Seabirds and climate change – double trouble

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Outline

1. Introduction
2. Problems at sea
3. Problems on land
4. Conclusions and directions

1. Introduction

- Seabirds have a divided life-cycle

They breed on land

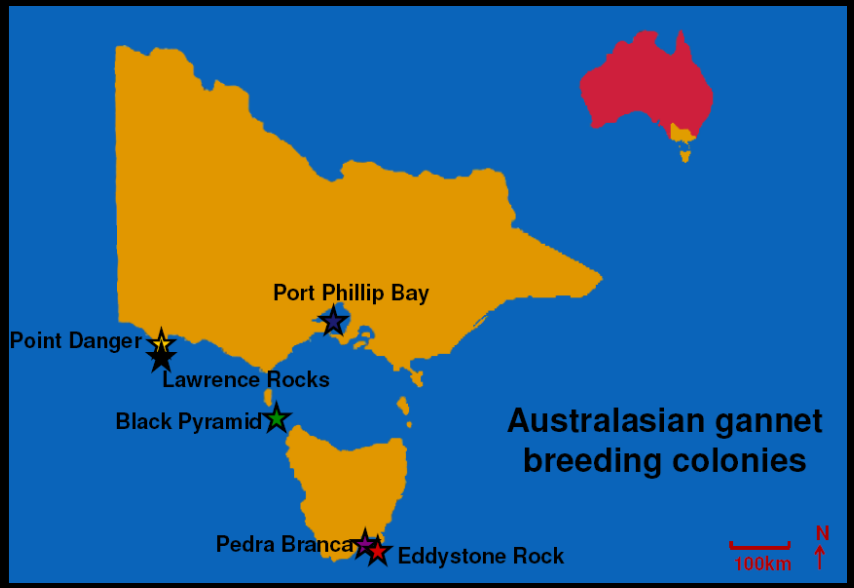
They commute between the two

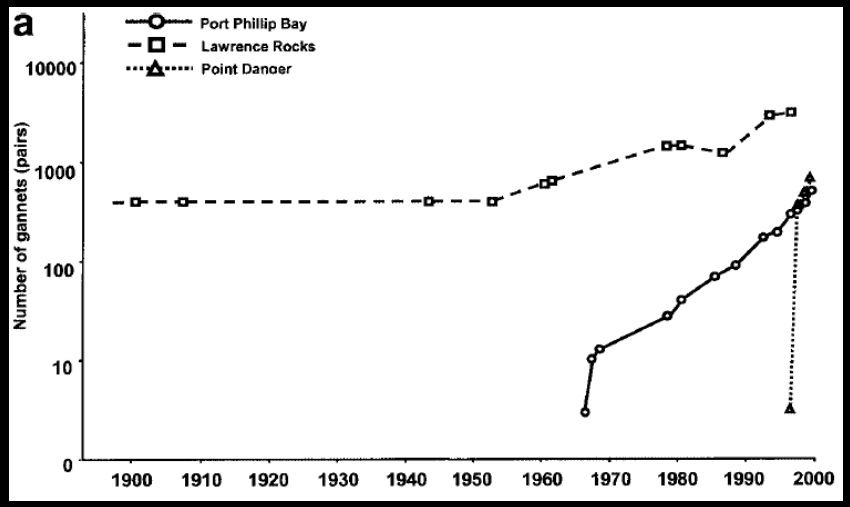
They feed at sea

- Each of these presents its own challenges
- Climate change will affect seabirds at every stage

Australasian gannet

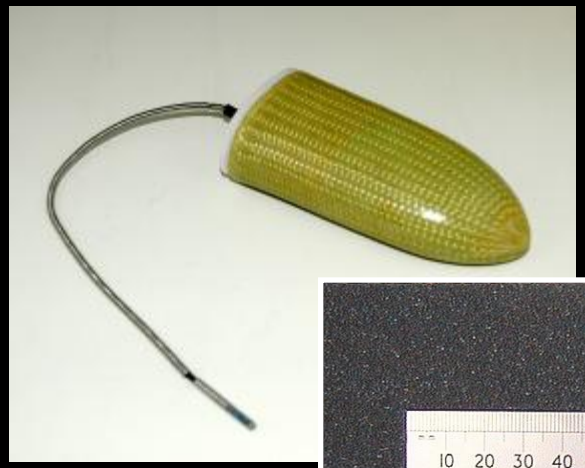
(*morus serrator*)

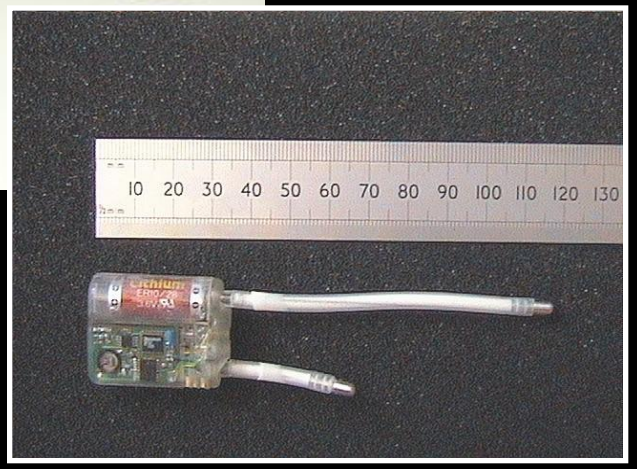




- Plunge-diving piscivore
- Generalist diet
- Restricted range
- Cool temperate waters
- Increasing population size
- Limited by nest site availability

