



# Tuatara nesting and climate change

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# Can we effectively conserve tuatara in the face of climate change?

1. Ensuring protection from causes of decline
2. Attention to genetic diversity
3. Future proofing for climate change

YES we can effectively conserve tuatara

# Climate change threat

One species – isolated populations

No capacity to migrate

Cold-adapted physiology

Temperature-dependent sex determination

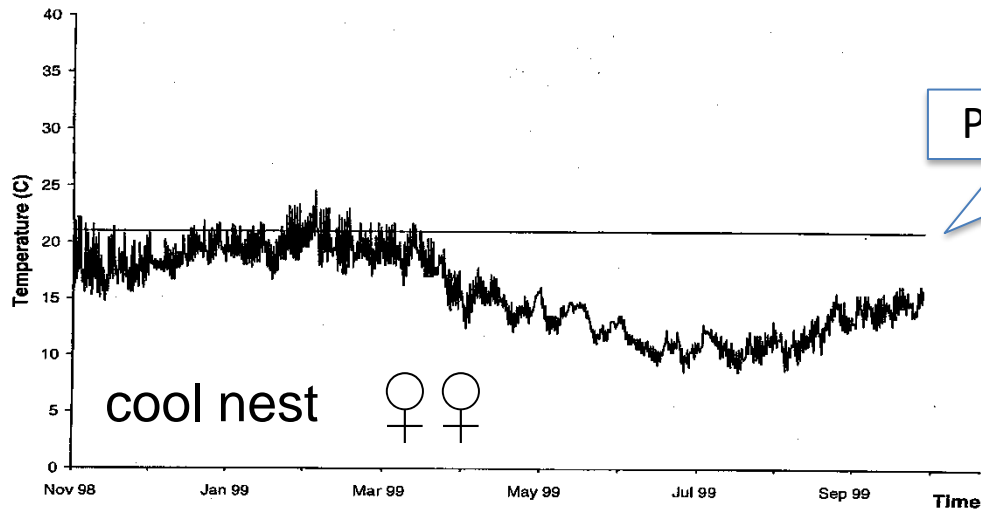


North Brother Island



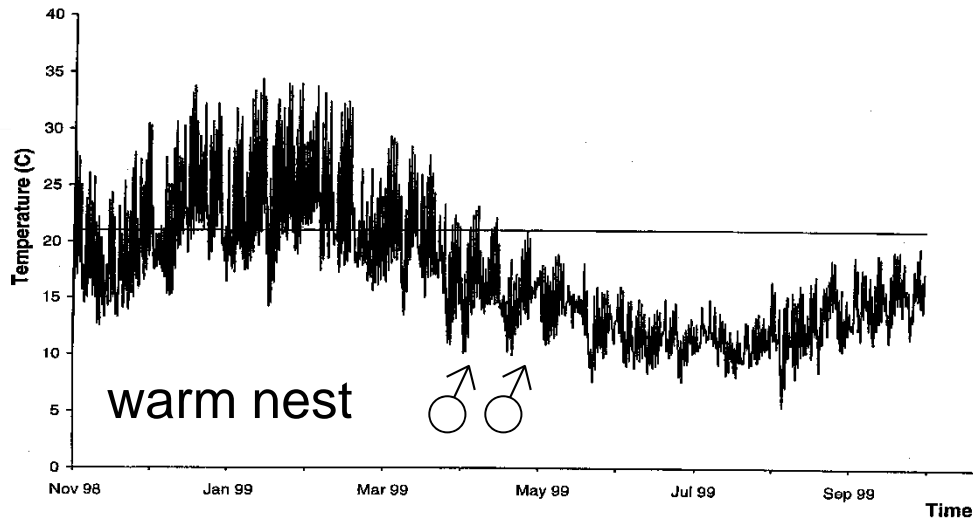
Tuatara nest with datalogger

