

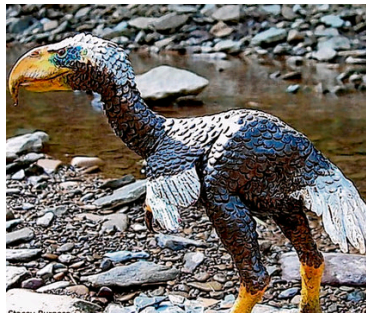
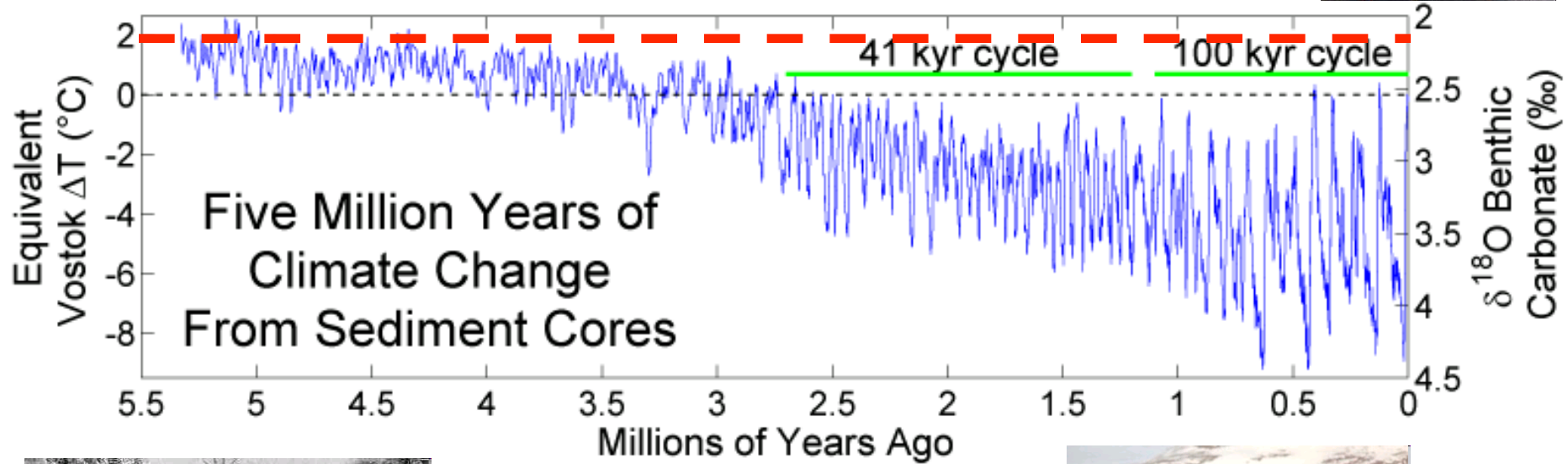
# Ecology and conservation at + 4°C



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after Lisiecki & Raymo (2005)



# The end of “Natural”

Change takes place even in  
“natural” and “protected”  
environments







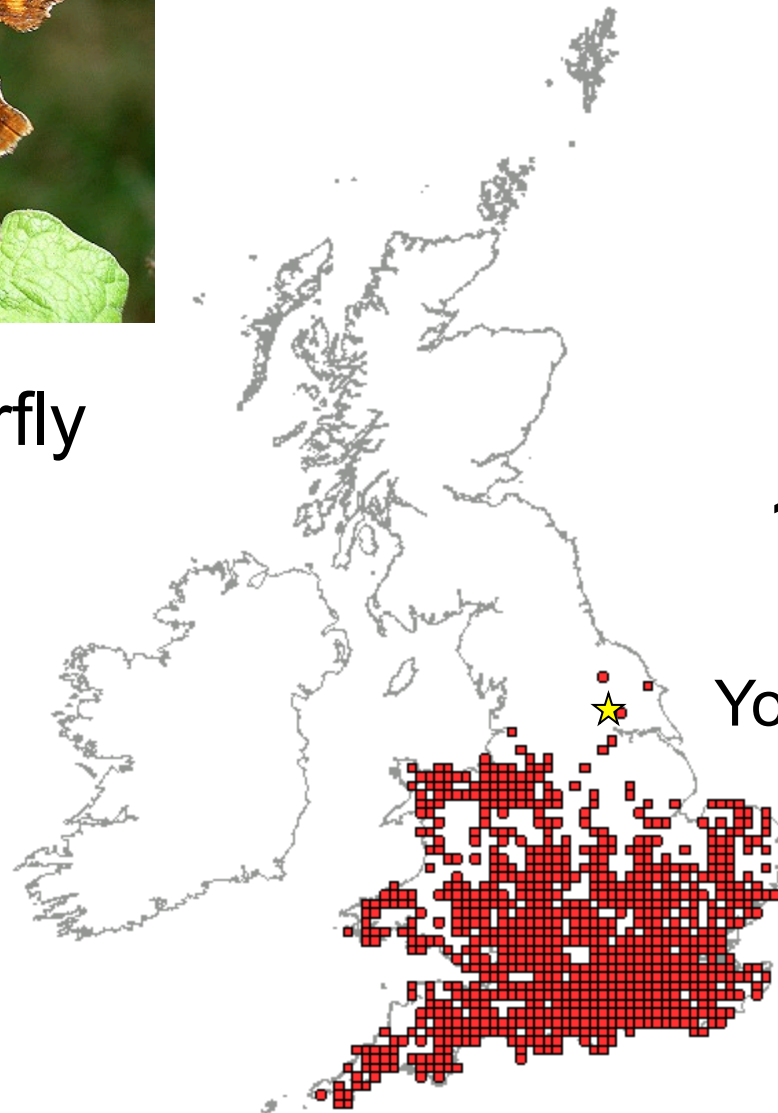
Conservation under climate change  
– the end of trying to recreate the past







