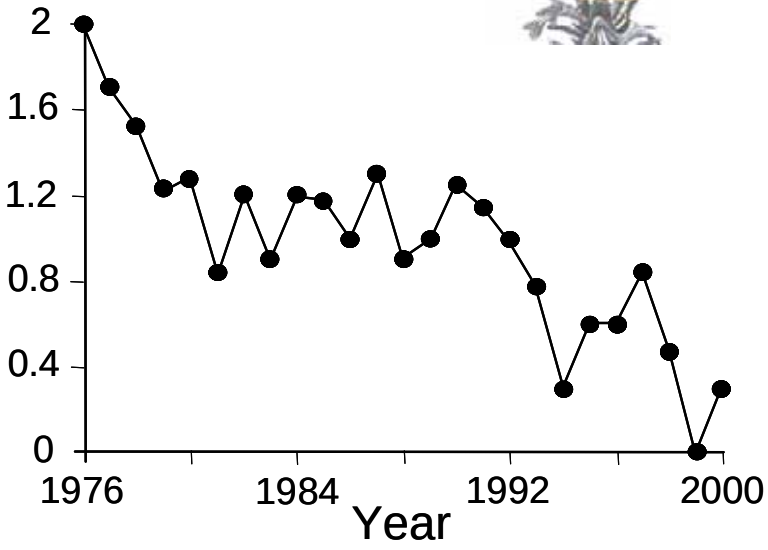


Thomas, JA 2005 *Phil Trans R Soc* **360**, 339-357

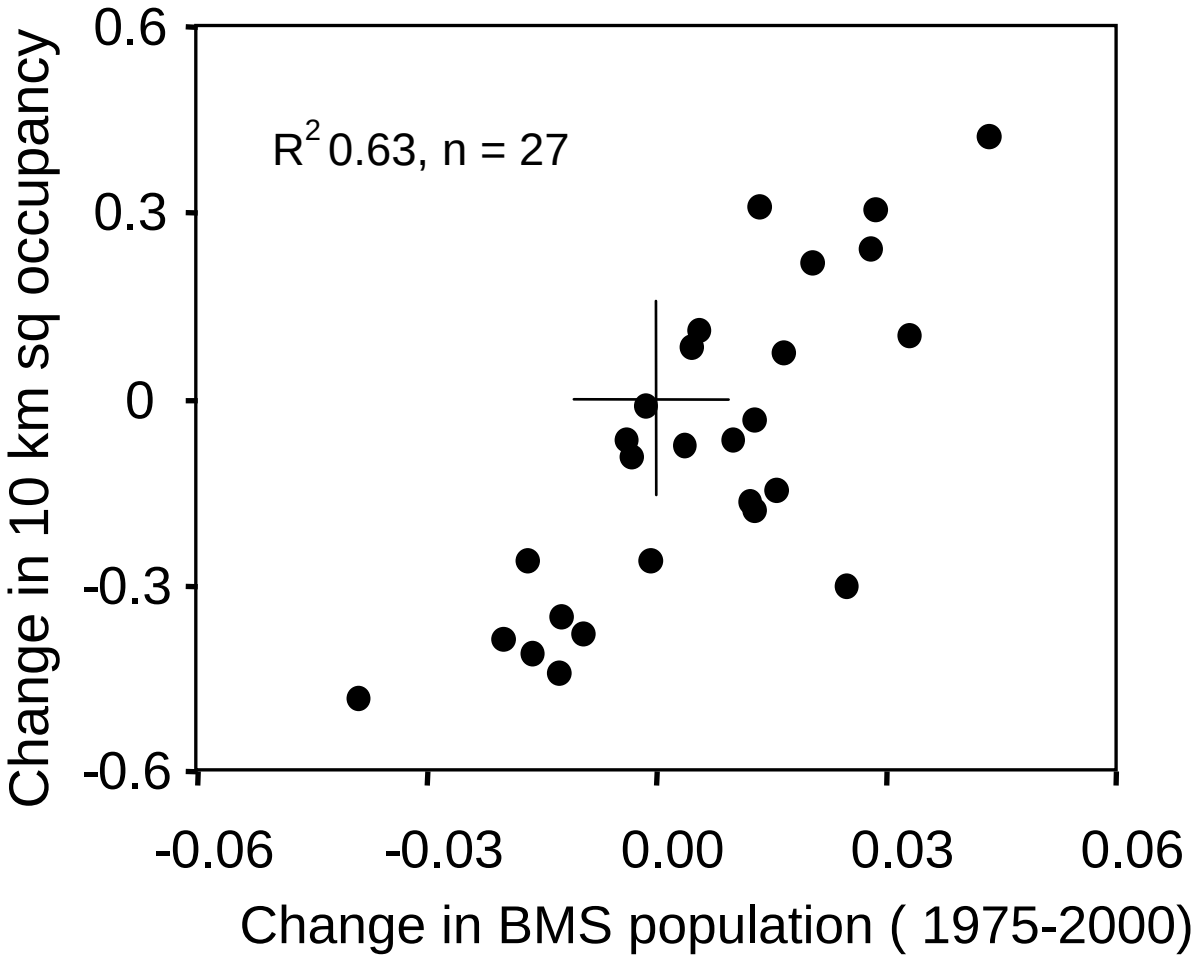
Monitoring changing population sizes using transects

