

Predicting the impacts of climate change on British bird and hoverfly distributions.



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Outline

- Climate change and biodiversity
- Species distribution models
- Testing models using time series data
- Implications for biodiversity research and conservation
- Future directions

Climate Change is Already Affecting Species

- Distributions shifting northwards and upwards
- Spring events earlier
- Population dynamics changes
- Community composition changes



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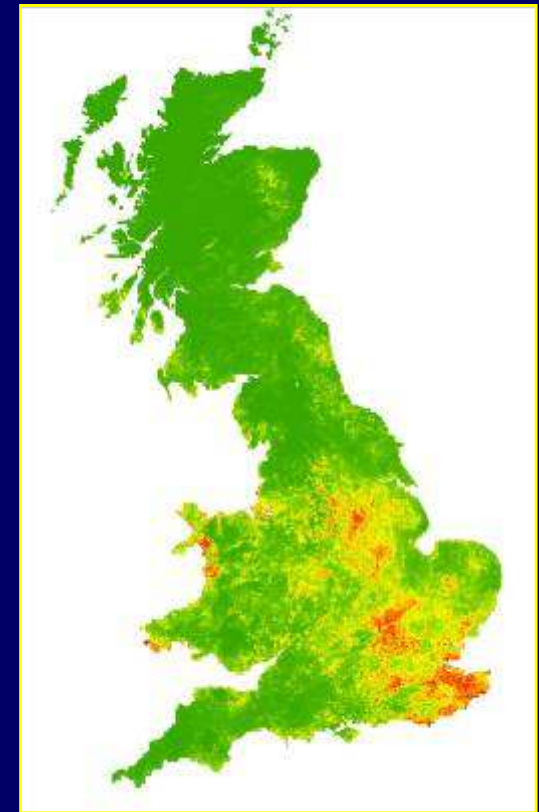
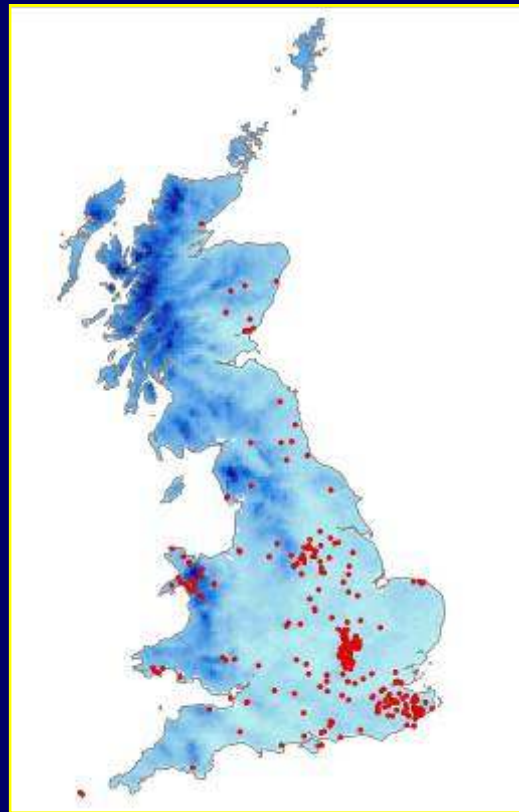
Species Distribution Models