Comma butterfly



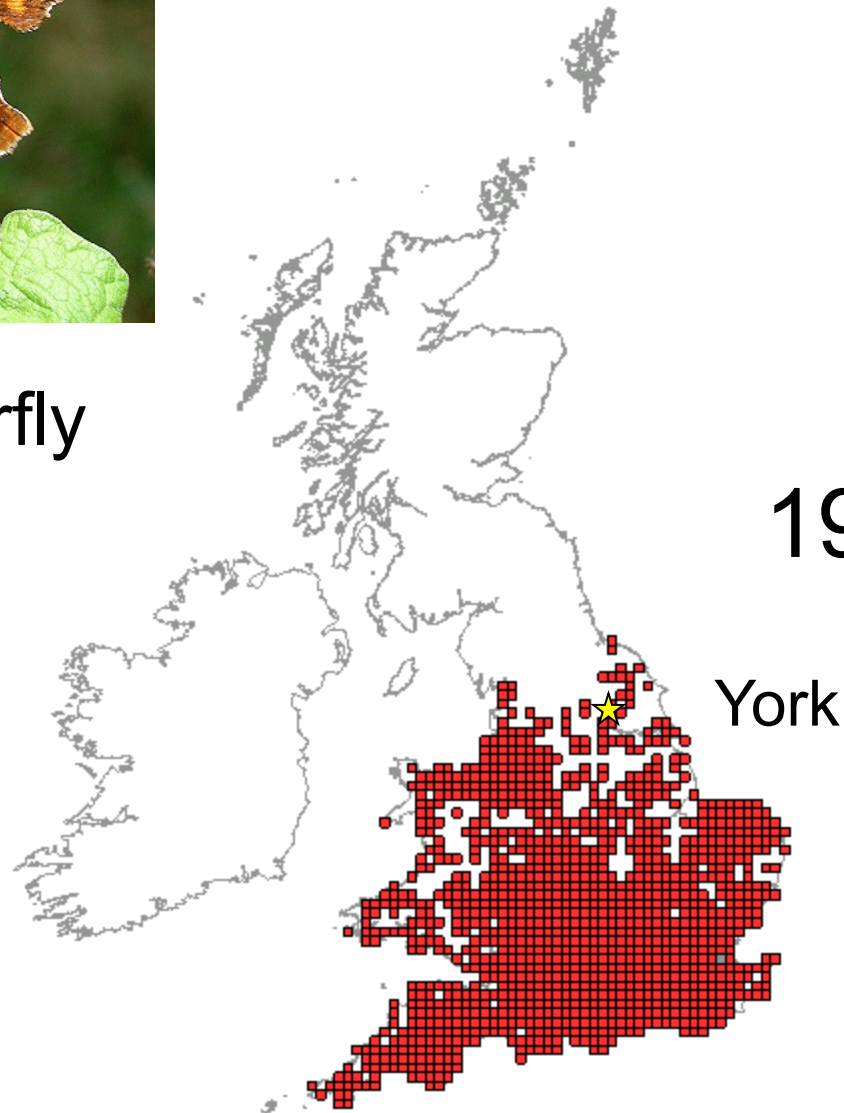
1970 - 1982

York





Comma butterfly



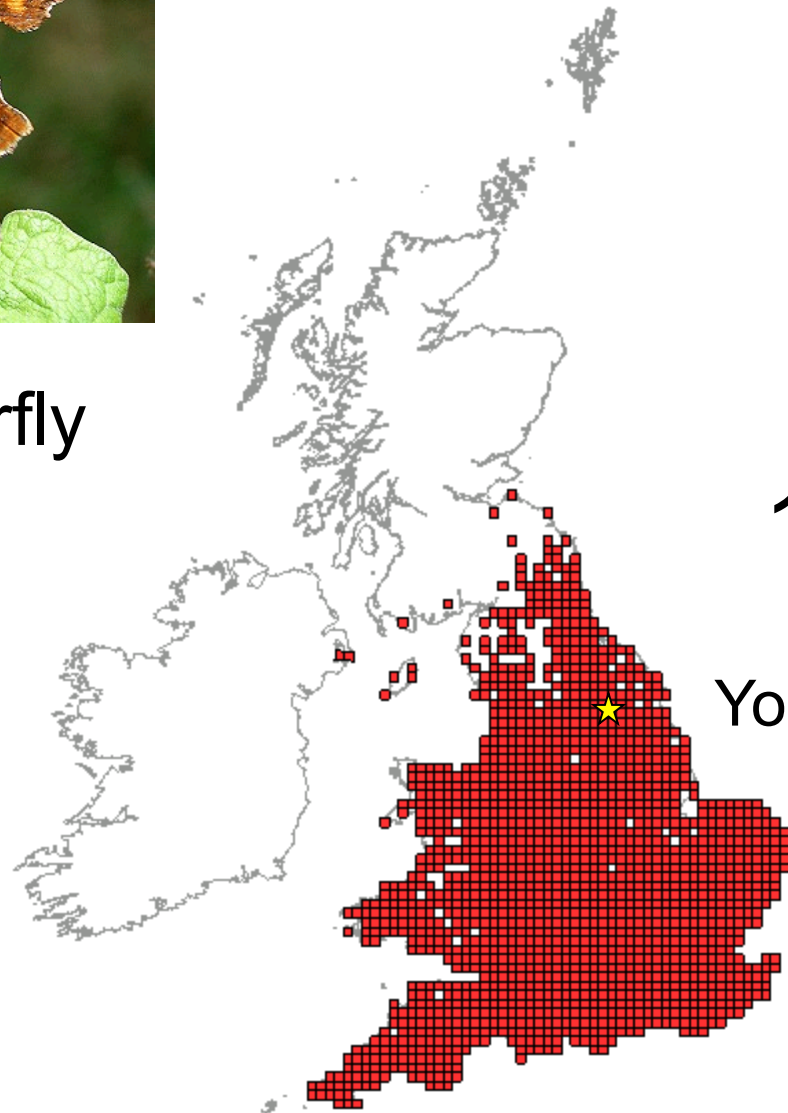
1970 - 1994

York





Comma butterfly



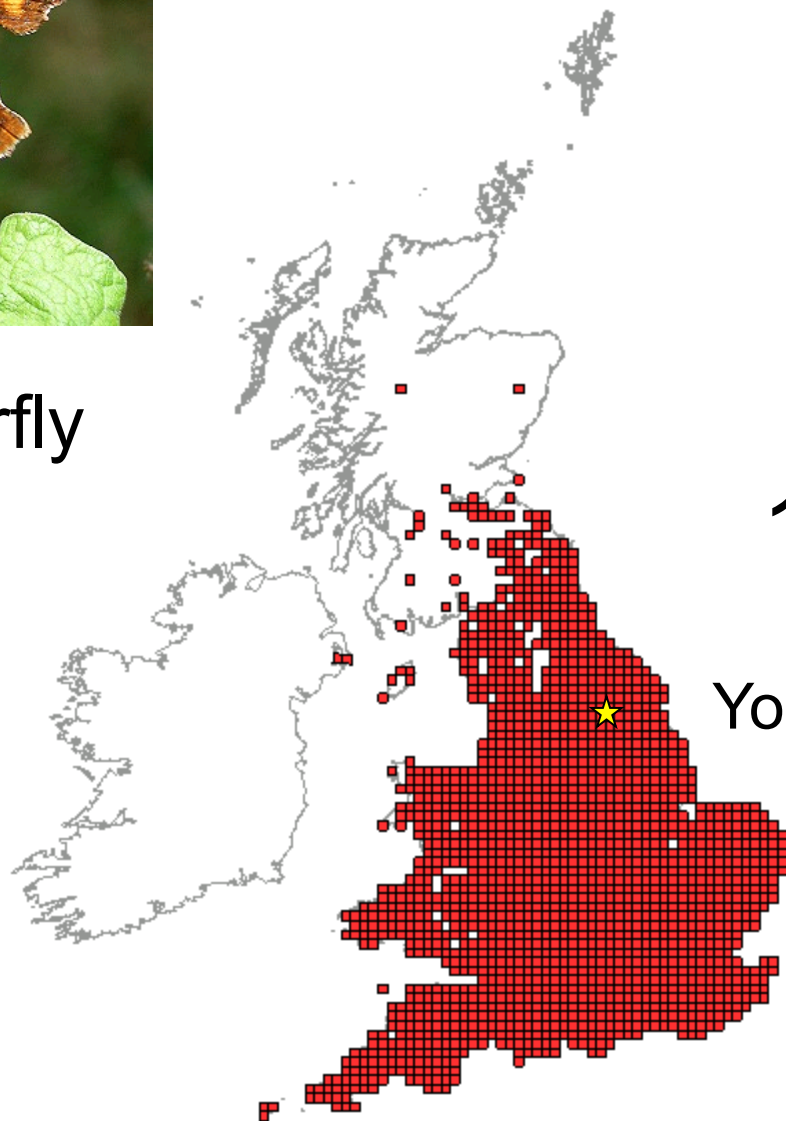