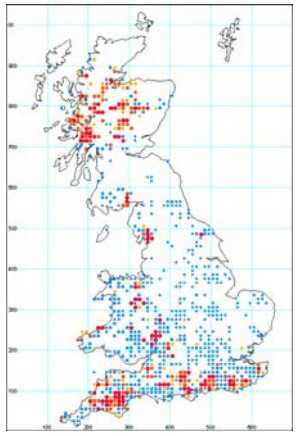
(2) UK-BMS Time series (1976-)
c.15,000 counts a year along fixed transects reveal clear-cut trends in existing population sizes

Pearl-bordered fritillary
B. euphrosyne



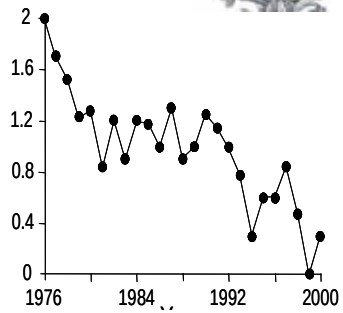
BMS trends correlated with BRC Atlas distribution changes





BRC Atlas

B. euphrosyne



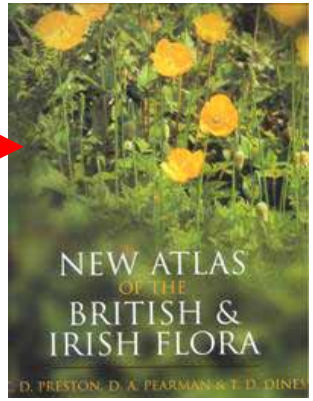
BMS

Warren et al 2001 *Nature* **414**: 65-69

Butterfly declines compared with other groups

Repeat Atlas surveys >15 million records

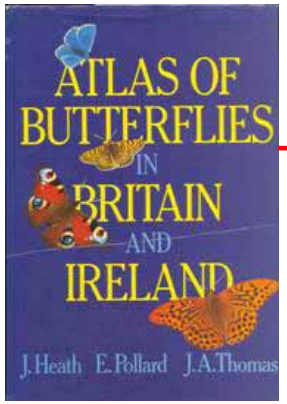
1960



2002

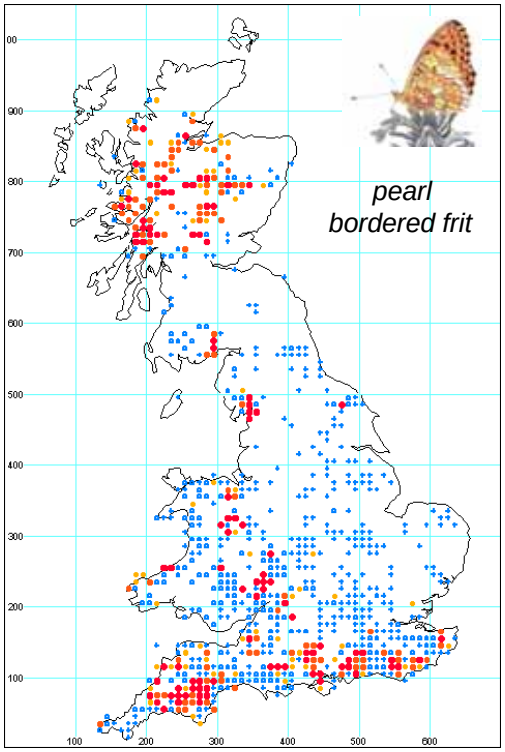
1972

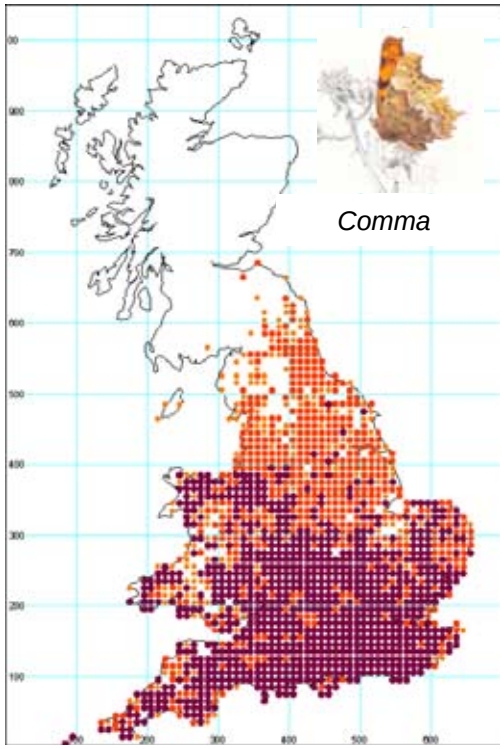
1991



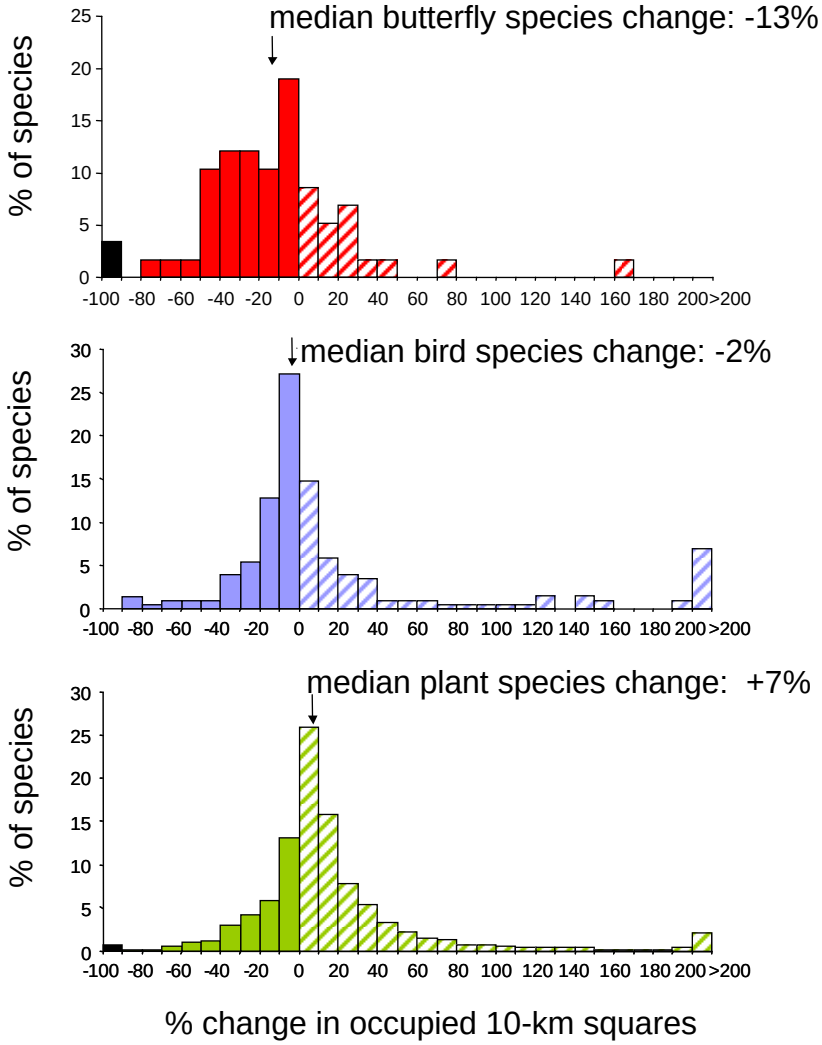
1982

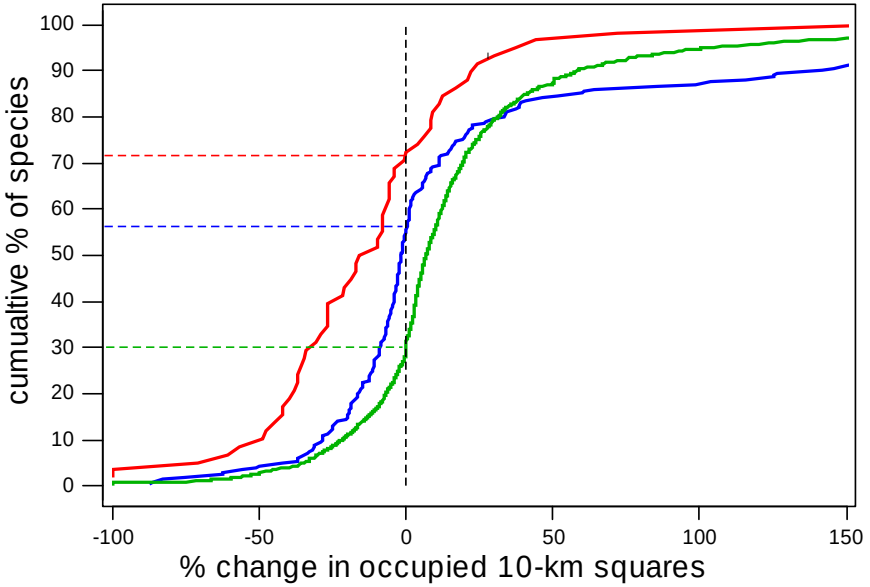
2001





Mapping records allow us to make the 1st large-scale comparison of insect, bird & plant changes





Butterfly declines > birds > plants at scale of a 228,000 km^2 nation

supports "6th extinction" hypothesis

Thomas et al 2004 *Science* ***303*** *1879*

1980s - Disproportionate declines in butterflies recorded over longer periods

e.g. Suffolk 1850-1980

Taxon	Number of species in: c. 1850	1980s	% change
Butterflies	50	29	**- 42%**
Vascular plants	1418	1343	**- 5%**
Amphib./reptiles	9	8	**-12%**
Mammals	35	34	**- 3%**
Birds	114	130	**+14%**

Thomas, JA 1991 In *The scientific management of temperate communities for conservation*, Blackwell pp149-19

Have other UK insects experienced similar changes?

Hambler & Speight (2004) *Science* **305**, *1562*

- "*notably a higher rate of loss*" than other invertebrates in UK RDB
- butterflies are a "*potentially misleading guide to extinction rates*"
- atypical because: warmth-loving & sensitive to climatic fluctuations
  + herbivorous

Thomas & Clarke (2004) *Science* **305,** 1563-4

- Not quite true – **bumblebees** & **dragonflies** had slightly higher rates
- Lower rates of extinction in other taxa an **artefact due to poor recording**

Artefact from direct comparison of well & poorly studied taxa

May, RM et al 1995 *Assessing Extinction Rates.*
In “Extinction Rates”, eds Lawton & May, OUP