Data on where the species is known to occur

+ Data on the environment at these locations

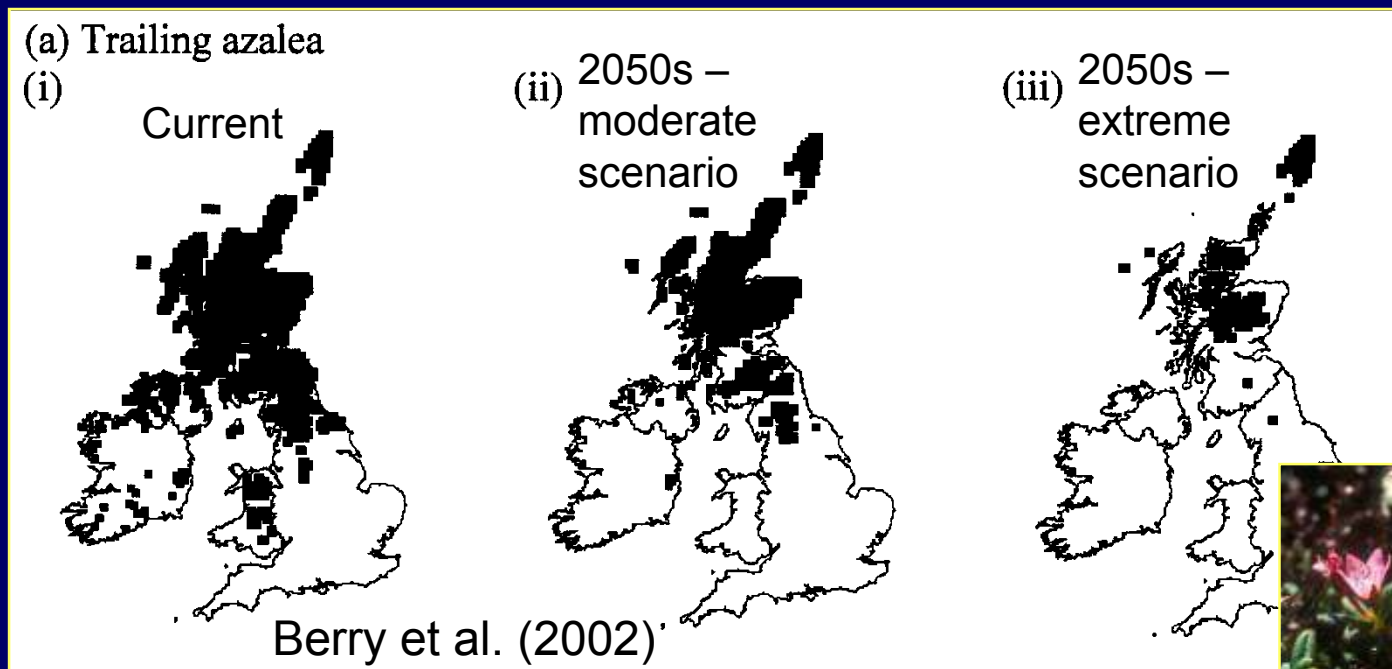
A model to relate them – what does the species require?

Produce a map of predicted distribution



Species Distribution Models

- Can predict future distributions
- Model coefficients applied to predicted future climates
- Previous studies predicted large shifts and alarming extinction rates



Species Distribution Models

- Difficult to assess accuracy because changes haven't happened
- Solution: Predict changes that have happened



Data

- 30-year time series (1972-2002):
 - British hoverflies (n = 256) and birds (n = 32)
 - Nationwide occurrence
 - Single-point abundance
 - Divided into five or six-year periods
 - Climate data (UKCIP)
 - Habitat data (ITE land cover)
 - Agricultural data (Edina censuses)