1970 - 2000

York





Comma butterfly

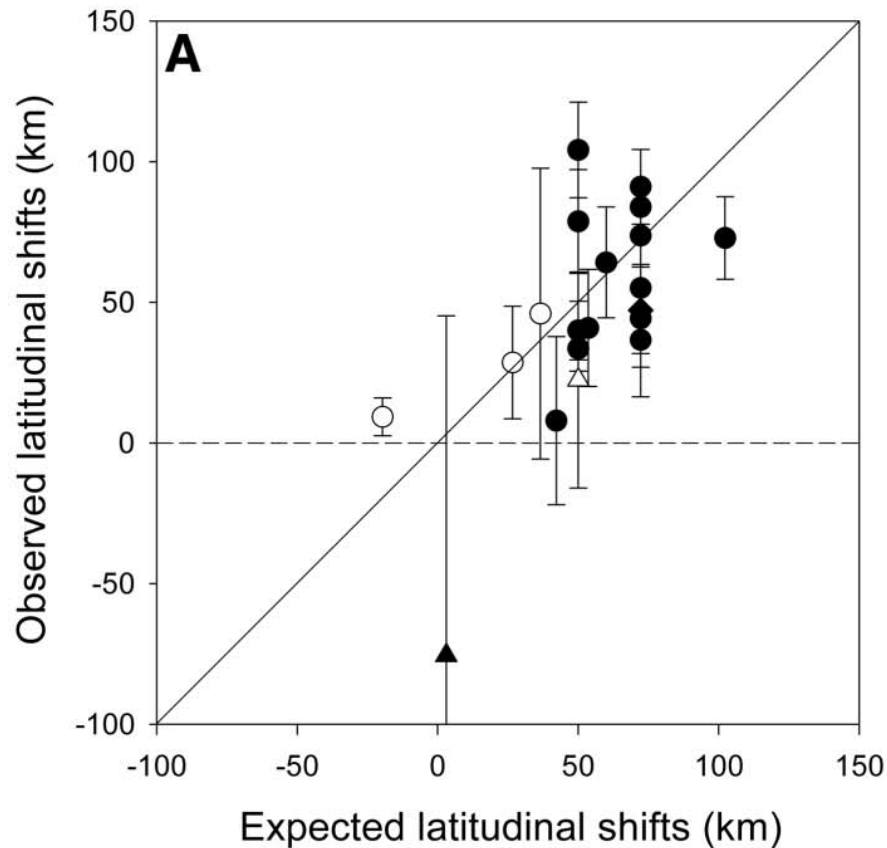


1970 - 2010

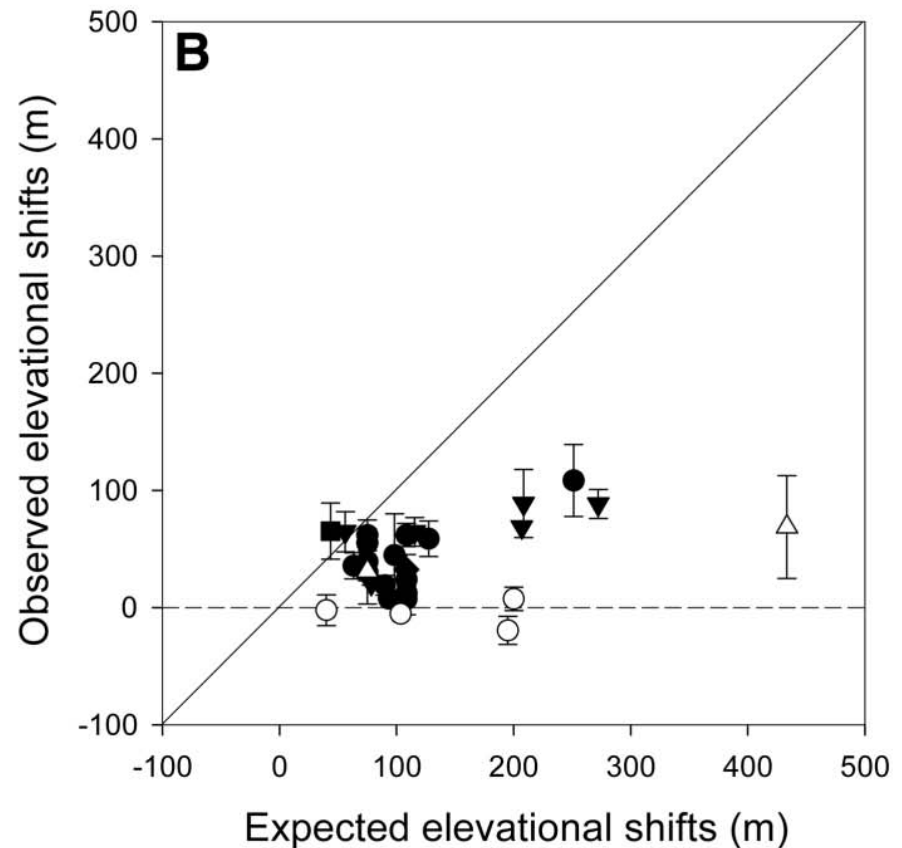
York



# Meta-analysis of median observed range shifts



Latitude:  