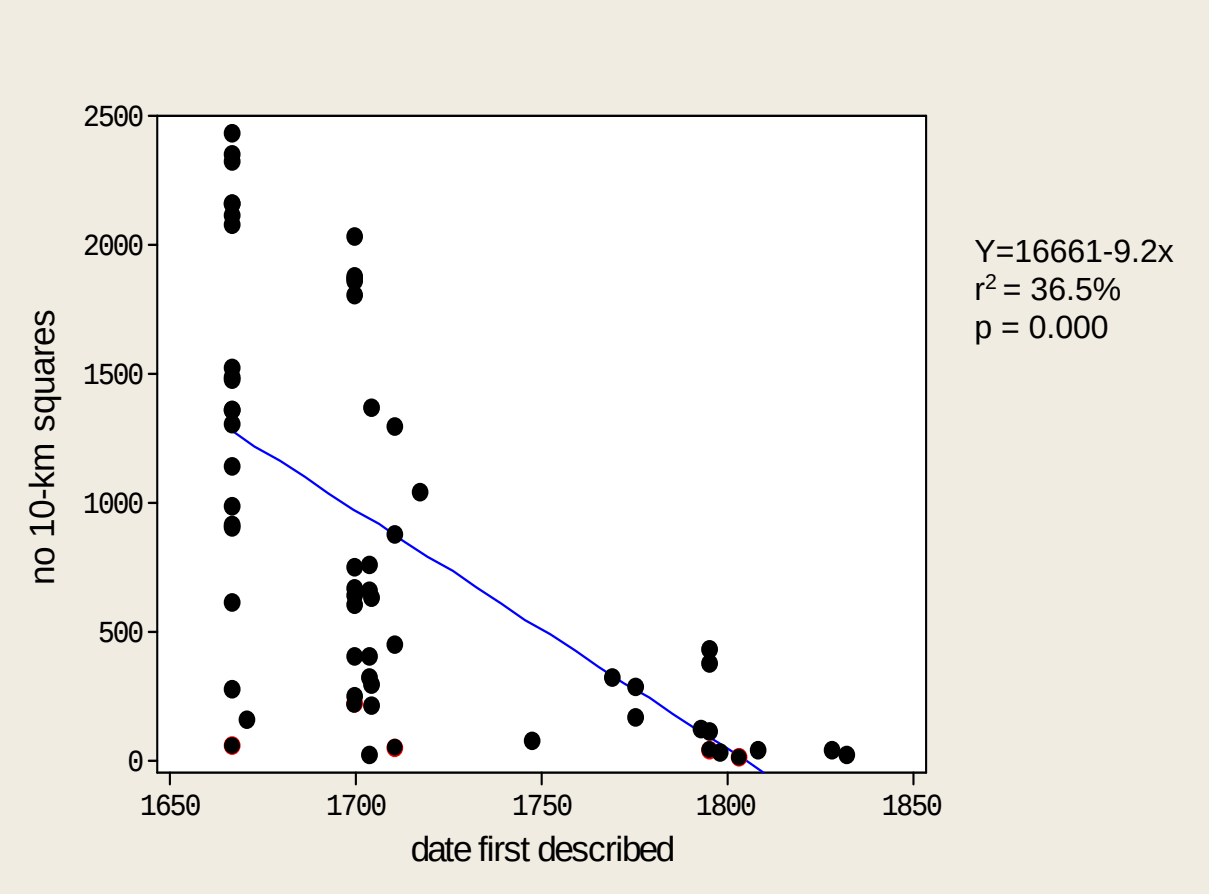
- rare species are discovered last
- rare species are most endangered
- therefore extinctions underestimated in poorly-studied taxa

McKinney, ML 1999 High Rates of Extinction and Threat in Poorly Studied Taxa *Conservation Biology* **13**, 1273-81

“in well-studied regions ..... many globally understudied taxa, such as insects and other invertebrates, have higher rates of threat than many other taxa, including mammals”