Study methods





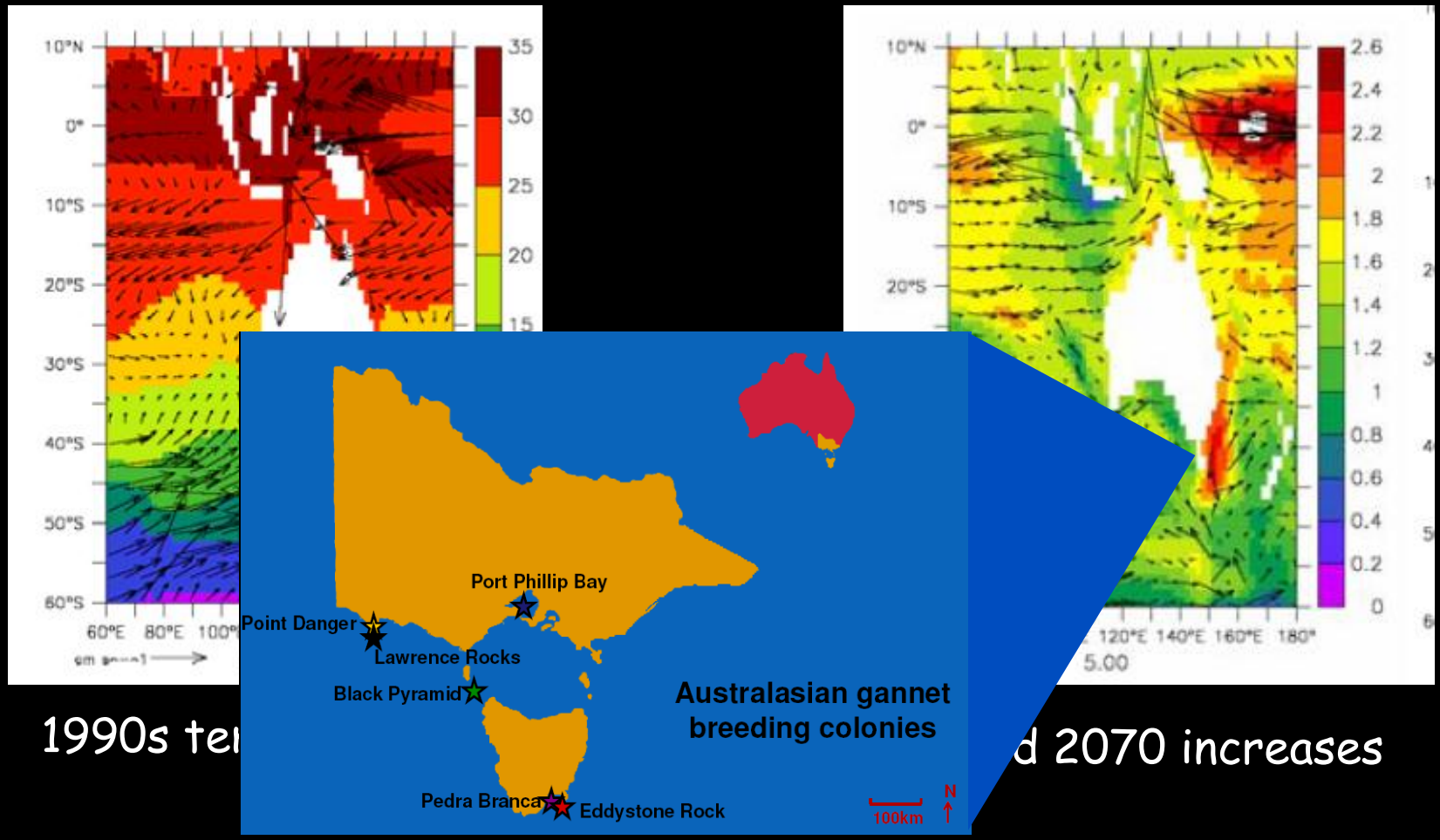
- Data loggers

- Colony monitoring

- Diet sampling

- Laboratory experiments

2. Problems at sea



1990s ter d 2070 increases

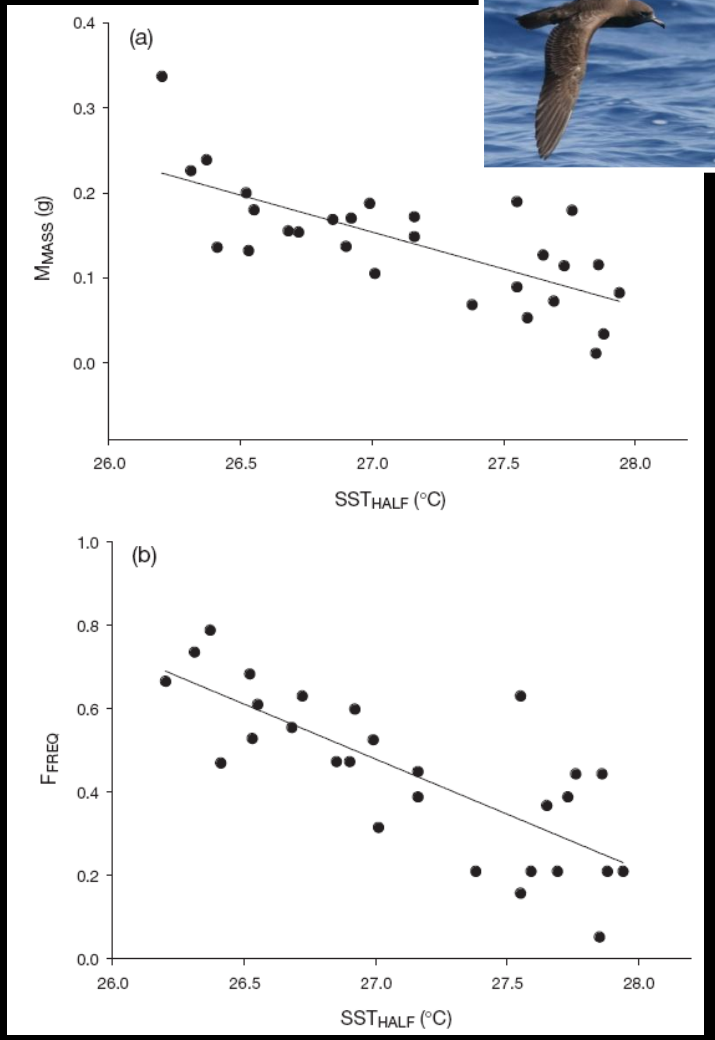
- Australasian waters will warm up
- SE Australia and Tasman Sea worst affected