16.9 km per decade

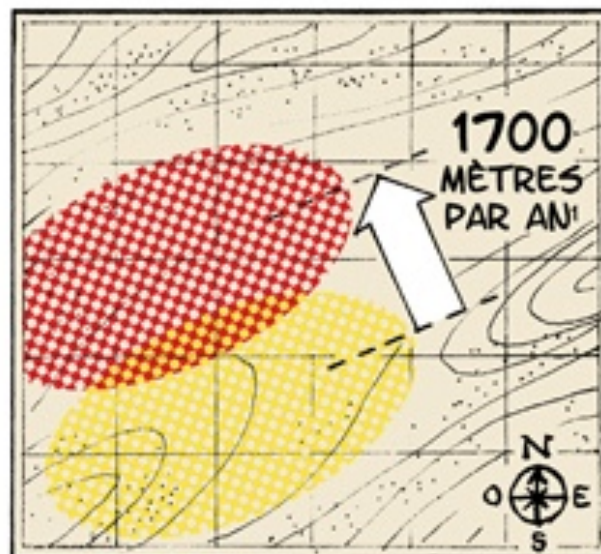


Altitude:  
11.0 m per decade

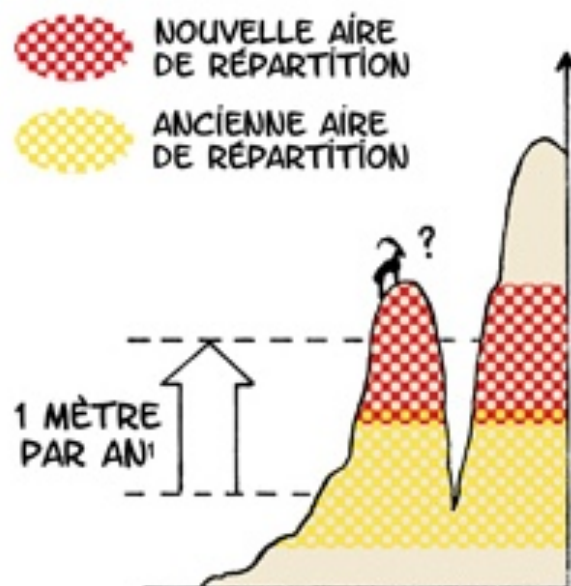


ELLES SE  
DÉPLACENT VERS  
D'AUTRES ZONES

'''



''' CHANGENT  
D'ALTITUDE.