Artefact from direct comparison of well & poorly studied taxa

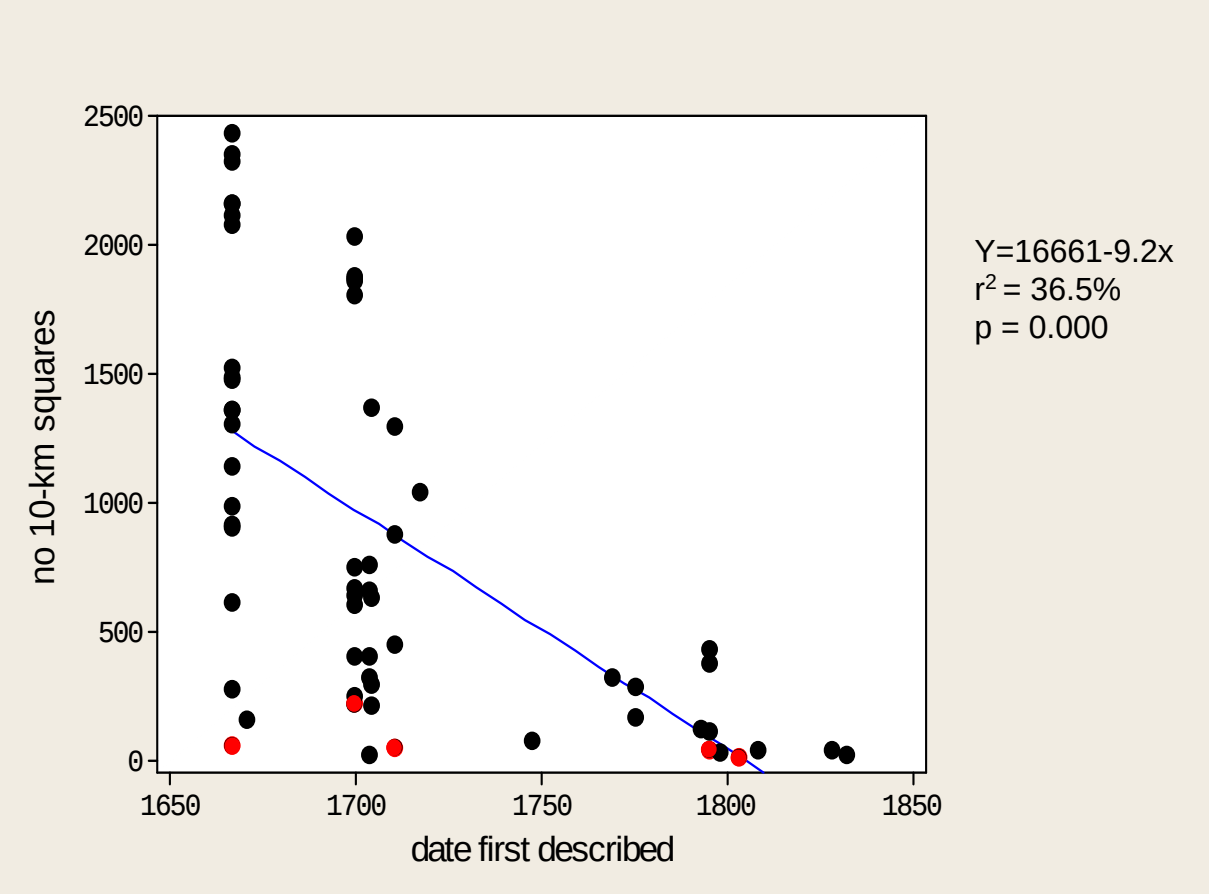
- rare species are discovered last
- rare species are most endangered
- therefore extinctions underestimated in poorly-studied taxa



Thomas, JA 2005 *Phil Trans R Soc* **360**, 339-357

Artefact from direct comparison of well & poorly studied taxa

- rare species are discovered last
- therefore extinctions underestimated in poorly-studied taxa
- rare species are most endangered



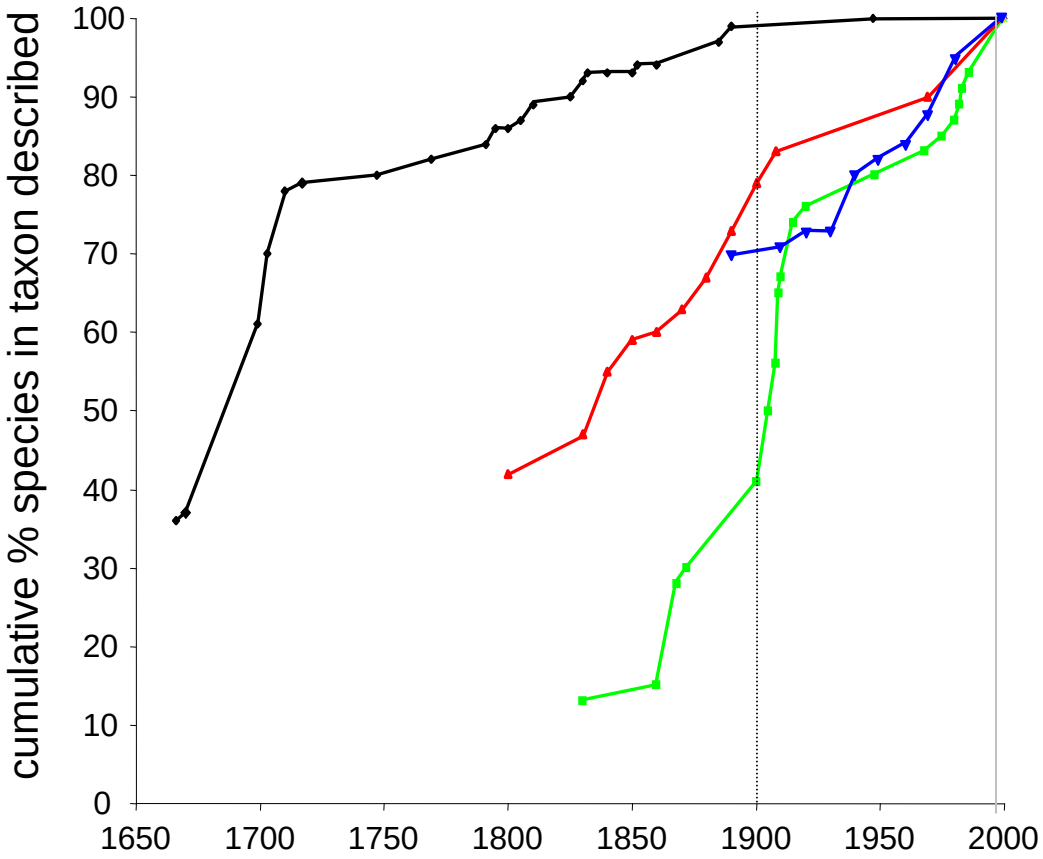
- extinct:
  79 ± 38 10-km squares
- persist
  935 ± 100 10-km squares

extinct < persist, P=0.000

Thomas, JA 2005 *Phil Trans R Soc* **360**, 339-357

Artefact from direct comparison of well & poorly studied taxa

- rare species are discovered last
- rare species are most endangered
- therefore extinctions underestimated in poorly-studied taxa (May et al 1995, McKinney 1999)