Predicted effects I

- "SST & Southward flow of EAC predicted to lead to:
  - Changes in phytoplankton abundance and distribution and timing
  - Southward movement of zooplankton, affecting their predators
  - Benthic and demersal fish will keep shifting south, most prominently in E and SE regions
  - Changes in temperatures, current patterns, and primary and secondary production may affect larval fish health and transport thereby influencing recruitment potential
  - Pelagic fish & seabirds will move or expand ranges Southwards
  - Nesting & feeding habitats lost"

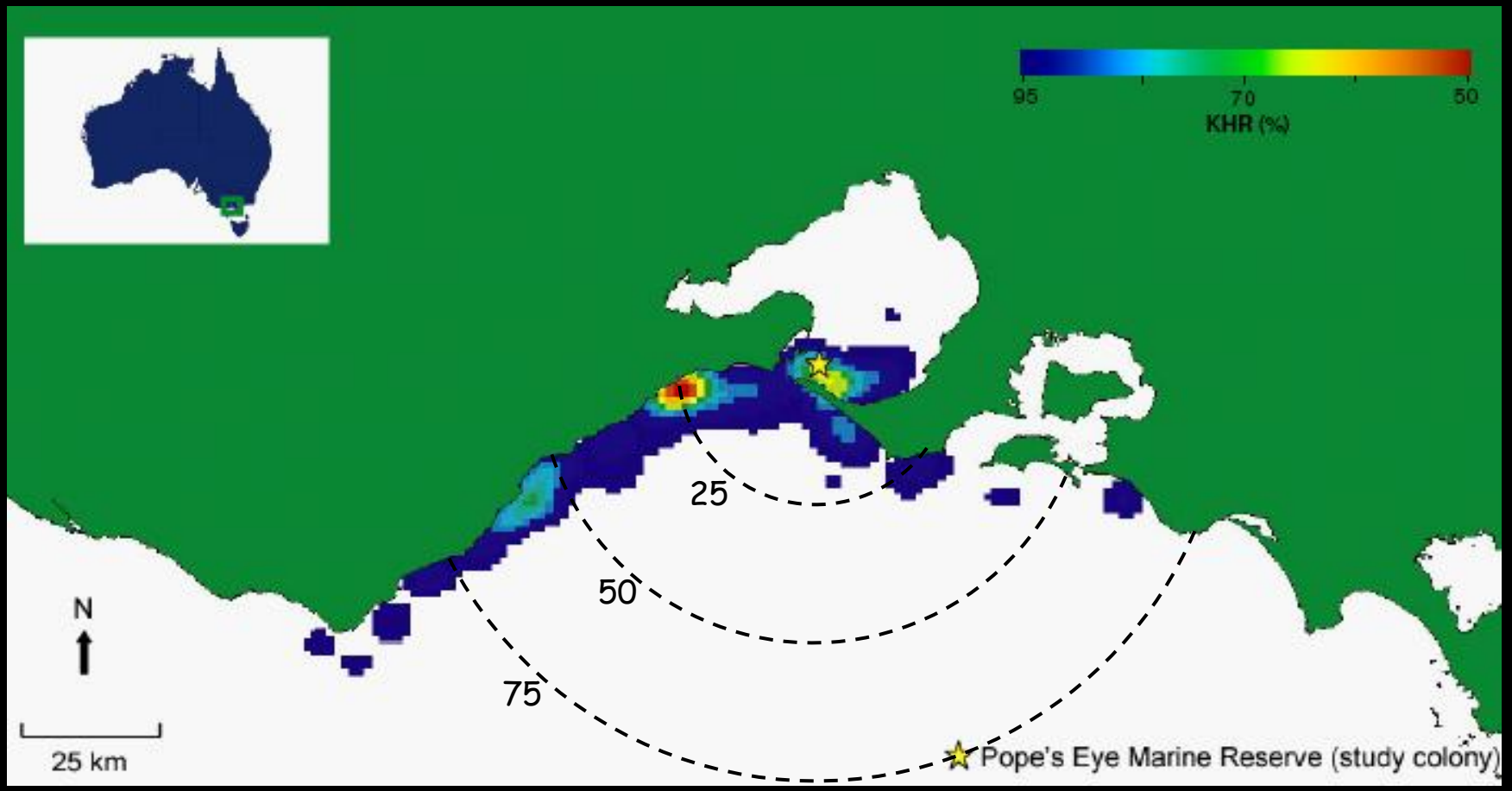
Australian Greenhouse Office (2006)