# What happens next?

Queensland

65 endemic species



S. Williams *et al.*, *Proc Roy Soc. B*, 2003

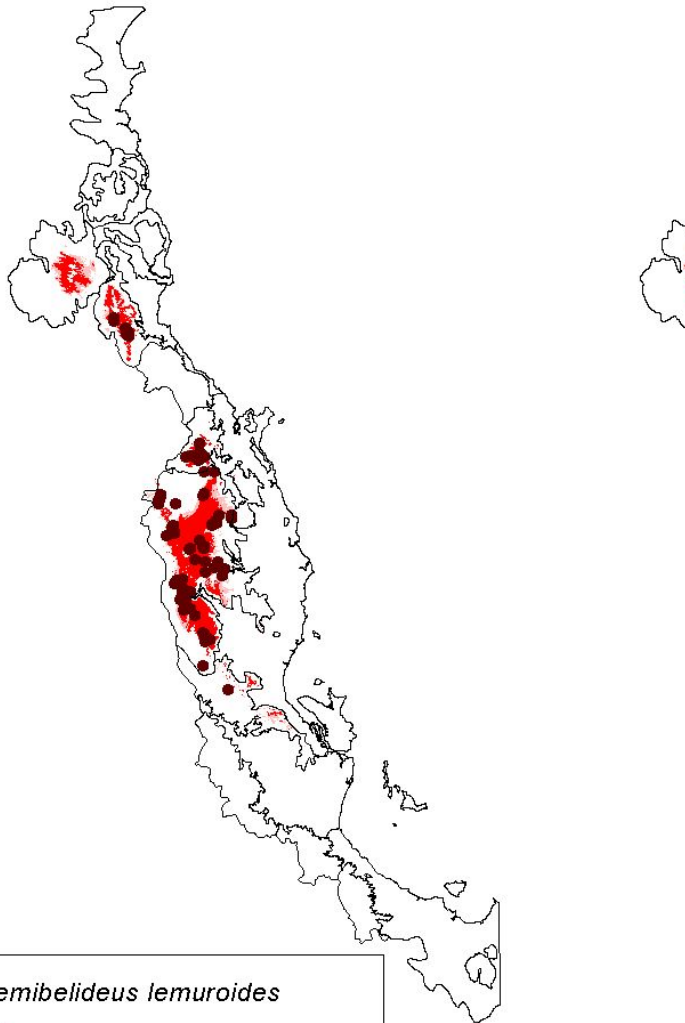


# Lemuroid Ringtail Possum

S. Williams *et al.*

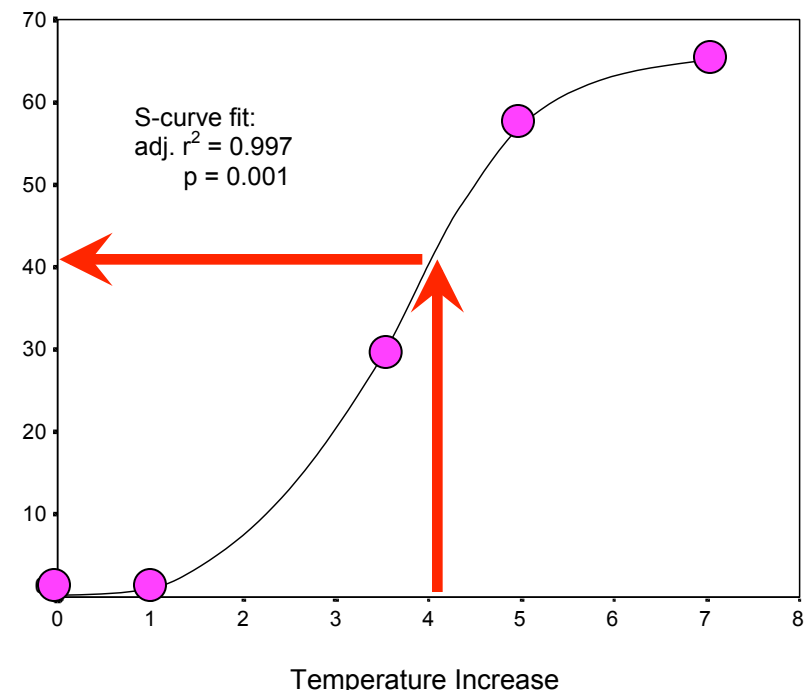
Present

+



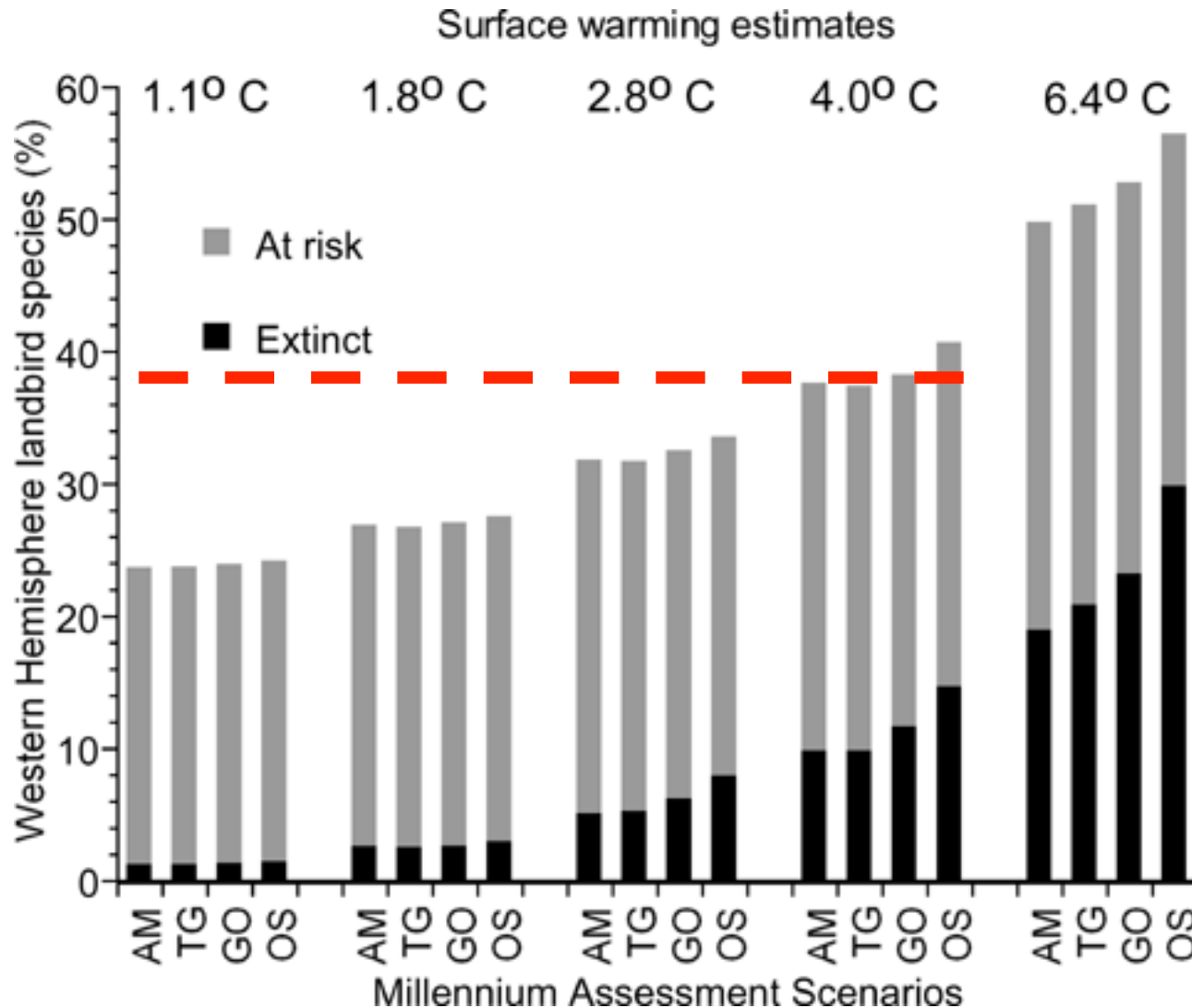
S. Williams *et al.*

Number of  
surviving  
endemic  
species

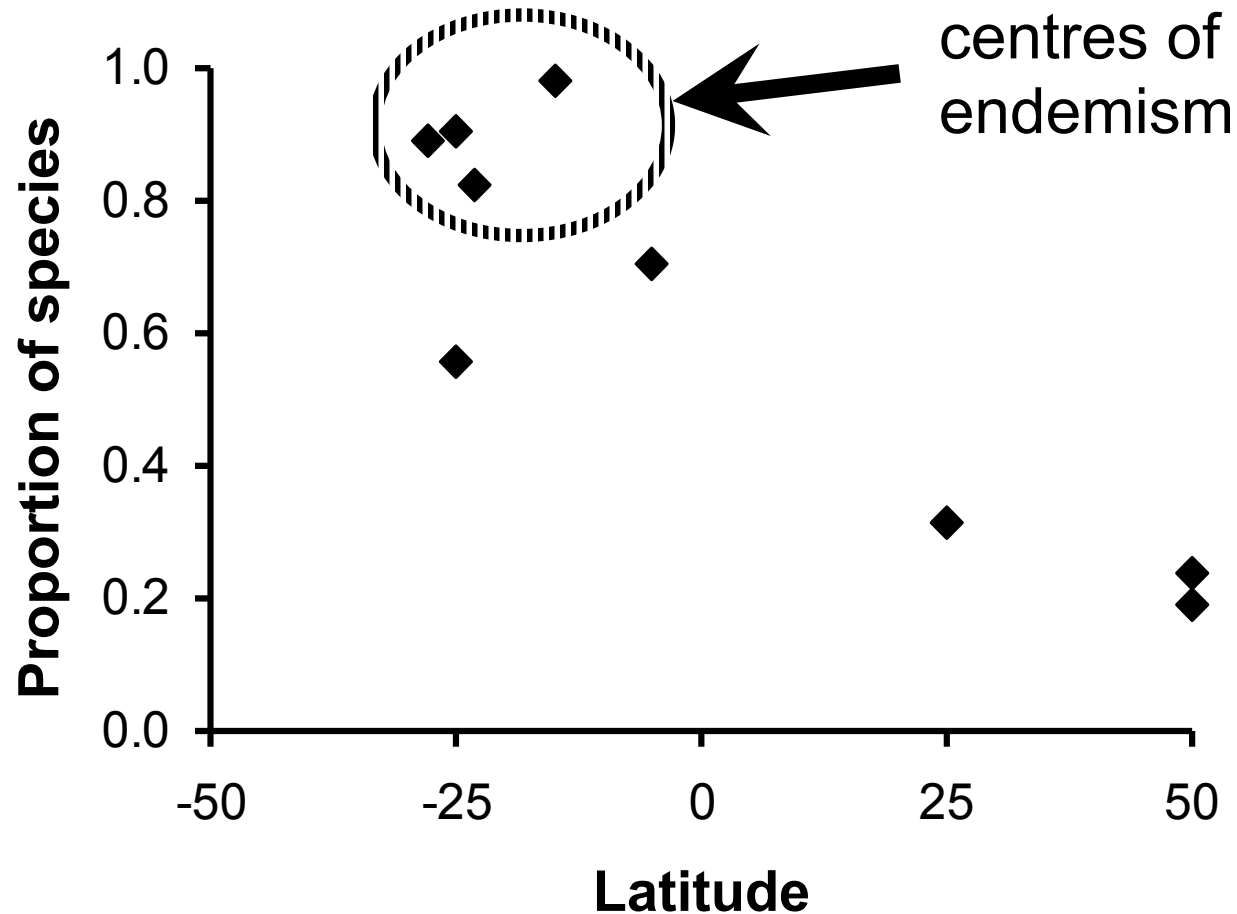




# Climate change and Bird Extinctions: New World



Proportion of species expected to lose over 50% of suitable range area by 2050 (mean of dispersal and climate scenarios)





# Ball park at +4°C :

- **25% to 50%** of species with no overlap between existing range and the type of climate they appear to need (especially high in centres of endemism)