# TSD – males from warmer nests



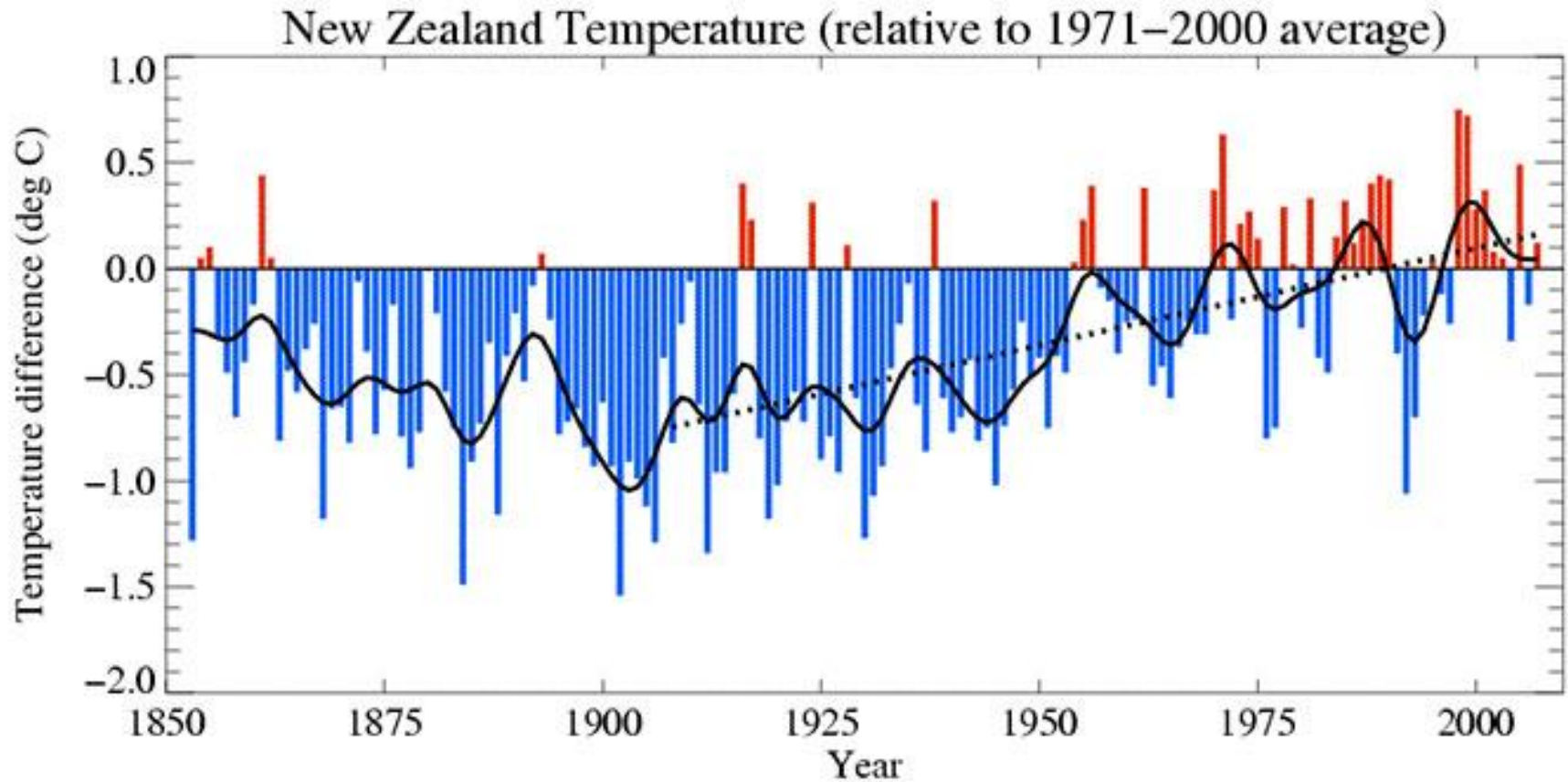
summer

winter



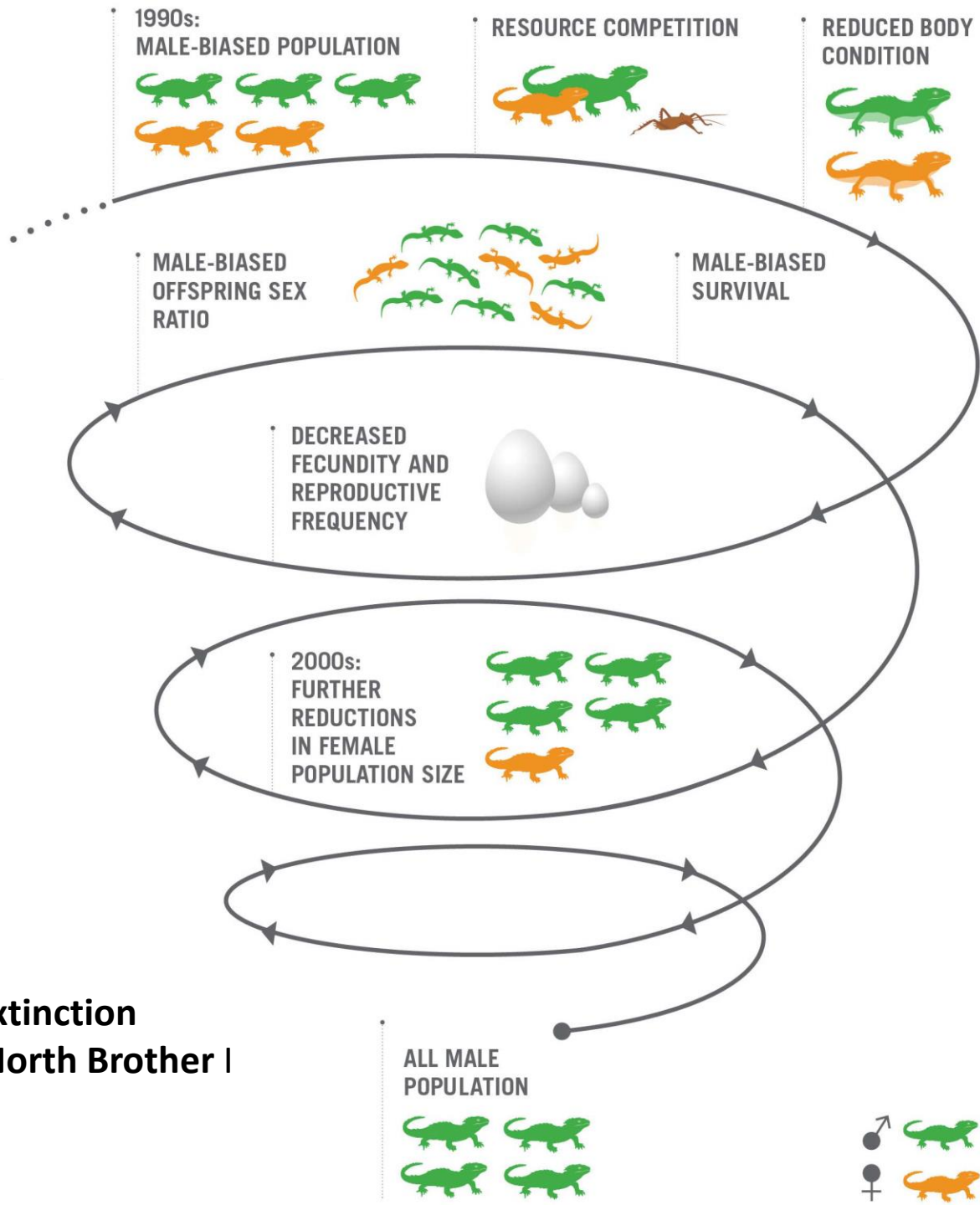
# More warm years expected

- concern for male bias in tuatara populations

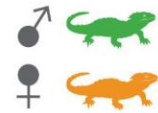




North Brother Island – 65% adult male tuatara

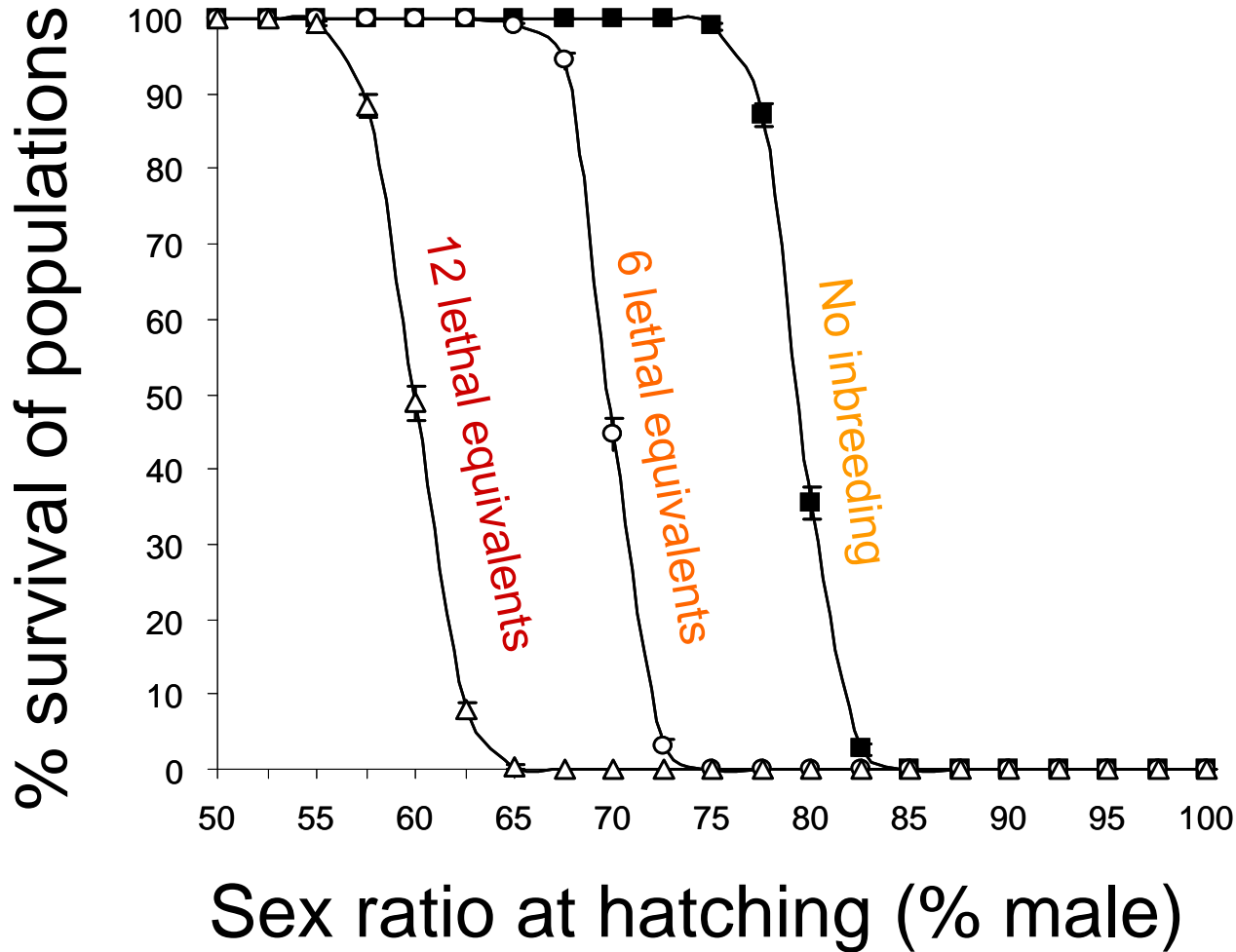


