Today's agenda

- **9:10 – 9.40 National overview on climate change adaptation, terrestrial biodiversity and the National Adaptation Research Plan – Prof Lesley Hughes**

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- **9.40 - 9.50 Terrestrial Biodiversity network – what you can get out of it – Yvette Williams**

-

- **9.50 - 10.00 Discussion**

-

- **10.00 – 10.30 What are the key issues for Tasmania for climate change adaptation – Prof David Bowman / Dr Kerry Bridle**

-

- **10:30 -11:00 *Morning Tea***

-

- **11:00-11:30 The science of biodiversity adaptation**
- Examples of biodiversity adaptation in Tasmania
- Dr Erik Wapstra (UTas) , A/Prof Mark Hovenden (UTas)

- **11:30-11:45 Discussion**

Today's agenda (cont)

11:45 -13:00 How are managers and policy-makers dealing with climate change adaptation for biodiversity and what are the greatest challenges

Presentations by the stakeholders
- State government agency – DPIPWE - Louise Gilfedder
- Local Government– Hobart City Council/ Southern Midlands Council – Graham Green
- Local conservation group – Tasmanian Land Conservancy and Bush Heritage Australia -Stuart Cowell and Matt Appleby

13:00-14:00 LUNCH

14:00-14:30 Identify key themes for adaptation challenges – Group Discussion

14:30-15:30 Working groups draw up adaptation research priorities and how they could be addressed

15:30-16.00 Report back and close, facilitator will draw together learning, threads and extract future options

16.00-16:30 *Afternoon Tea*

Why have a Roadshow?

Why are we here?

- Roadshow across Australia in each state/node
- Scope of workshop:
  - What is adaptation?
  - Sector / State / Regional / Ecosystem priorities
  - Increase stakeholder involvement in network

- How can involvement benefit everyone concerned?

- Outcomes:
  - Raising awareness and participation in NCCARF & the Terrestrial Biodiversity network
  - Increased networking/collaboration between research & stakeholder groups
  - Summary of each node workshop – network website / DCCEE
  - Report collating results across all nodes

How do YOU think the national priorities fit your ecosystem / region / sector?

- Are there any serious omissions?

- What are the priorities / challenges in your area of interest ?

- What research is needed to have the knowledge to make the best possible choices about adaptation?

- What are the main impediments?

Climate Change & Terrestrial Biodiversity

Global Surface Temperatures

Four independent records show nearly identical long-term warming trends.
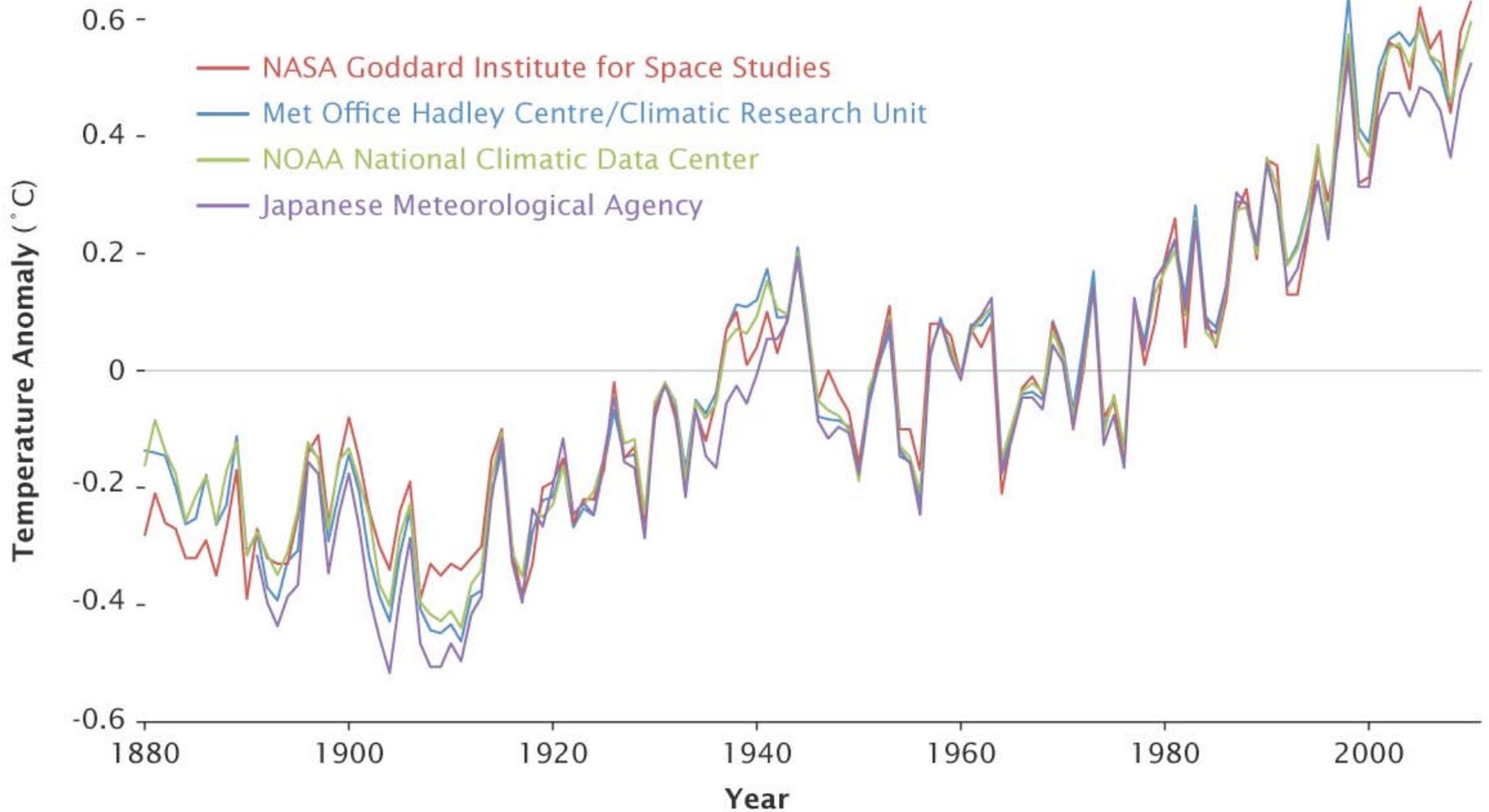
Credit: NASA Earth Observatory/Robert Simmon