- About half of these with no other suitable climate within the same region

# Trends in Ecology & Evolution

Lynx in the UK? Species  
translocation as a response  
to climate change

Cell  
PRESS

Thomas, *TREE* (2011)

## OPINION

# Shelter from the storm

Some places are ideal havens for species threatened by climate change. One is Britain, and it should throw open its doors, says **Chris Thomas**

VISIT an estuary or wetland in the lowlands of Britain and chances are you will see a slender white bird called the little egret. Although widespread, the species is a recent arrival from more southerly latitudes: the first breeding population established itself in 1996.

The little egret isn't the only one. As the climate warms, species all over the world are relocating to higher latitudes at an average rate of 17 kilometres per decade.

However, some species are unable to relocate – those restricted to the summits of single mountain ranges, for example. Many are projected to become extinct.

What are the options for such species? One possibility is "assisted colonisation", which means deliberately introducing them into areas where the



Thomas, *New Scientist* (2011)

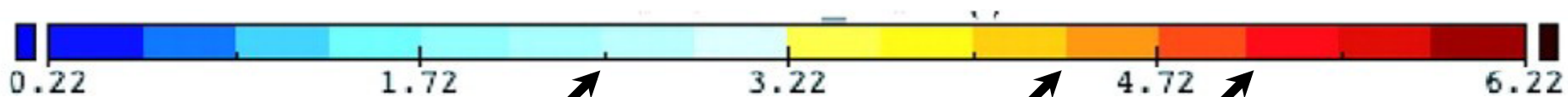
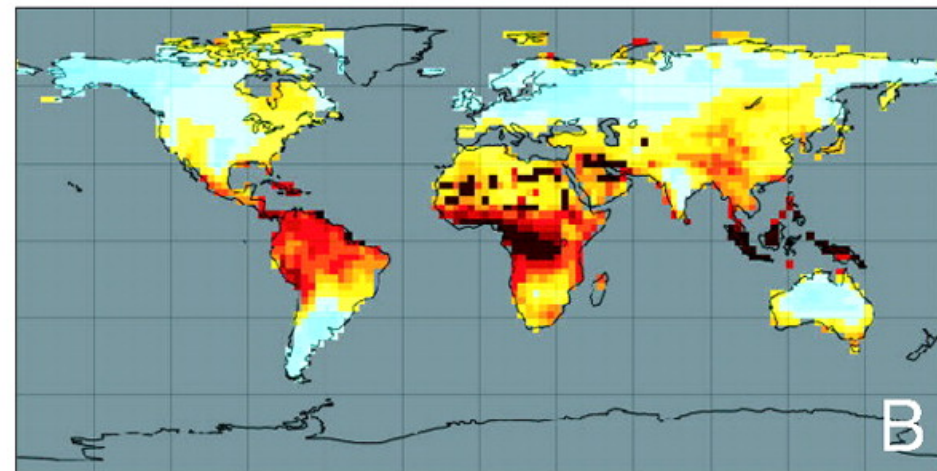
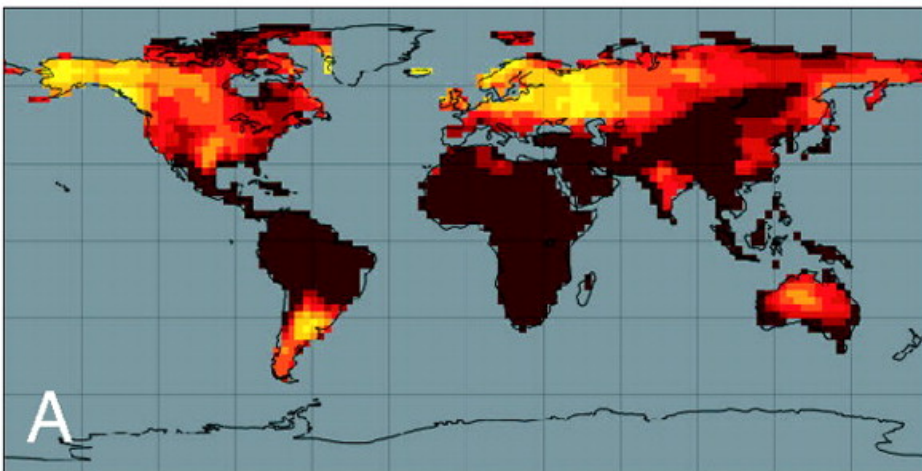


# Mapped indices of climate change risk for end of 21st-century climates

A2 (3.4°C)

Local Change

B1 (1.8°C)