**Concern: extinction vortex on North Brother I**

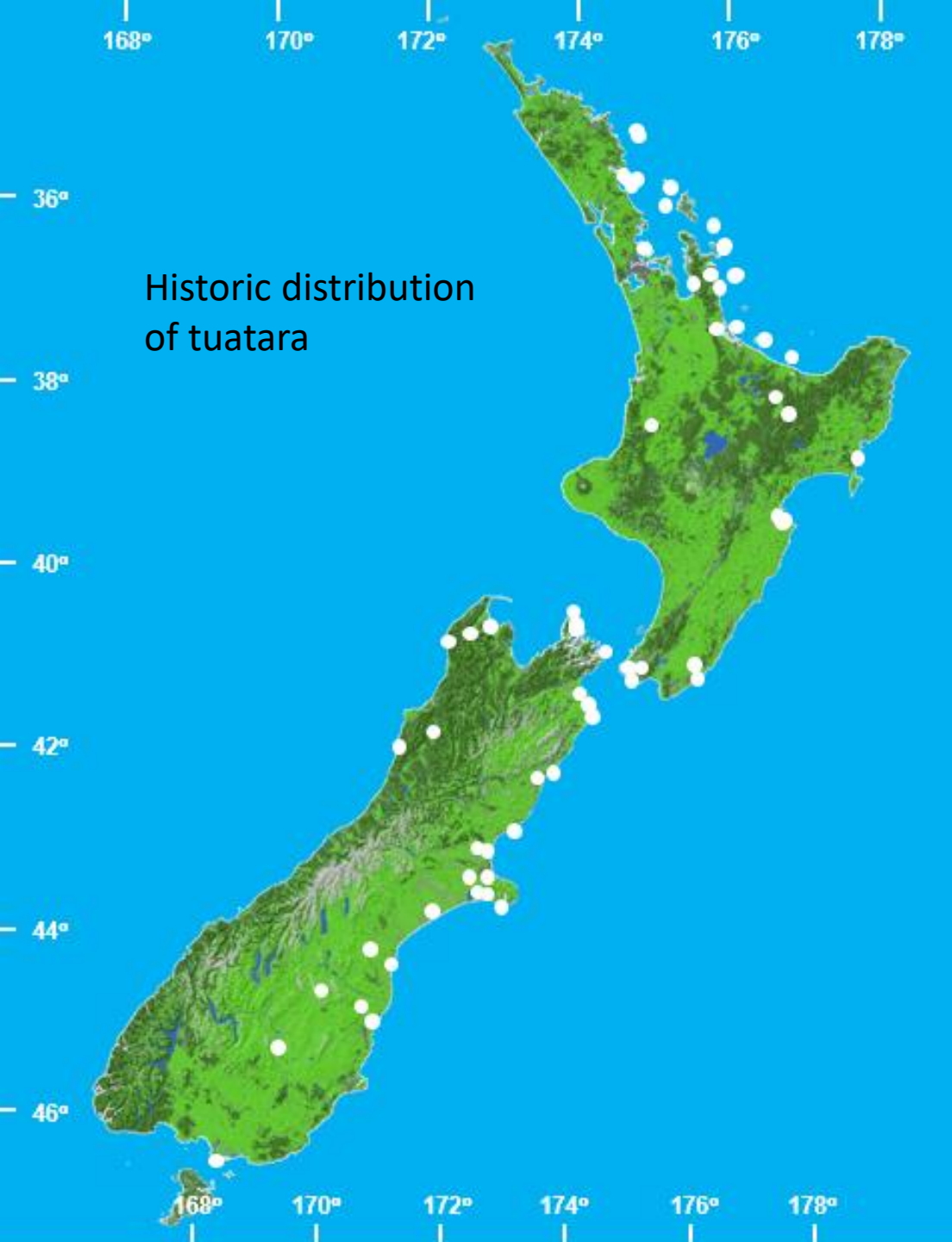


# Climate change and genetic diversity

Mitchell et al. 2009, Global Change Biology

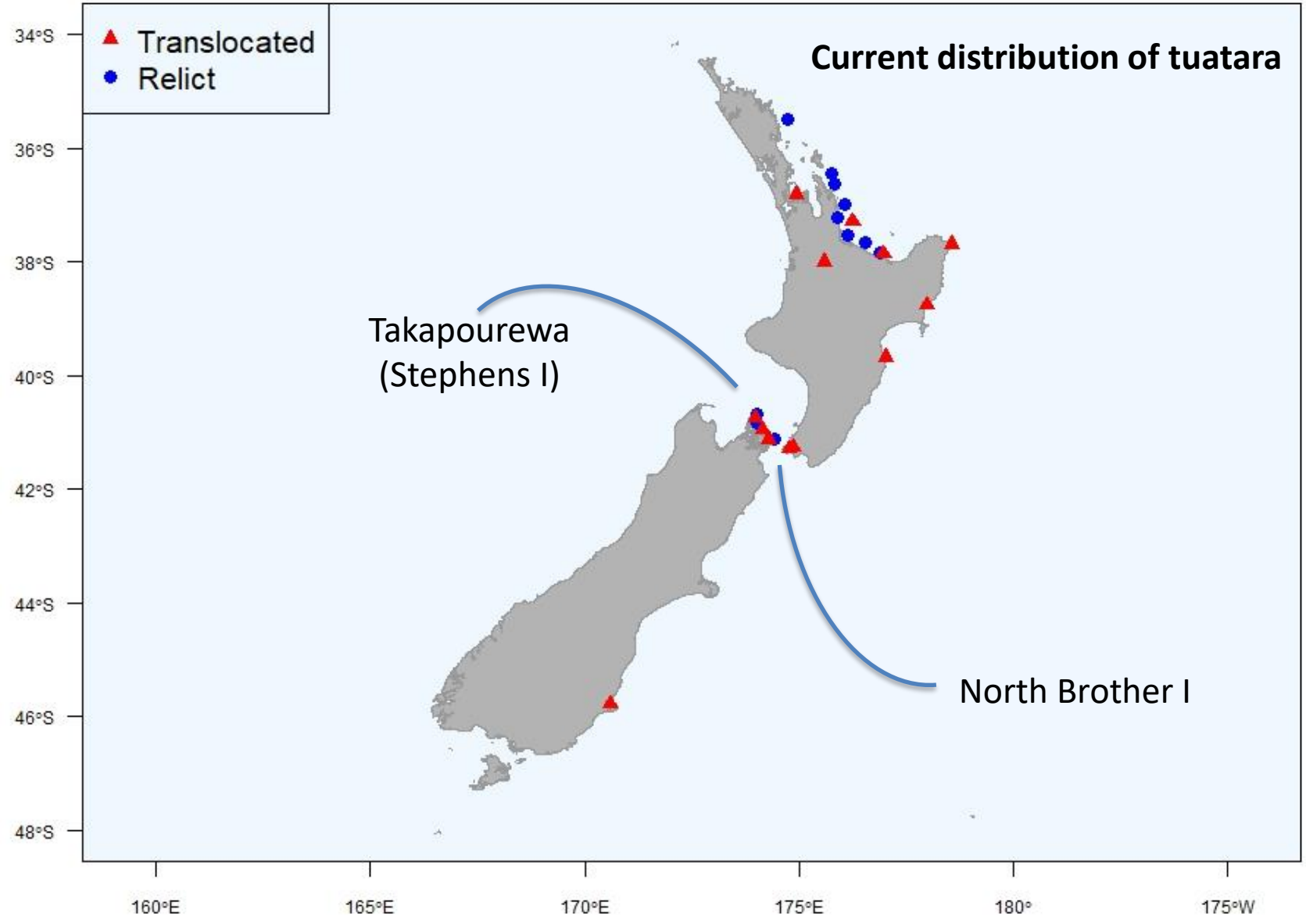






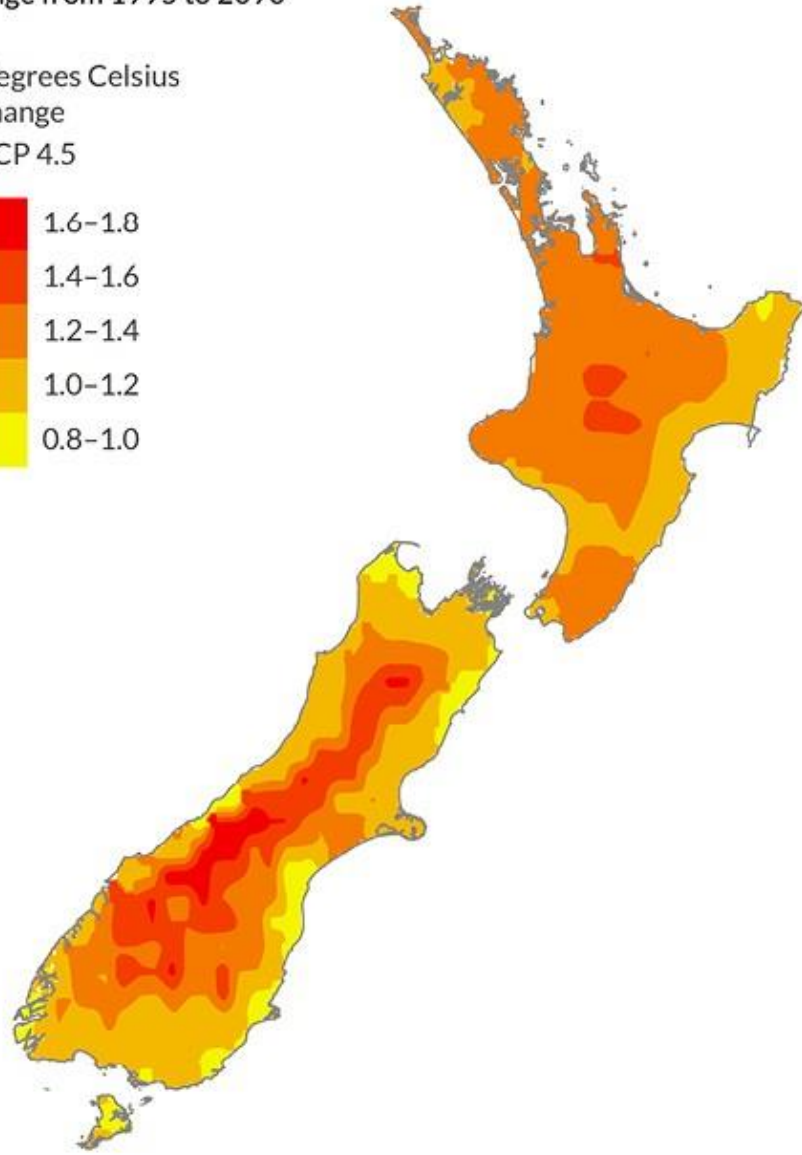
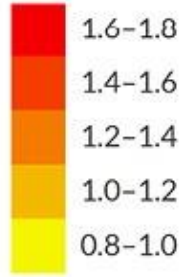
# Current distribution of tuatara