% current list known in c.1900


99%


83%


70%


40%

Thomas, JA 2005 *Phil Trans R Soc* **360**, 339-357

Recorded 20th century extinction rates of British inverts cf the proportion of each taxon discovered in Britain by c. 1900

Key

■ butterfly 

1) macro-moth 

2) spider 

3) weevil 

4) hoverfly 

5) soldierflies 

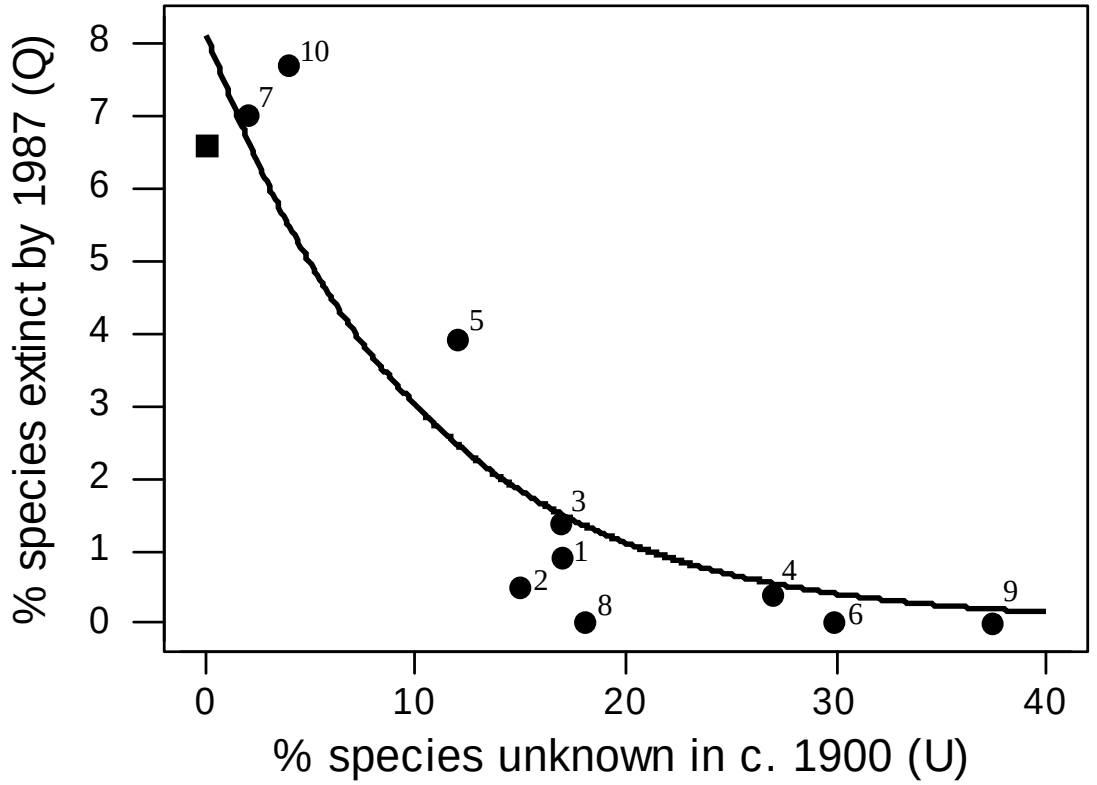
6) ant 

7) dragonfly 

8) cricket grasshopper 

9) mosquito 

10) bumblebee 

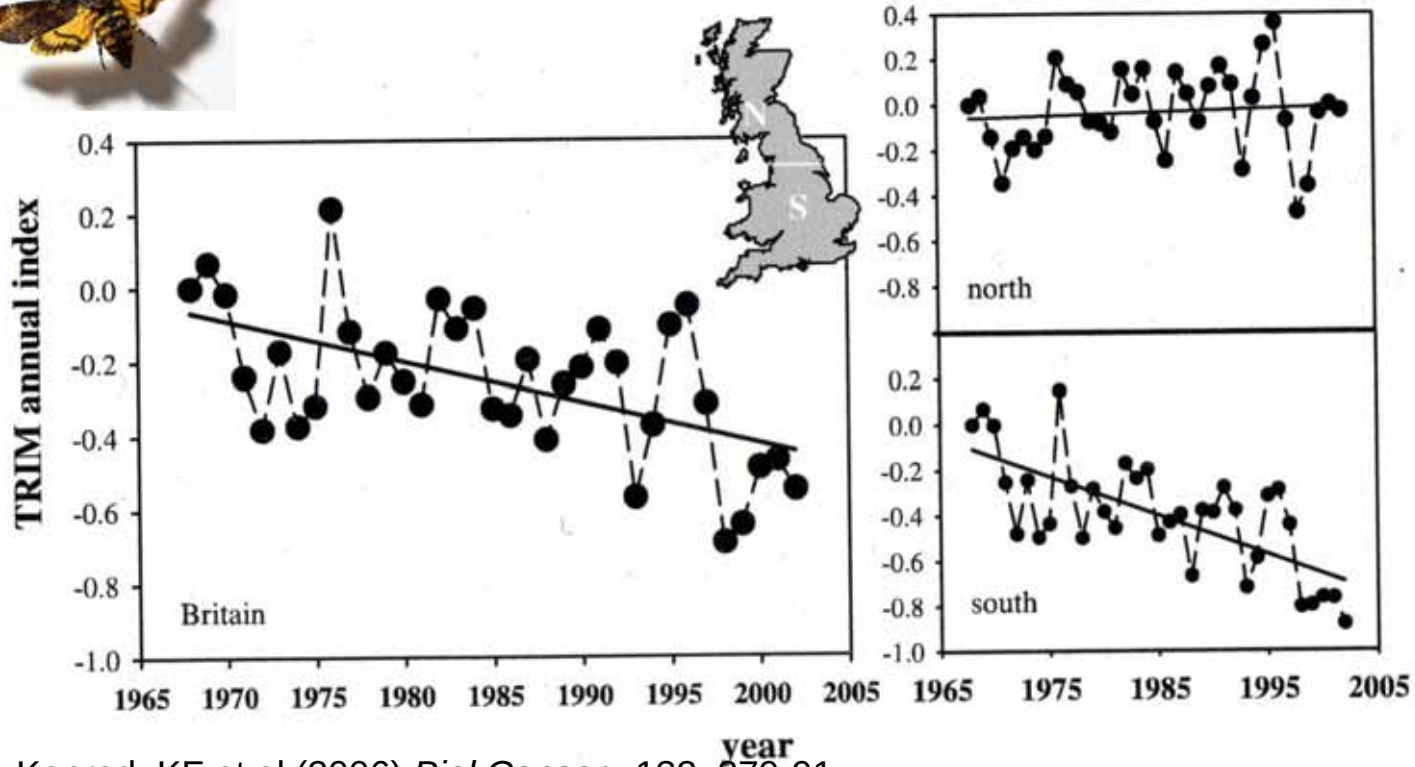


$Q = 8.13e^{-0.109u}$ p<0.001, rank r^2= -0.91
∑ n = 2799, ≈10% British arthopod spp