Predicted effects II



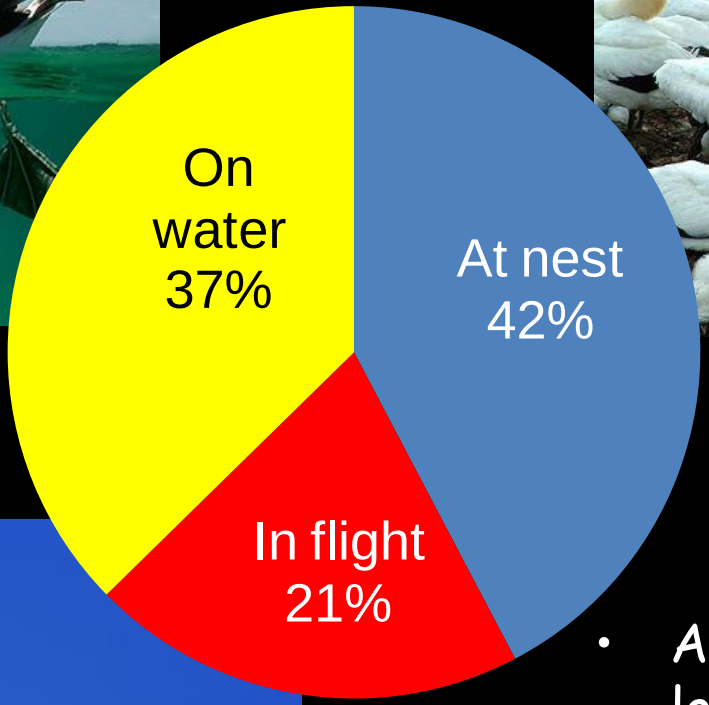
- Increases in SST have had negative effects on breeding of some species of seabirds
- But what is the mechanism underpinning these changes?
- Can we use seabirds to monitor changes in ecosystems due to climate change?

(Frederiksen et al, 2007, Peck et al, 2004)



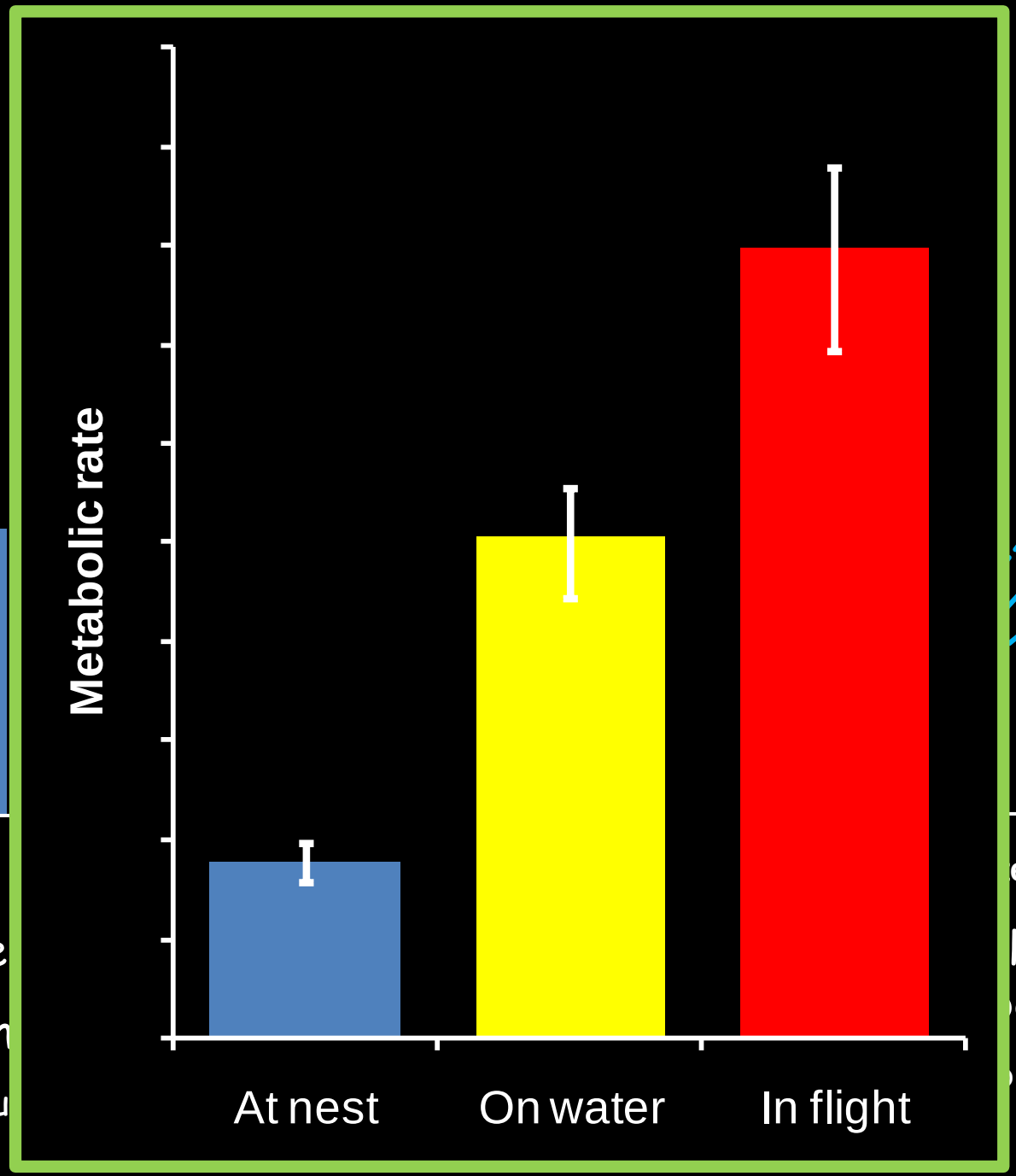
- Australasian gannets forage relatively close to their breeding colony
- Foraging occurs in shallow coastal waters 16 – 19 ^{o}C
- Feed on inshore schooling pelagic fish

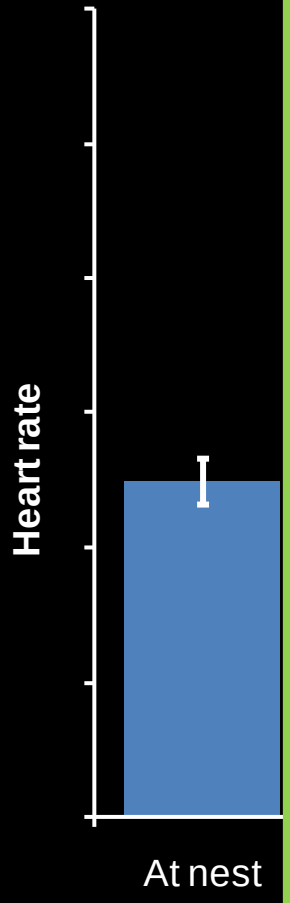
(A. Bunce, unpublished data)