- ▲ Translocated
- Relict



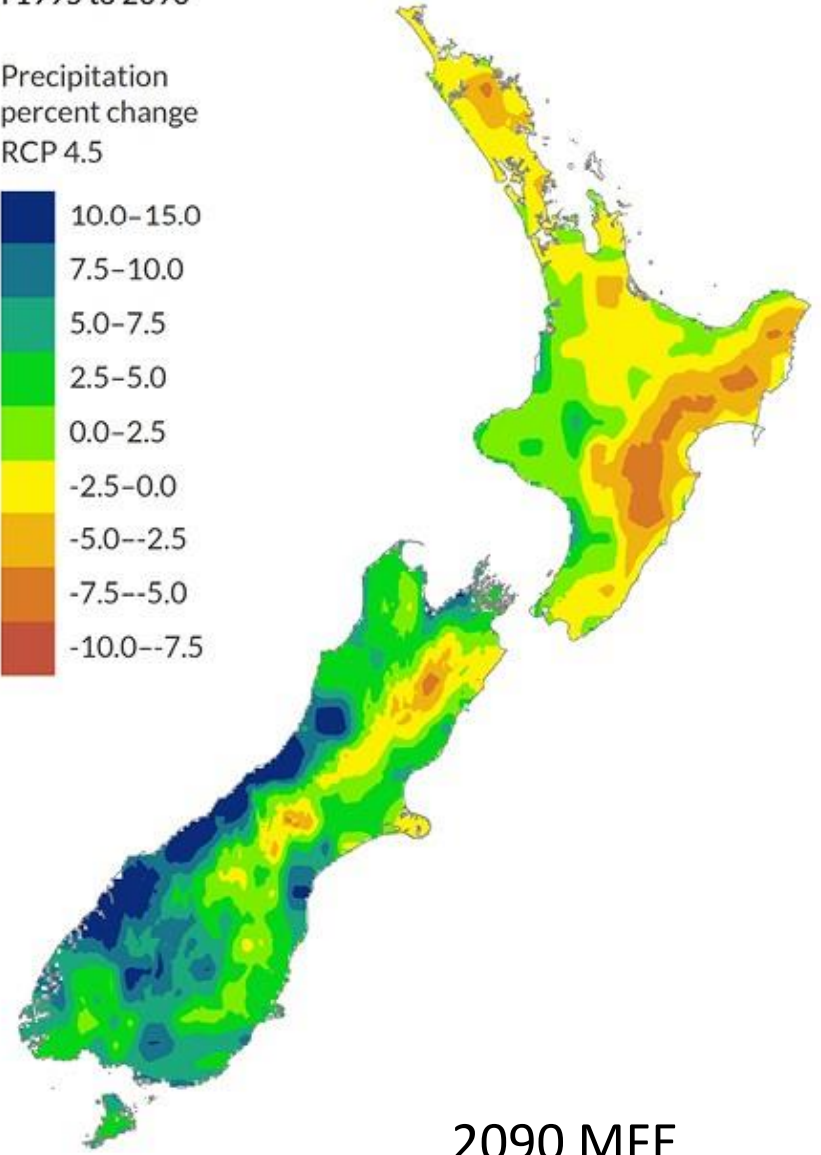
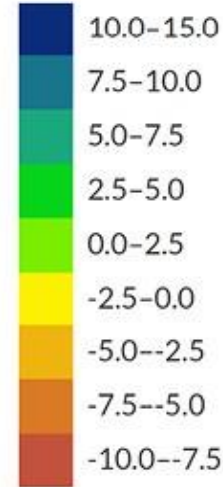
Projected annual mean temperature change from 1995 to 2090