Thomas & Clarke (2004) *Science* **305**: 1563-1564

Since then, direct evidence of similar declines in UK & European insects, e.g. bumblebees & moths

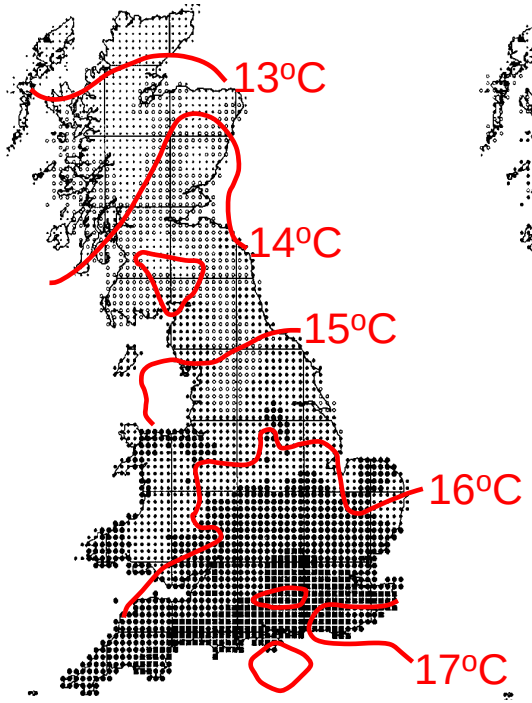
"[UK macro-Moth] declines are at least as great as those recently reported for British butterflies and exceed those of British birds and vascular plants."



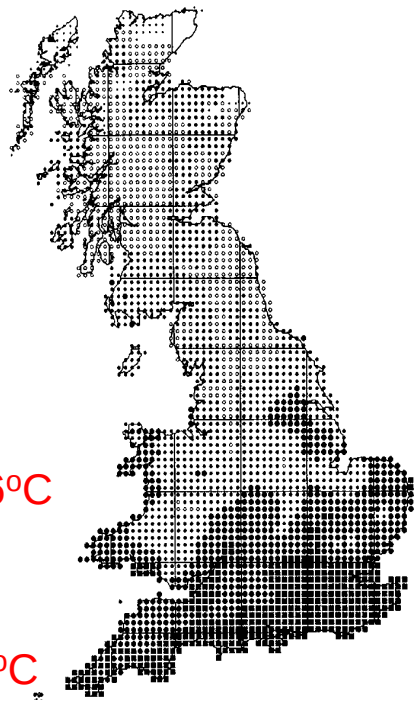
Konrad, KF et al (2006) *Biol Conserv* 132, 279-91

Are butterflies atypically thermophilous? - no

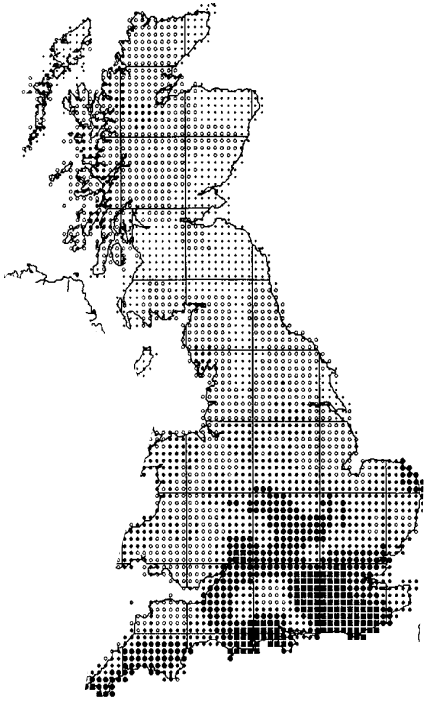
Butterfly species-richness increases with warm summer isotherms