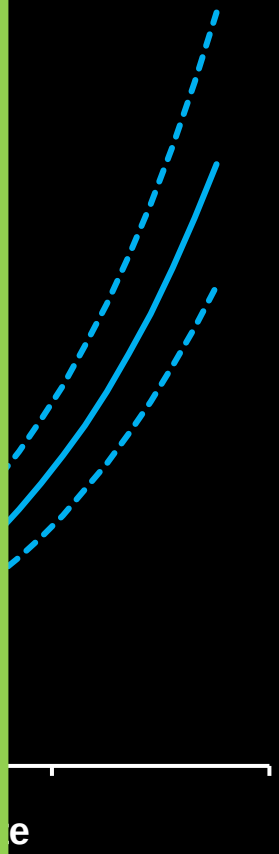


- Analysis of data loggers tells us how the birds allocate their time

(Green et al, unpublished data)







- Heart rate
- Variable en

(Green et al, unpu

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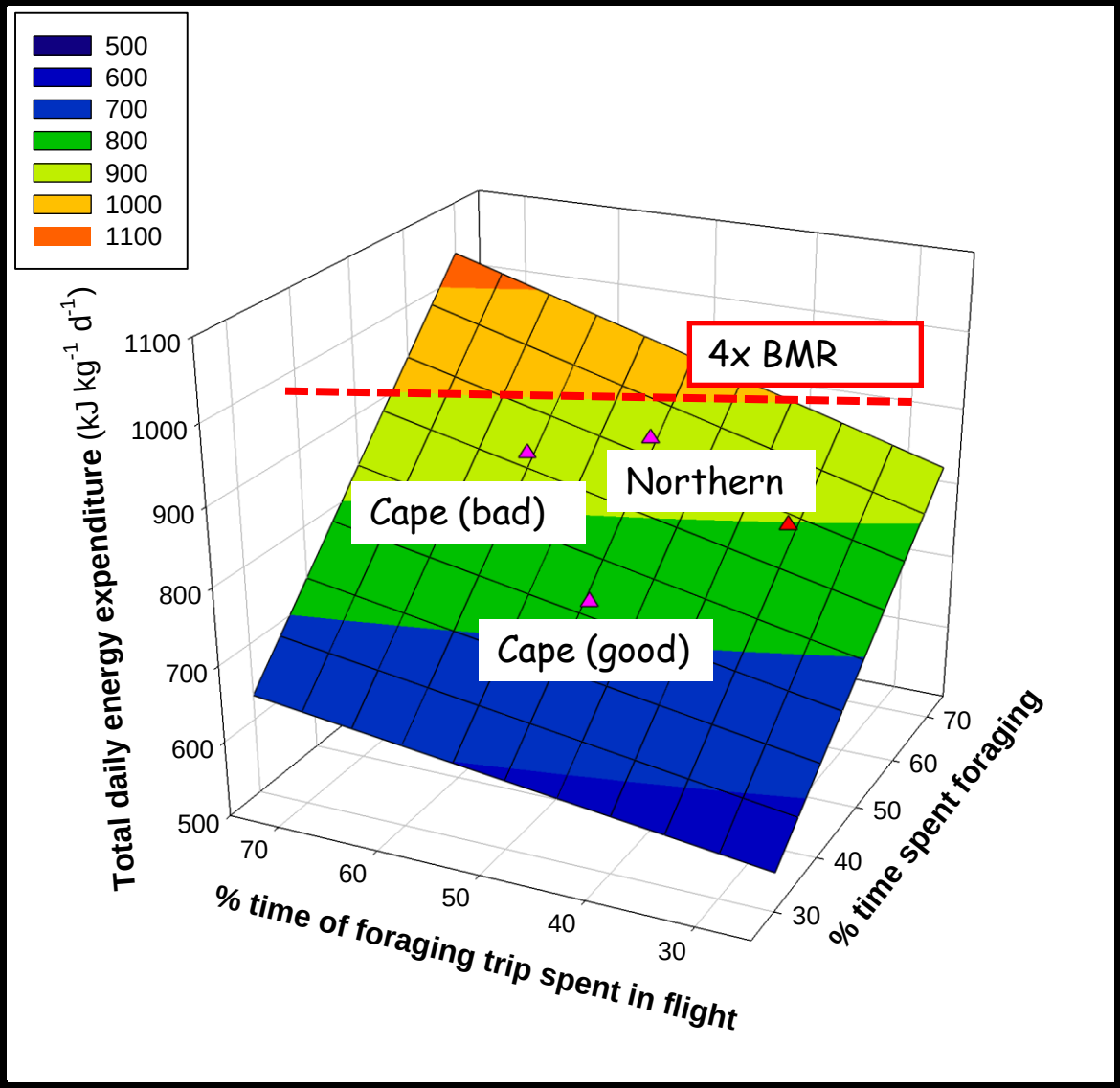
oratory
lished data)