Degrees Celsius change  
RCP 4.5



Projected annual mean precipitation change from 1995 to 2090

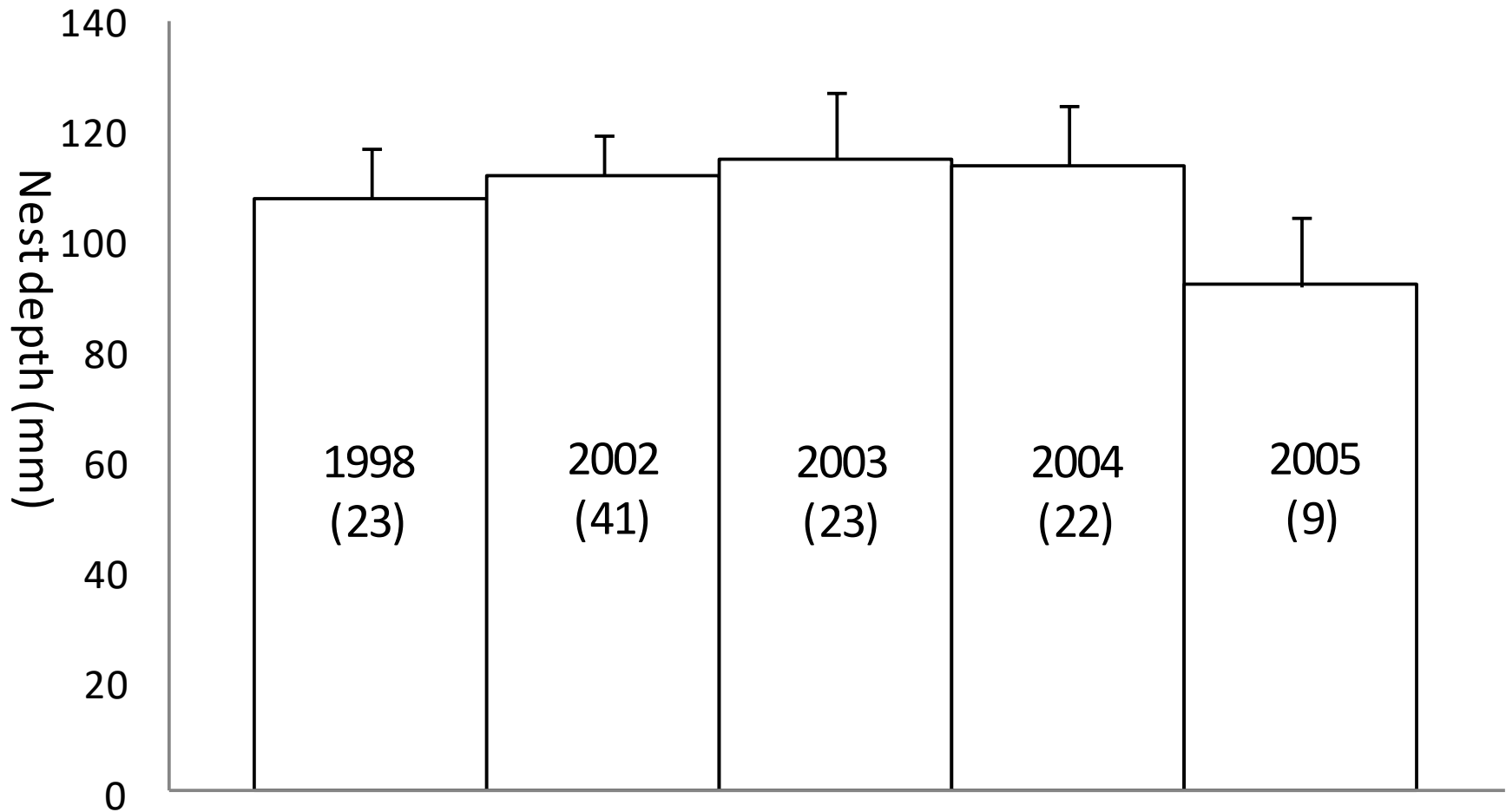
Precipitation percent change  
RCP 4.5



2090 MFE



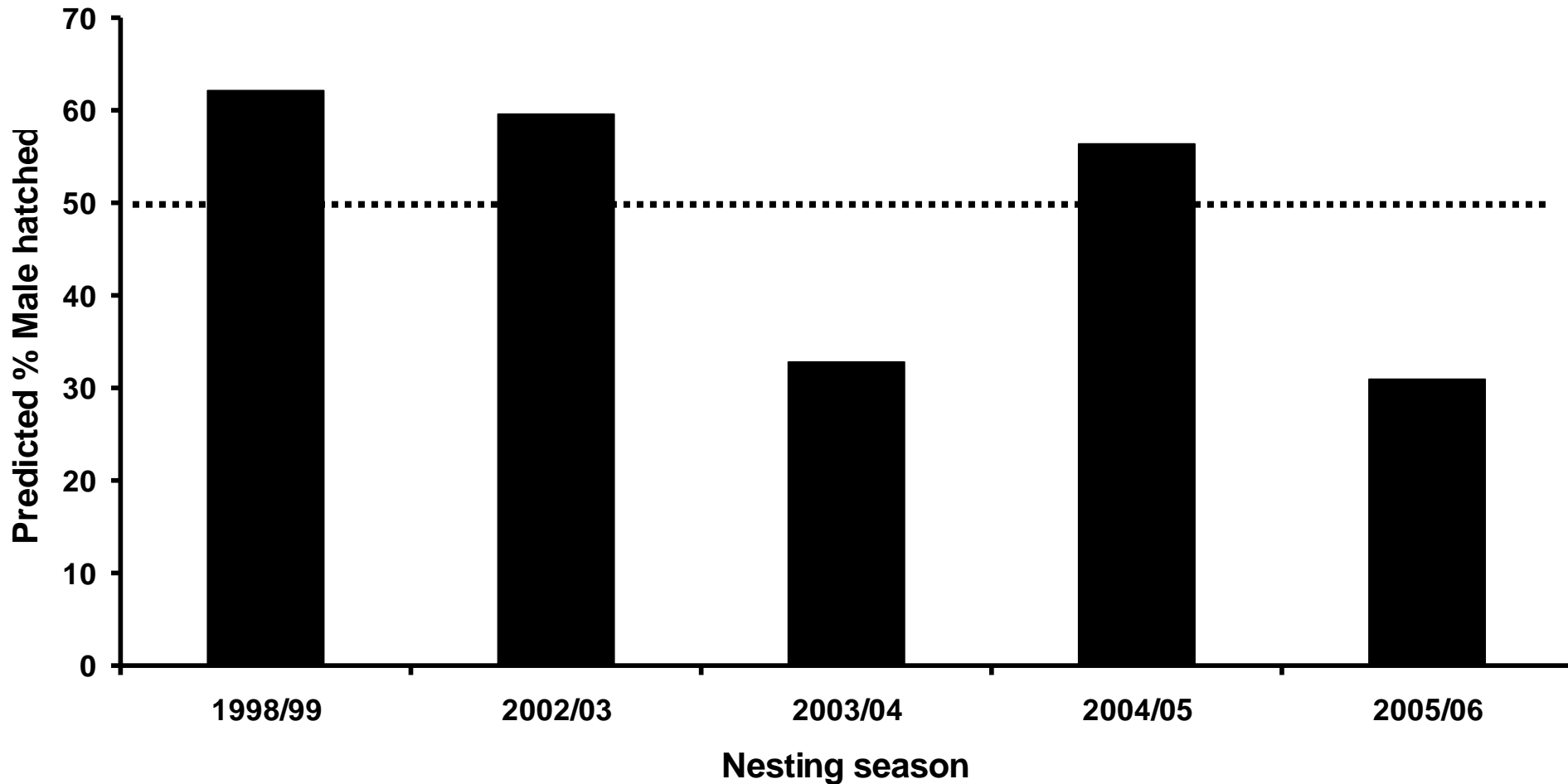
Tuatara nest for success – no significant variation among years  
Average nest depth  $111 \pm 0.4$  mm