Data Sources: NASA Goddard Institute for Space Studies, NOAA National Climatic Data Center, Met Office Hadley Centre/Climatic Research Unit, and the Japanese Meteorological Agency.

Satellite-based measures of average global temperature (near-surface lower atmosphere), by year (Sept-Feb period), 1979-2010

Temperature variation (^{o}C), relative to reference temperature

1998-99
2004-05
2009-10

Reference temperature, circa 1980

www.copenhagendiagnosis.com
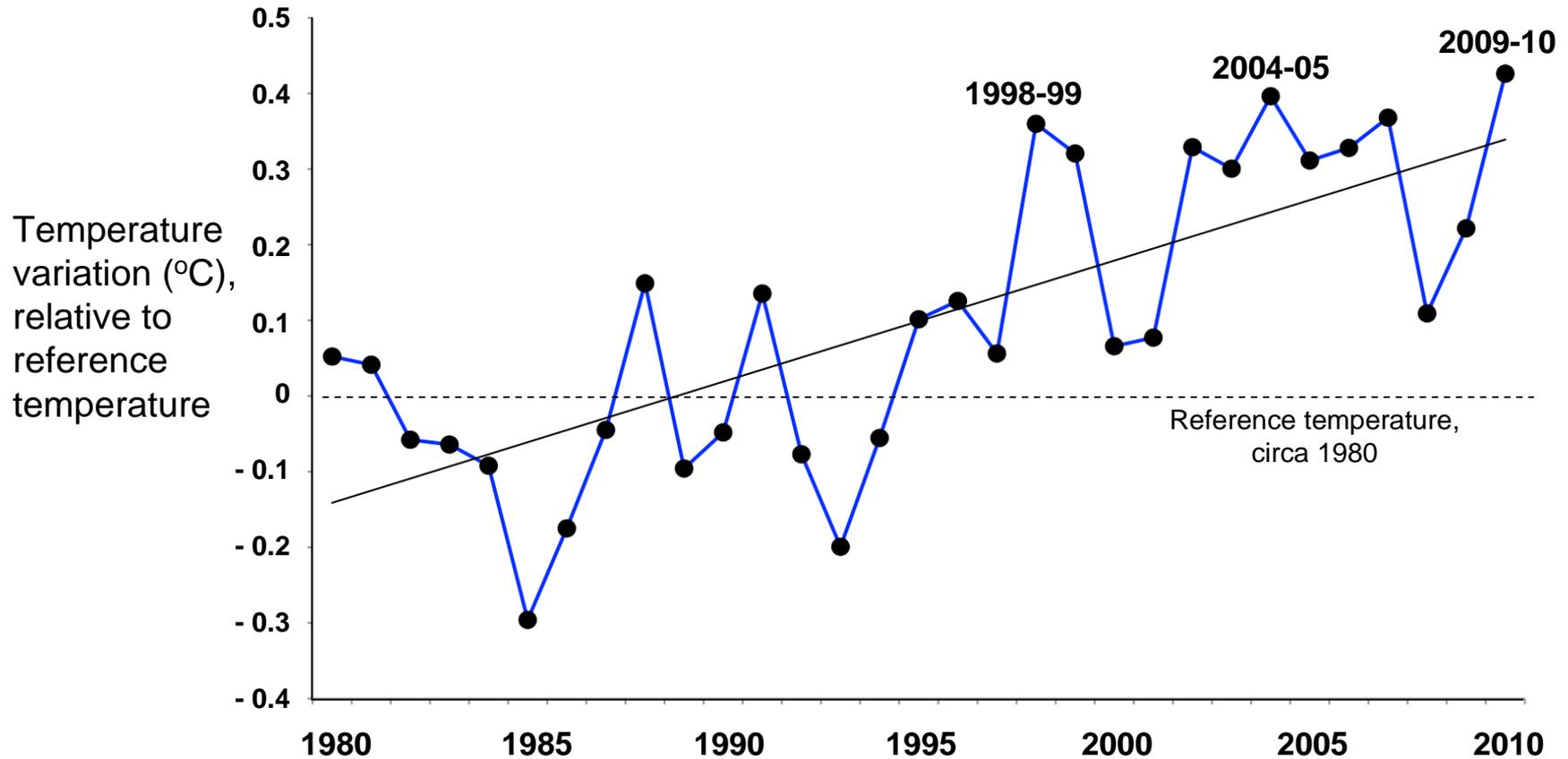
Global Temperature Projections