Data

Hoverflies



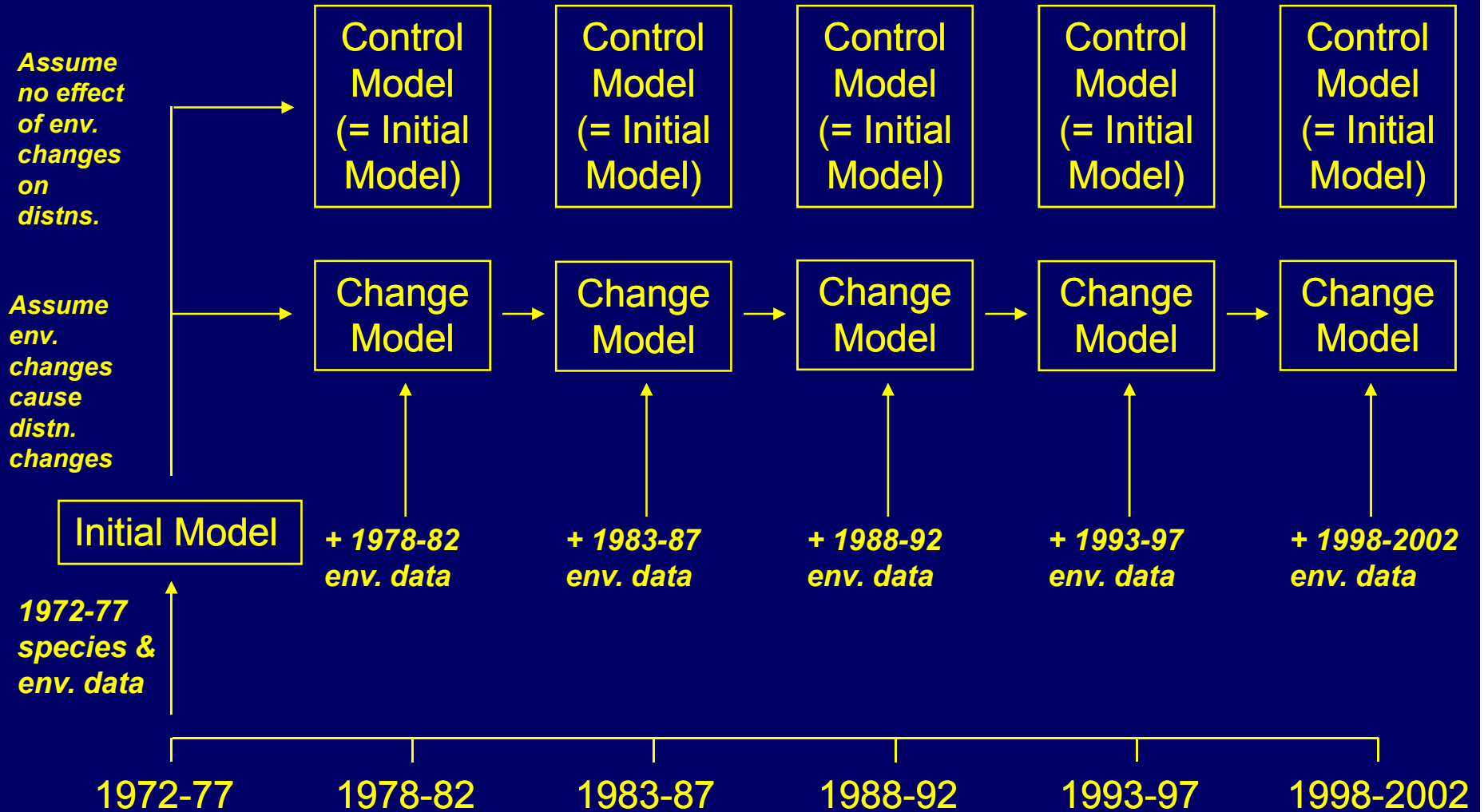
Birds