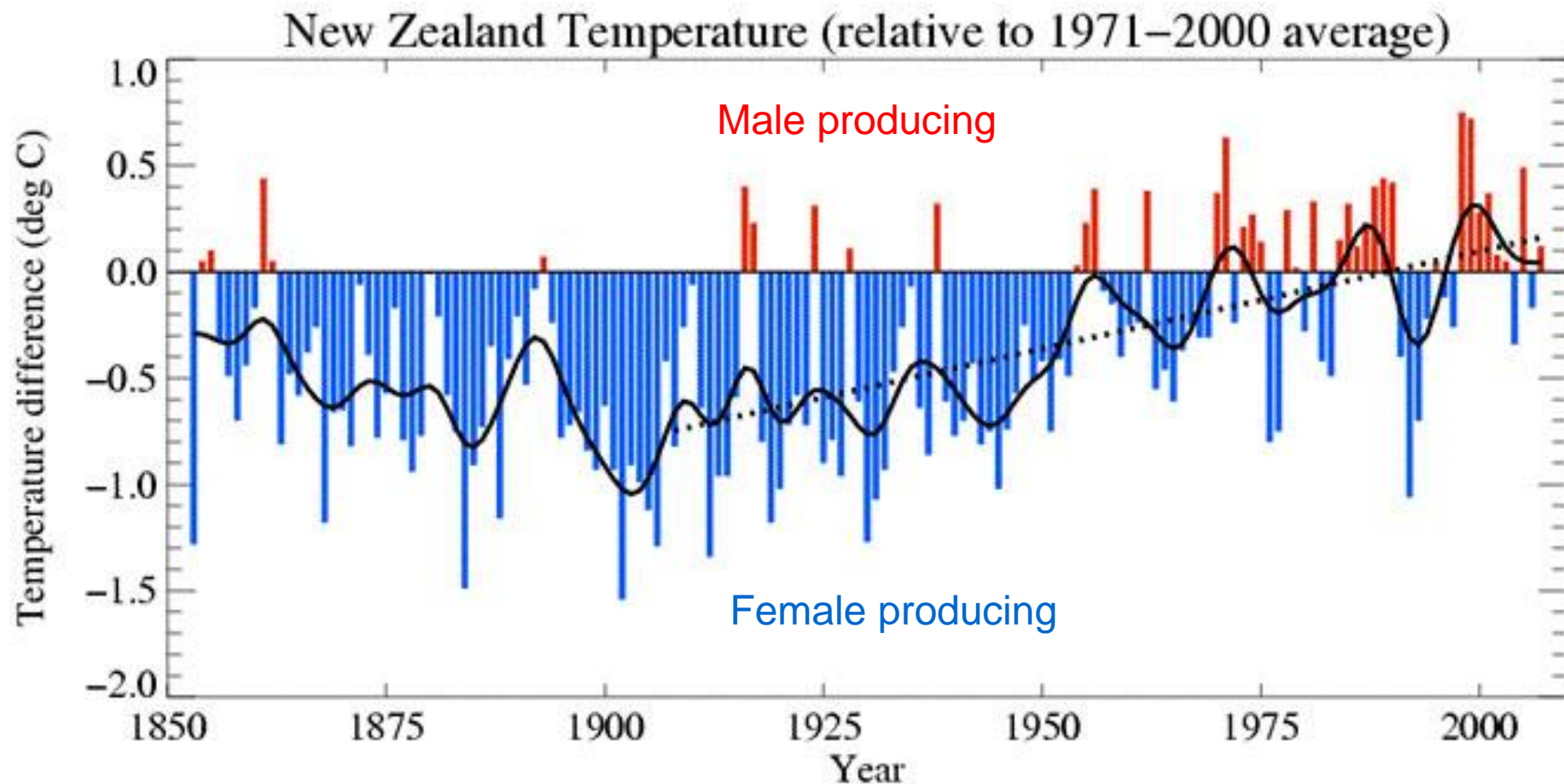


Sex ratio varies with rookery

# Predicted sex ratio varies annually



# Warm years predicted to produce more males





# Predictions

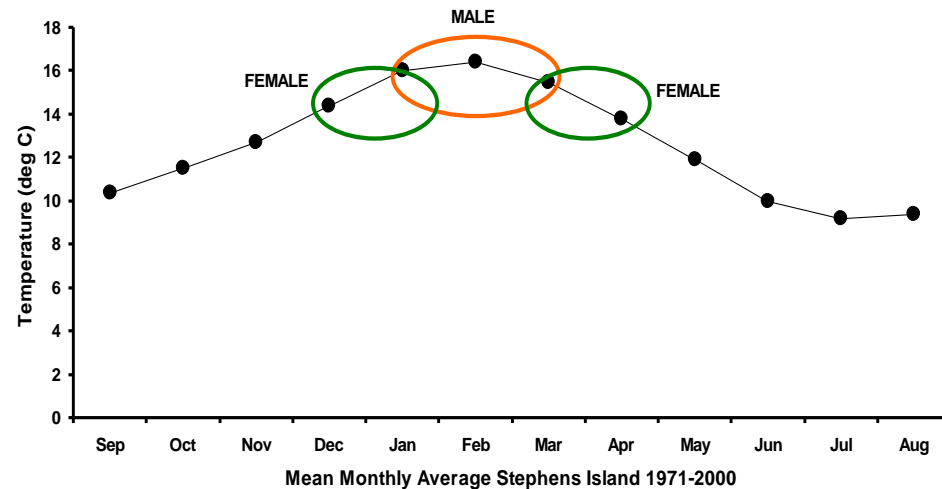
Early nesting can produce *female* bias

Late long thermosensitive period can produce *female* bias

Robust system to ensure both sexes

Female behaviour may be able to moderate

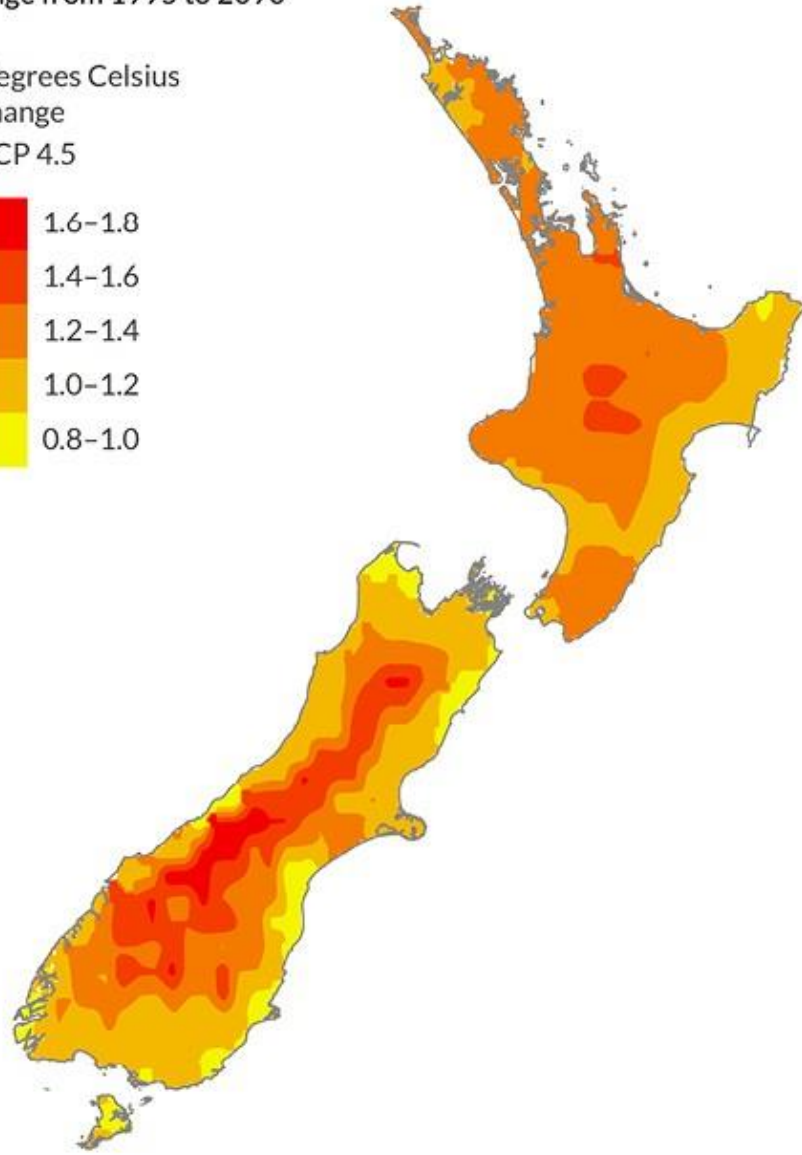
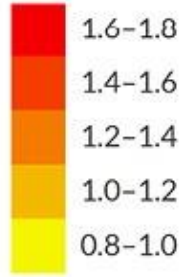
Habitat variability is crucial