Orthoptera are also more species-rich in warm latitudes



So are Odontata (& aculetae Hymenoptera)



But Staphylinid beetles abound in cooler climates

Thomas, JA 2005 *Phil Trans R Soc* **360**, 339-357

Drivers of decline: intensive agriculture eliminates larval foodplant(s) of all but 1 UK butterfly

2 changes explain butterfly declines in UK landscapes

- Larvae of >90% spp's more specialised than once thought
- Quality of (niches in) habitat within surviving sites changed

"the 2 major reorientations in butterfly biology & conservation in 20 years" Hanski (1999)

2 changes explain butterfly declines in UK landscapes

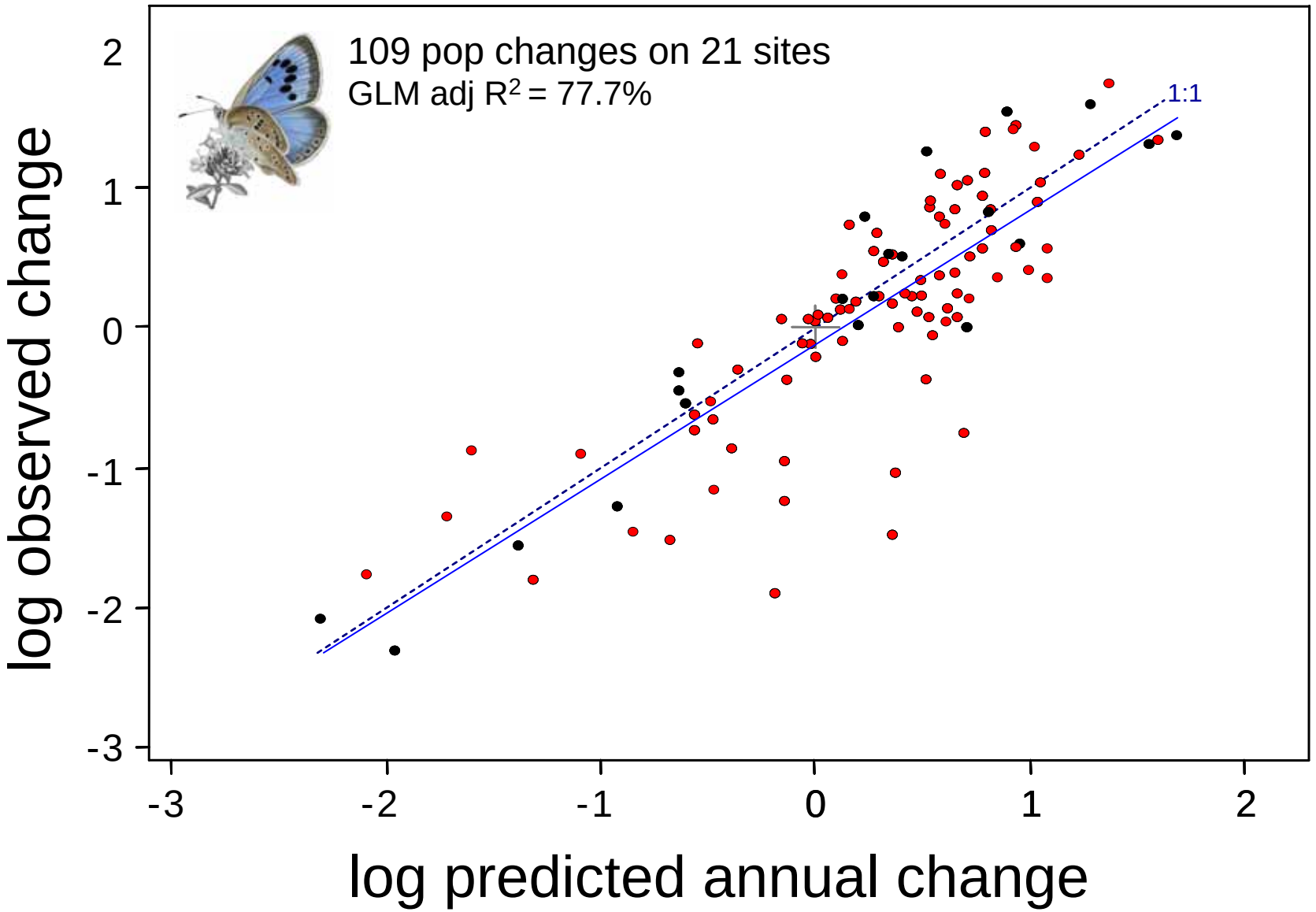
- Surviving patches are ***too small*** or ***too isolated***
- Adults of c. 70% spp less dispersive than once thought

"the 2 major reorientations in butterfly biology & conservation in 20 years" Hanski (1999)

With knowledge of larval niche, can create new habitat from scratch on railway (or intensive agricultural) land

e.g. 5 years later (2011): supports *M. arion* (Large blue) colony & much else

New populations match model predictions



Conclusions

- UK Butterfly declines severe: > birds plants
- Representative of many insects, but not freshwater or saproxylic species
- Main drivers on agricultural land: habitat loss & degradation/isolation of surviving fragments
- with knowledge of precise larval habitat, have probably saved 4-5 spp from UK extinction

Mellicta athalia

Polyommatus bellargus

Hesperia comma

Maculinea arion

- other rare/declining insects thrive on targeted butterfly conservation sites