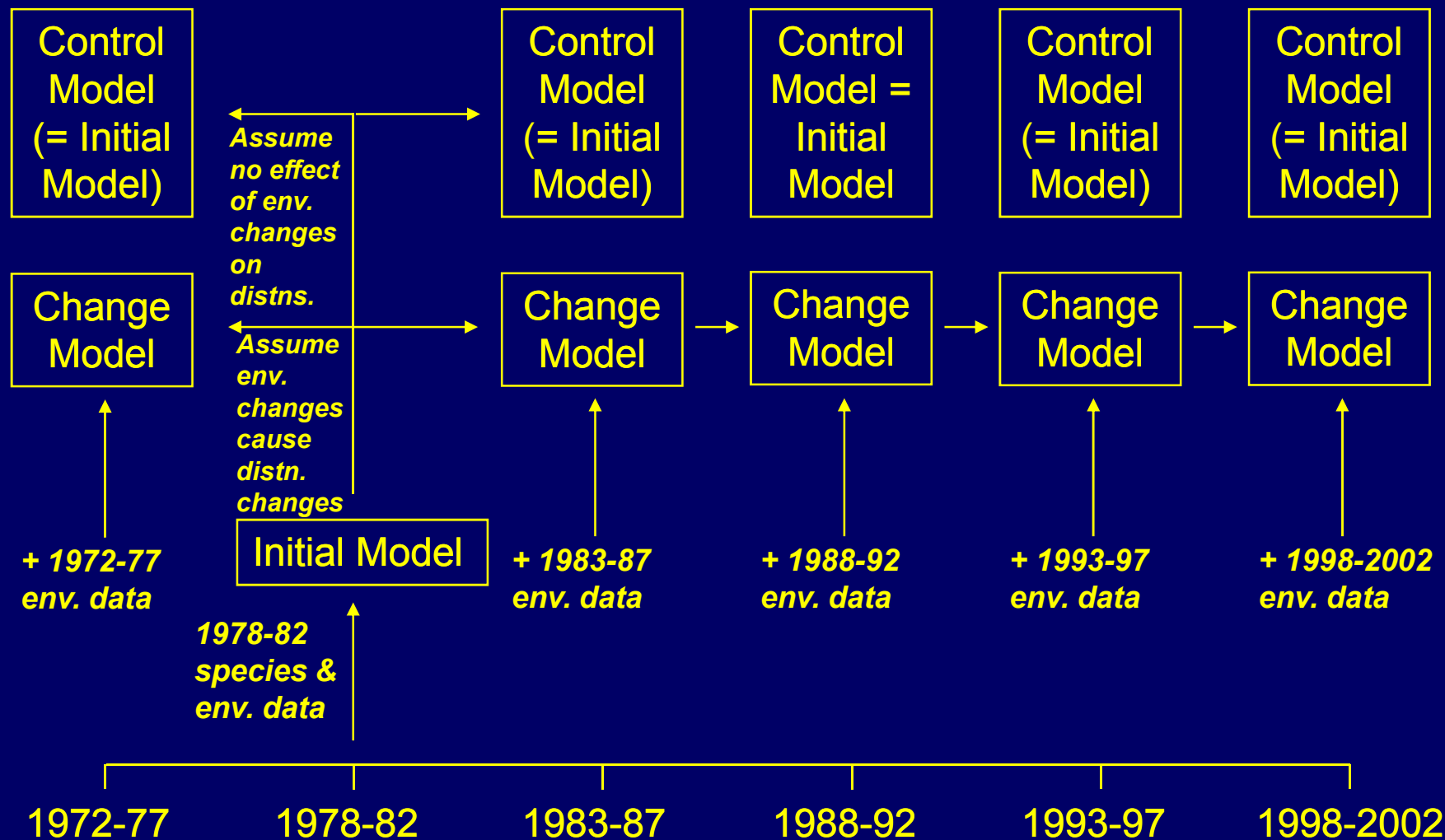
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The Models