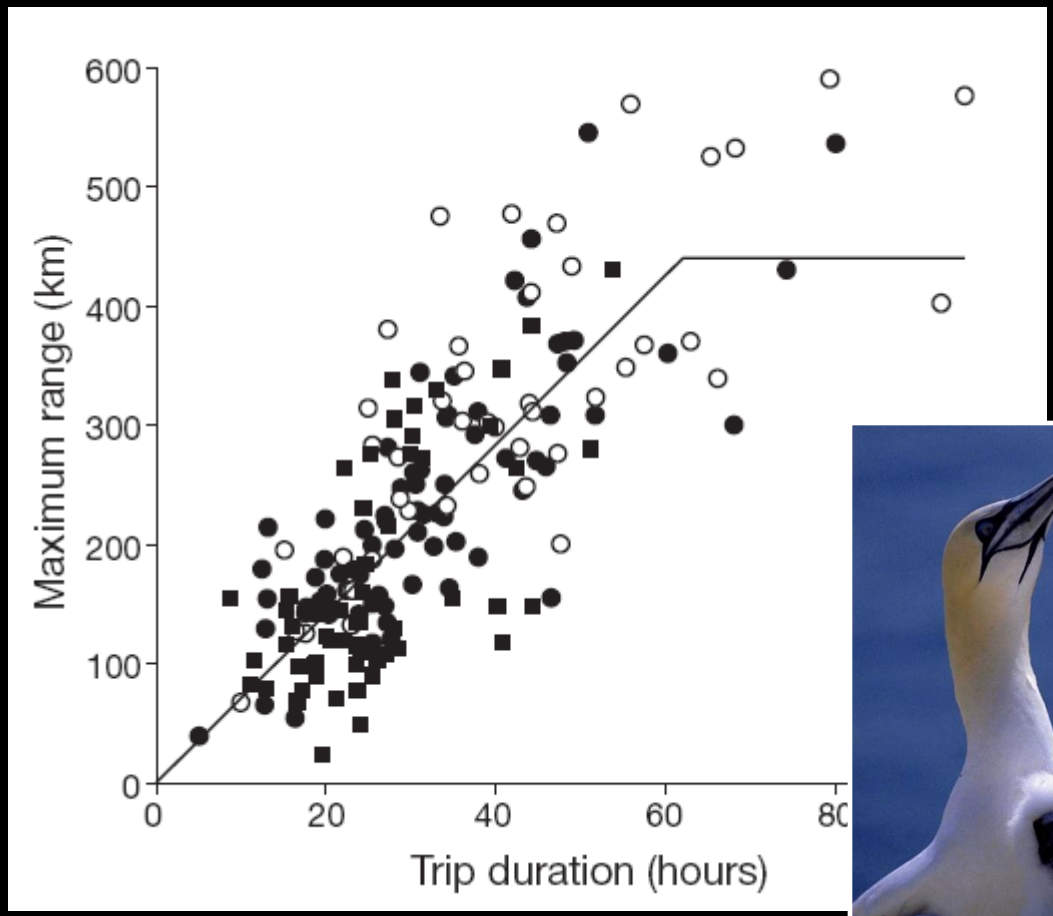
- Multiplying time budget by energy costs gives total energy expenditure



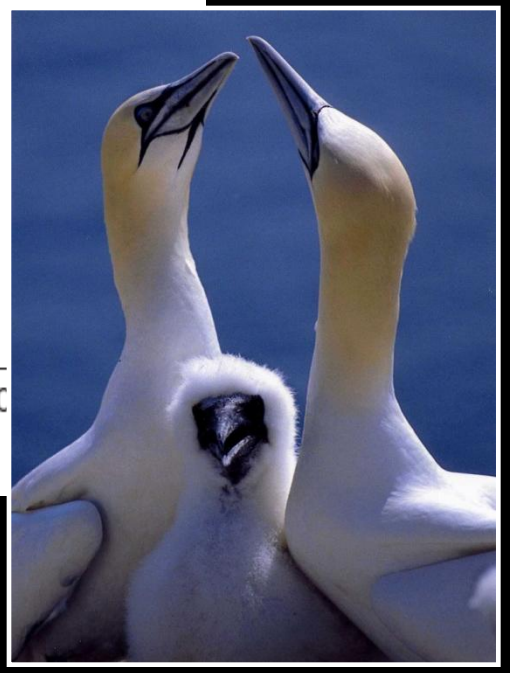
- Northern and Cape gannets close to performance limits

(Pichegru et al, 2007, Enstipp, 2006)

- Demonstration of performance limits
- Amount of time spent in flight reaches a limit in longer trips



(Hamer et al, 2007)