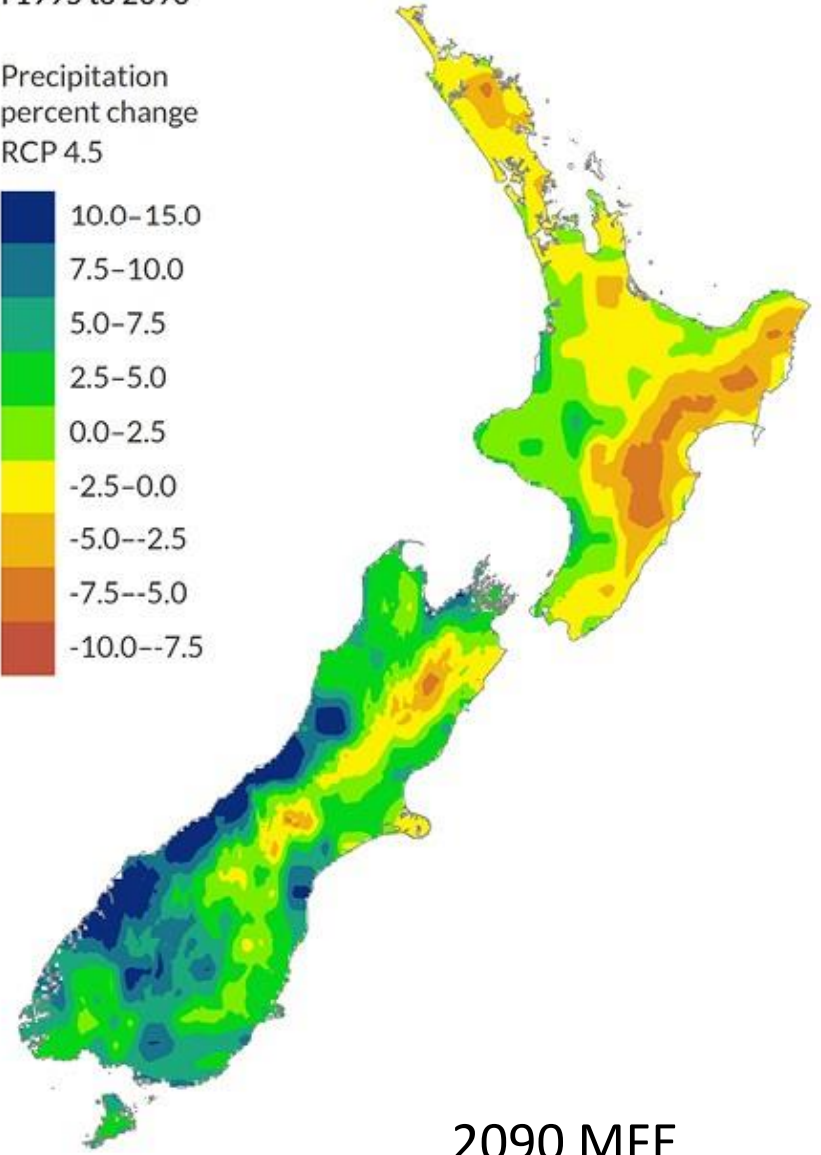
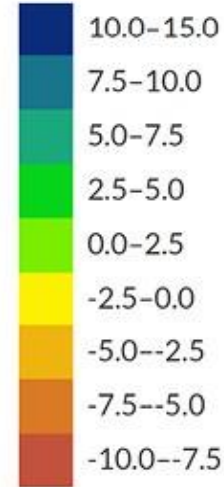
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Projected annual mean precipitation change from 1995 to 2090

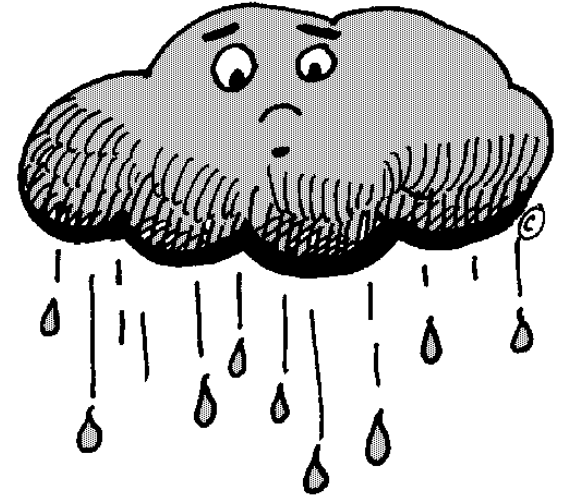
Precipitation percent change  
RCP 4.5



2090 MFE

# Other facets of climate change

- Water levels
- Extreme weather events
- Water availability



# Future work

aspects of water on nesting success

site fidelity for nesting

monitoring sex ratio and implications on North Brother

sex ratios in other populations

importance of our natural experiment at sanctuaries

# Acknowledgements

San Diego Zoo, Tumbleweed Tees, US National Science Foundation, Centre for Biodiversity and Restoration Ecology for funding

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