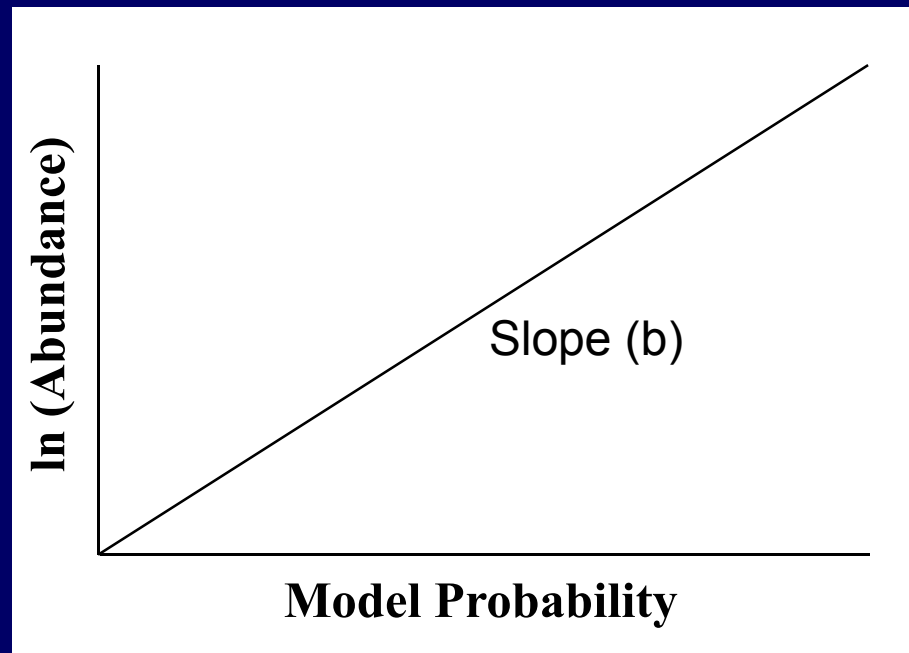


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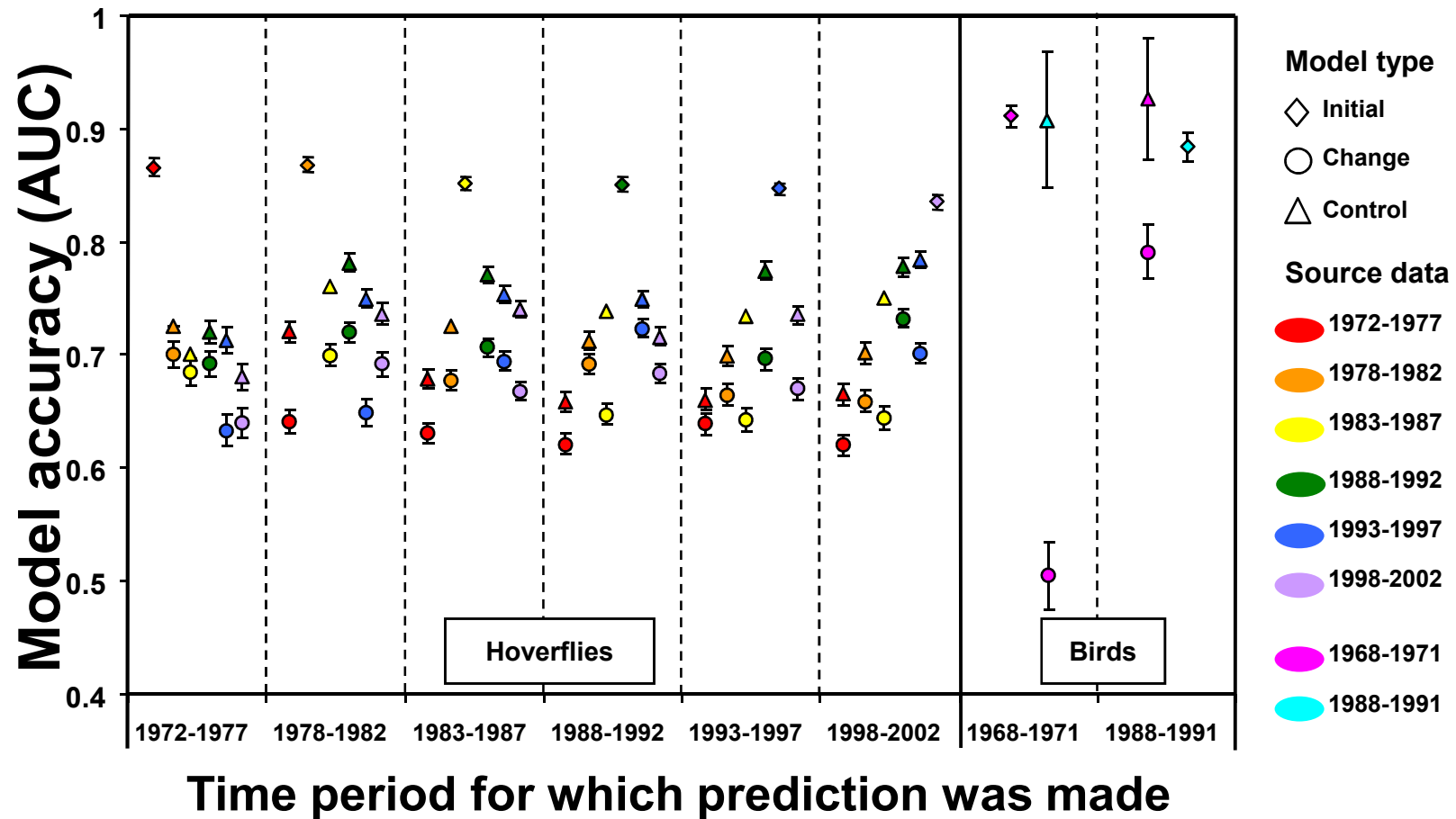


Testing the Models

- Against nationwide occurrence:
 - AUC statistic
- Against single-site abundance:
 - Related abundance to model probabilities using a GLM with negative binomial errors (slope & AIC)