3. Problems on land

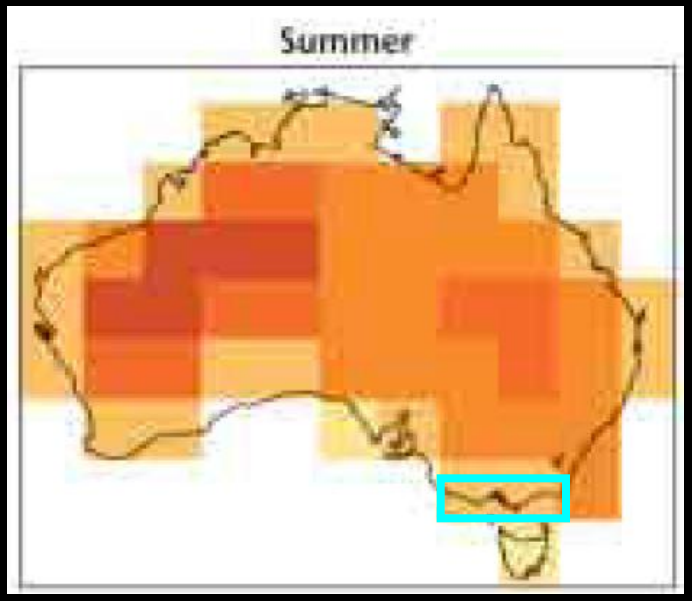


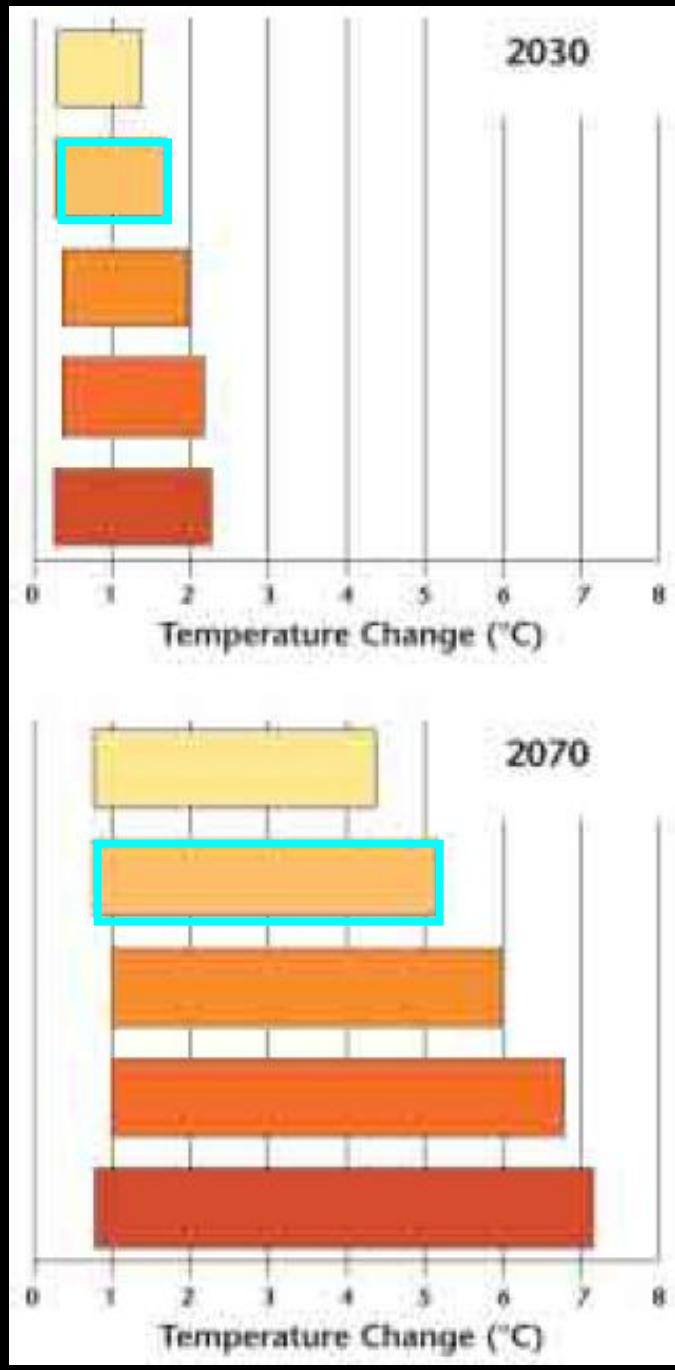
Table 4:
The average number of summer days over 35 °C at capital cities (excluding Darwin) for present conditions, 2030 and 2070.

Number of summer days over 35 °C

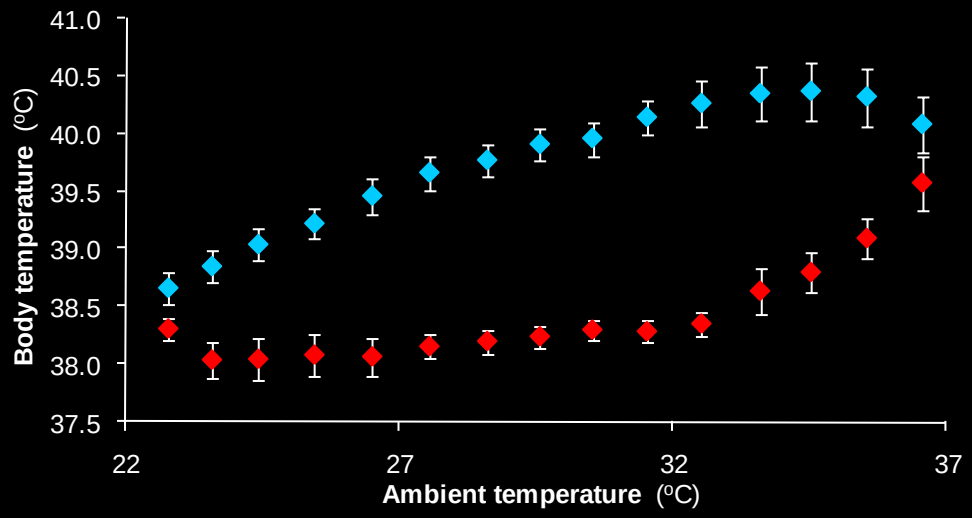
	Present	2030	2070
Hobart	1	1-2	1-4
Sydney	2	2-4	3-11
Brisbane	3	3-6	4-35
Canberra	4	6-10	7-30
Melbourne	8	9-12	10-20
Adelaide	10	11-16	13-28
Perth	15	16-22	18-39

- Its not just the sea which is warming up

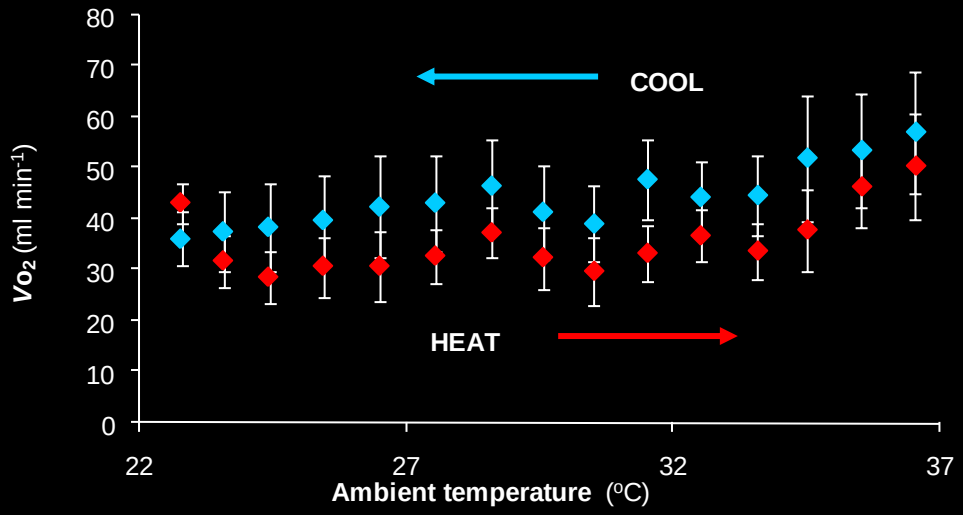
Australian Greenhouse Office (2006)



- It can get very hot in Australia!!!