<1/100

<1/100,000

<1/1,000,000

“once in a million” year becomes the norm in red/dark areas

PNAS

Native species



*Ilex aquifolium*

New biological  
assemblages:  
Walther *et al.*  
*Nature* (2002)



*Cinnamomum  
glanduliferum*

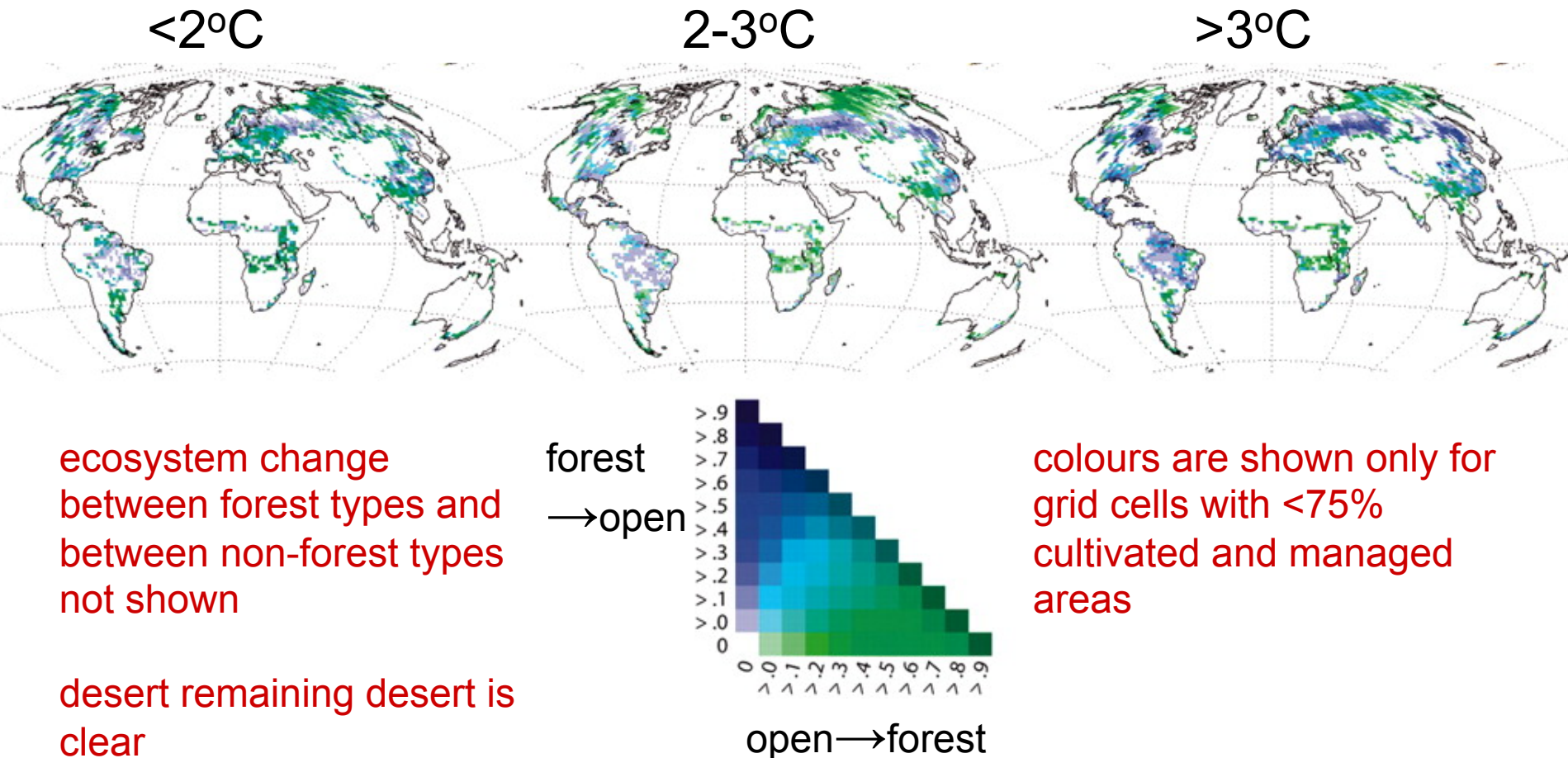
Introduced  
species

*Trachycarpus  
fortunei*





# Probability of exceeding critical levels of change between 1961–1990 and 2071–2100 for three levels of global warming.



# Conservation strategies

## Broad strategy

- *in situ* (reserves, protection, etc. in existing range)
- *ex situ* (zoos, botanic gardens, gene/seed banks )
- *trans situ* (moved to new locations)

## Recent

primary

secondary

trivial

## Future

increased

(more, bigger, better, heterogeneous, engineered)

increased

(gene banks, for *trans situ*)

increased

(joined up, moved)



# Conclusions: at + 4°C

1. The *status quo* (or reverting to the past) is not tenable
2. Our current philosophy of “natural” and “native” are blown out of the water
3. Ecosystems and biological communities fundamentally changed – but we still like them!
4. A major programme of establishing “refugia” is in place
5. Conservation strategies for perhaps a third of species involves moving them around the planet
6. Mega-wildlife parks and countries (e.g., Britain) focus on receiving biological refugees
7. Mass transfer and major engineering solutions are underway to prevent ecosystem collapses
8. We are reviled as the generation that failed to act

Report: One-third of all species could be extinct in 50 years due to global warming.

THE SCENERY  
ISN'T LIKE  
IT WAS IN THE  
SUV COMMERCIAL.



## Off-Road Kill

TOLLS

UNIVERSAL PRESS SYND.  
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ABOUT ELEVEN  
SPECIES PER GALLON