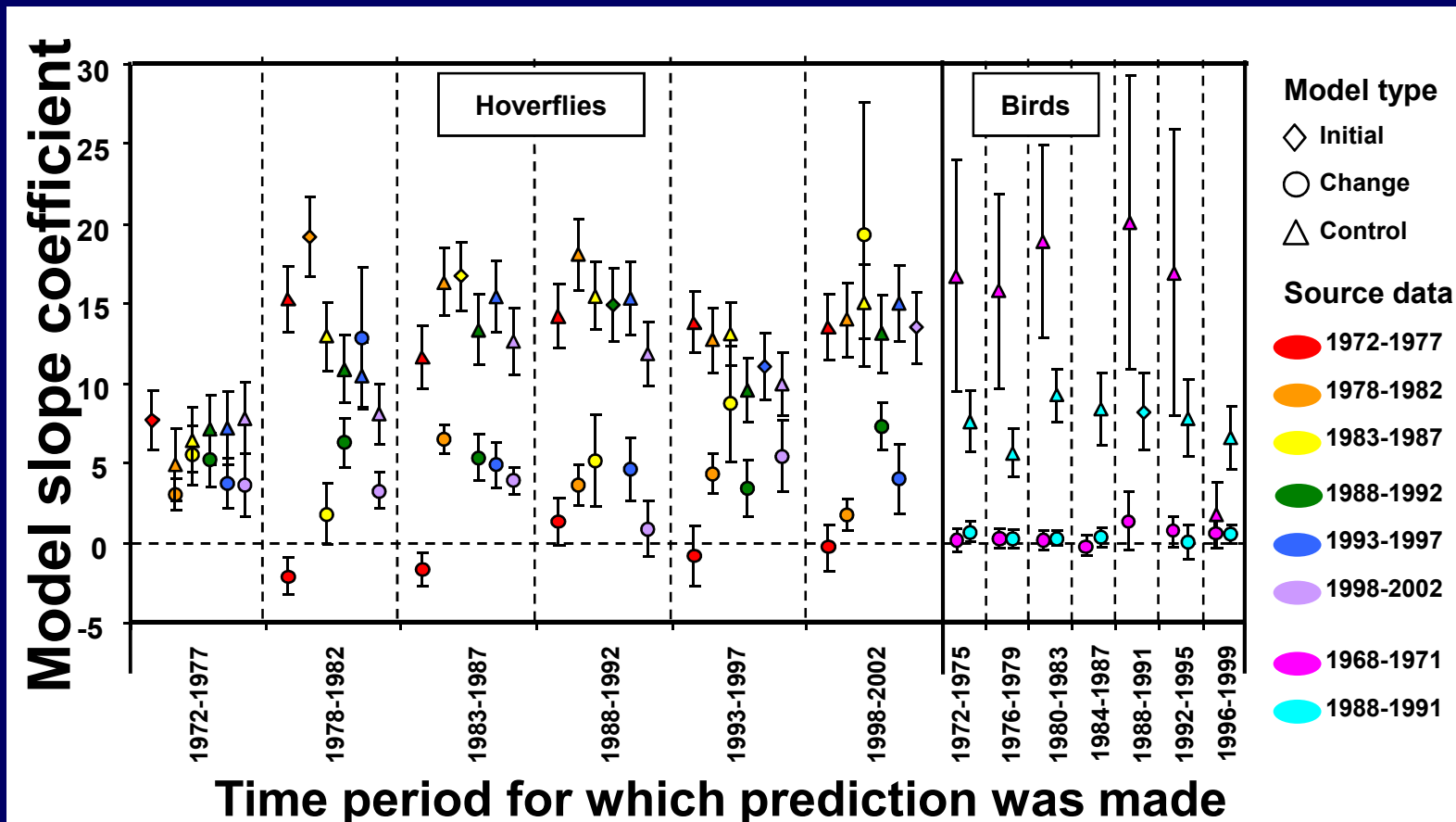


Testing Against Nationwide Occurrence Data



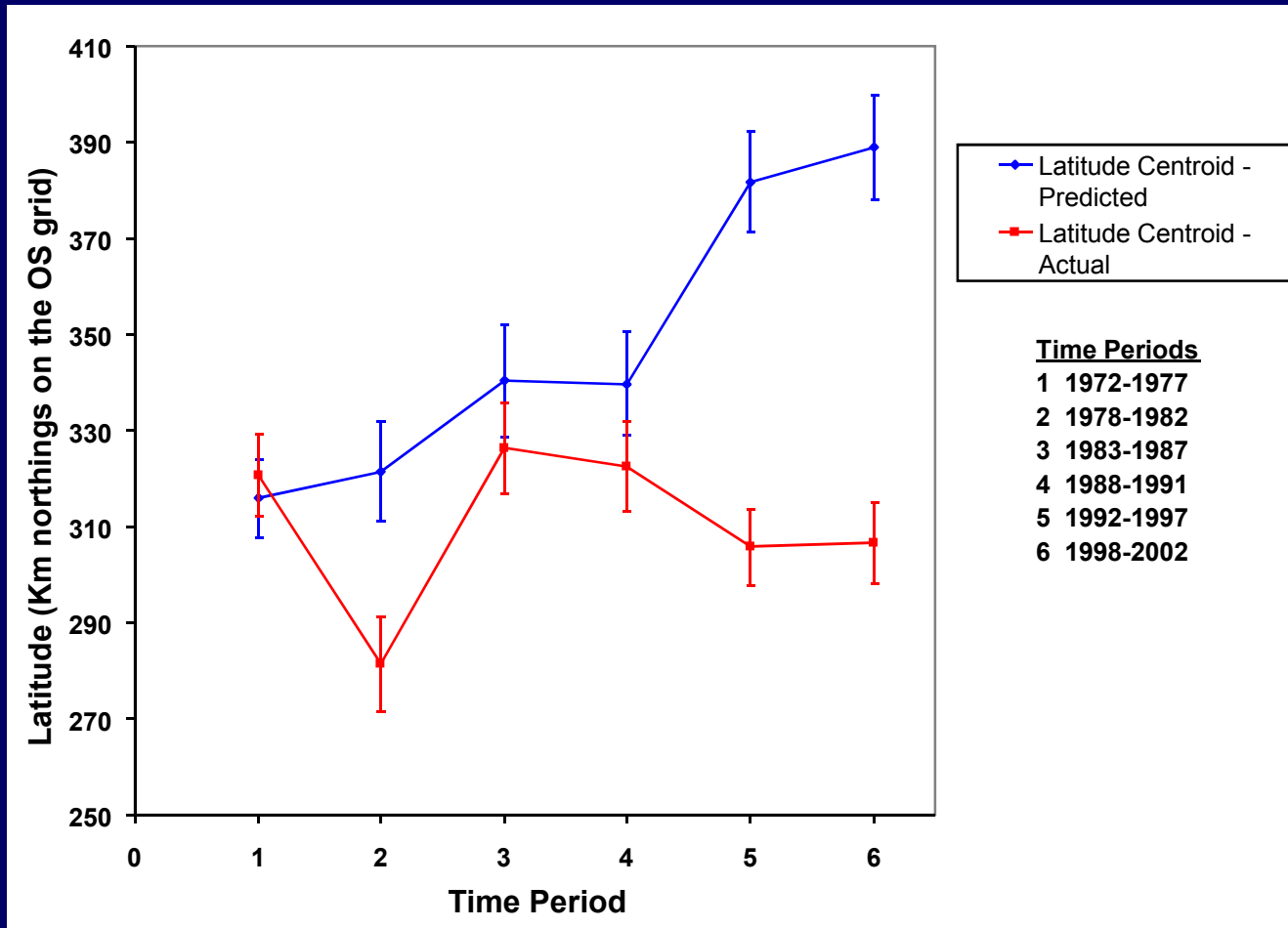
Wilcoxon matched-pairs statistic always >2.3 ($p < 0.05$) and usually >3.4 ($p < 0.001$)

Testing Against Single-Site Abundance Data



In all but 2 cases, slope coeff. greater than for control models and in all but 2 cases AIC less for control models

A Northward Shift?



Reasons for Model Failure

- Lags - dispersal limitation
- Adaptation (~30 generations?)
- Phenotypic plasticity – Charmantier et al. (2008)
- Interactions not captured
- Population trends (but models didn't predict abundance well)



Implications

- Similar models are often used to predict effects of climate change
- Resulting conservation decisions could be inappropriate
- Most studies only test initial models
- These were highly accurate

The Future

- Testing lags in species' response
- Are species moving upwards (higher altitude) rather than northwards?
- More studies of adaptations
- How can we quantify species interactions?



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