- Gannets show hysteresis in body temperature
- Novel response for birds

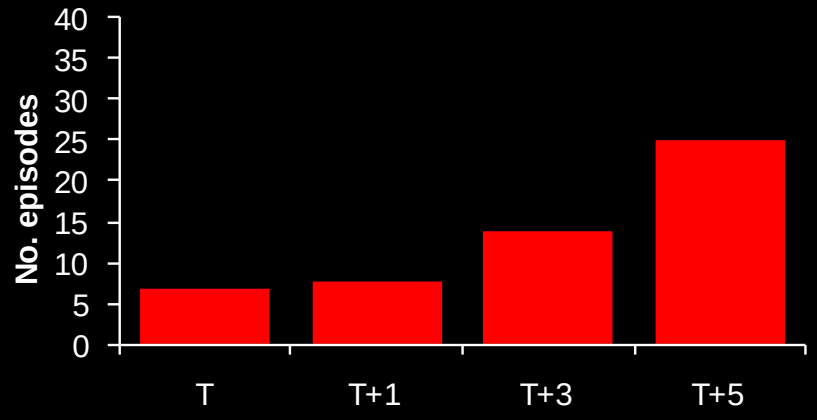


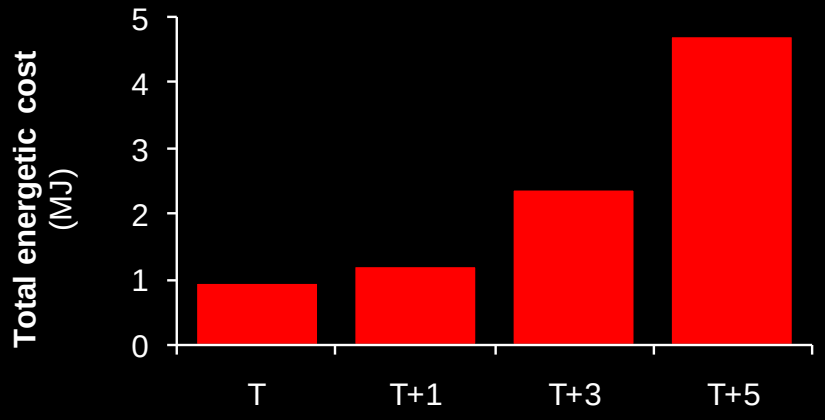
- High temperatures lead to an increase in metabolic costs

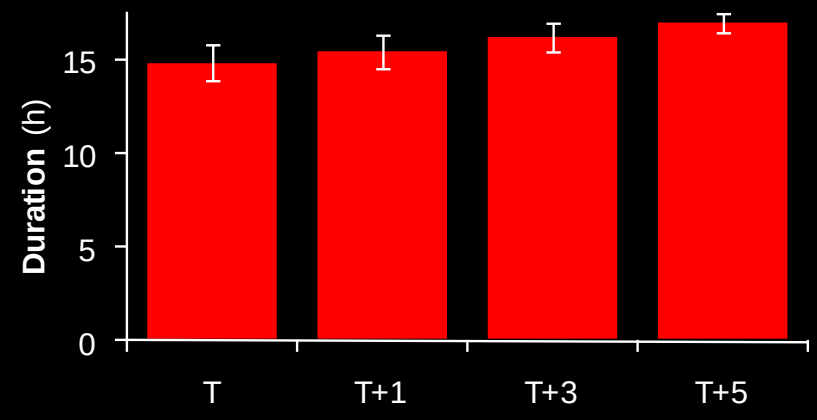
- Risk of deserting increased
- Possible to predict costs of thermoregulation

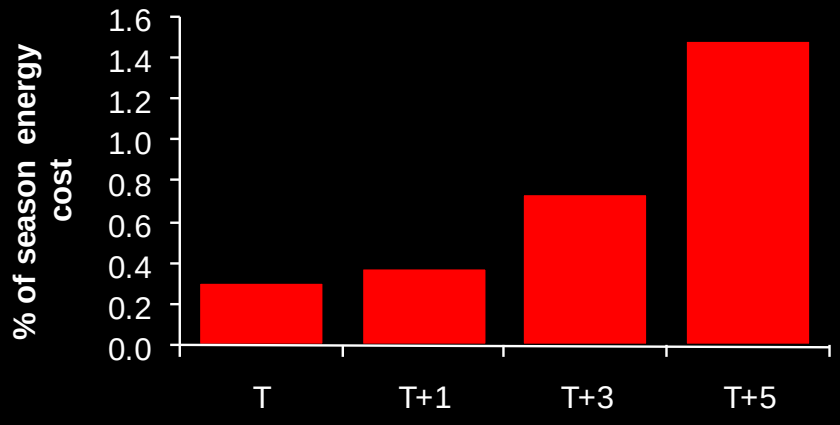
(Green et al, unpublished data)

- Thermoregulation on 'hot' days under different projected regimes









- Increasing temperatures will lead to more episodes of warming with greater intensity
- This will lead to a small but significant increase in energy expenditure

(Green et al, unpublished data)

4. Conclusions?

- Work still in its early stages
- Changes in climate will impact on seabirds
- These impacts will occur both at sea and on land
- More work is needed on the functional response between environment and the ecology of seabirds
- Understanding this can help us to
  - Predict impacts of change
  - Use seabirds as indicators of environmental change

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