Multi-model Averages and Assessed Ranges for Surface Warming
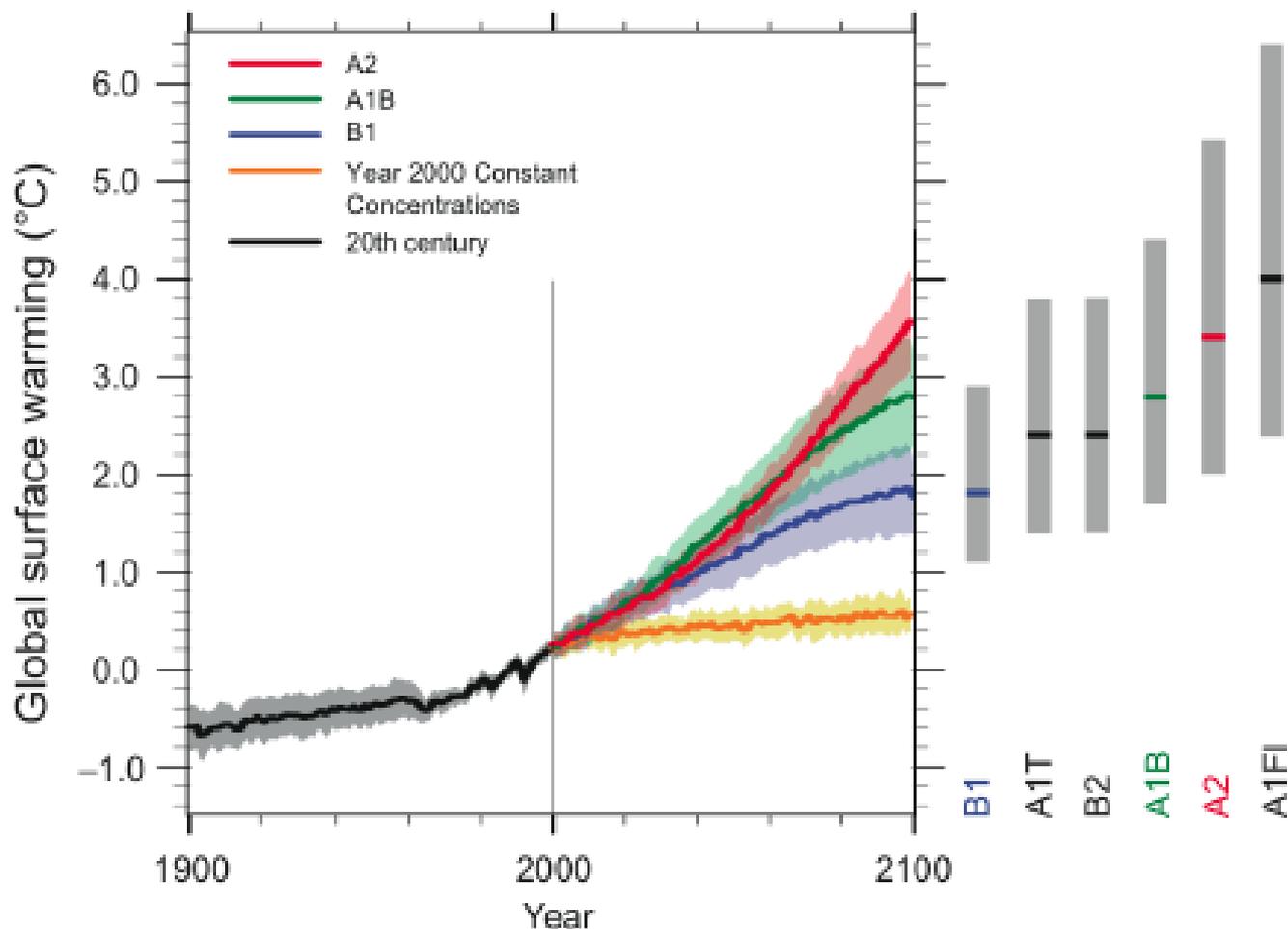
- 0.2°C per decade to end of 21st century
- 1.8-4.0°C warming (range 1.1-6.4°C)

(IPCC 2007)

But:

- CO_2 has almost tripled since the 1990s from 1.1% pa to 3.1% in the 2000s (Raupach *et al.* 2007)
- Sea levels also rising faster than IPCC projections
- Projections do not take melting of the West Antarctic Ice Shelf (WAIS) into account (Oppenheimer *et al.* 2007)

Actual emissions travelling at uppermost IPCC projection
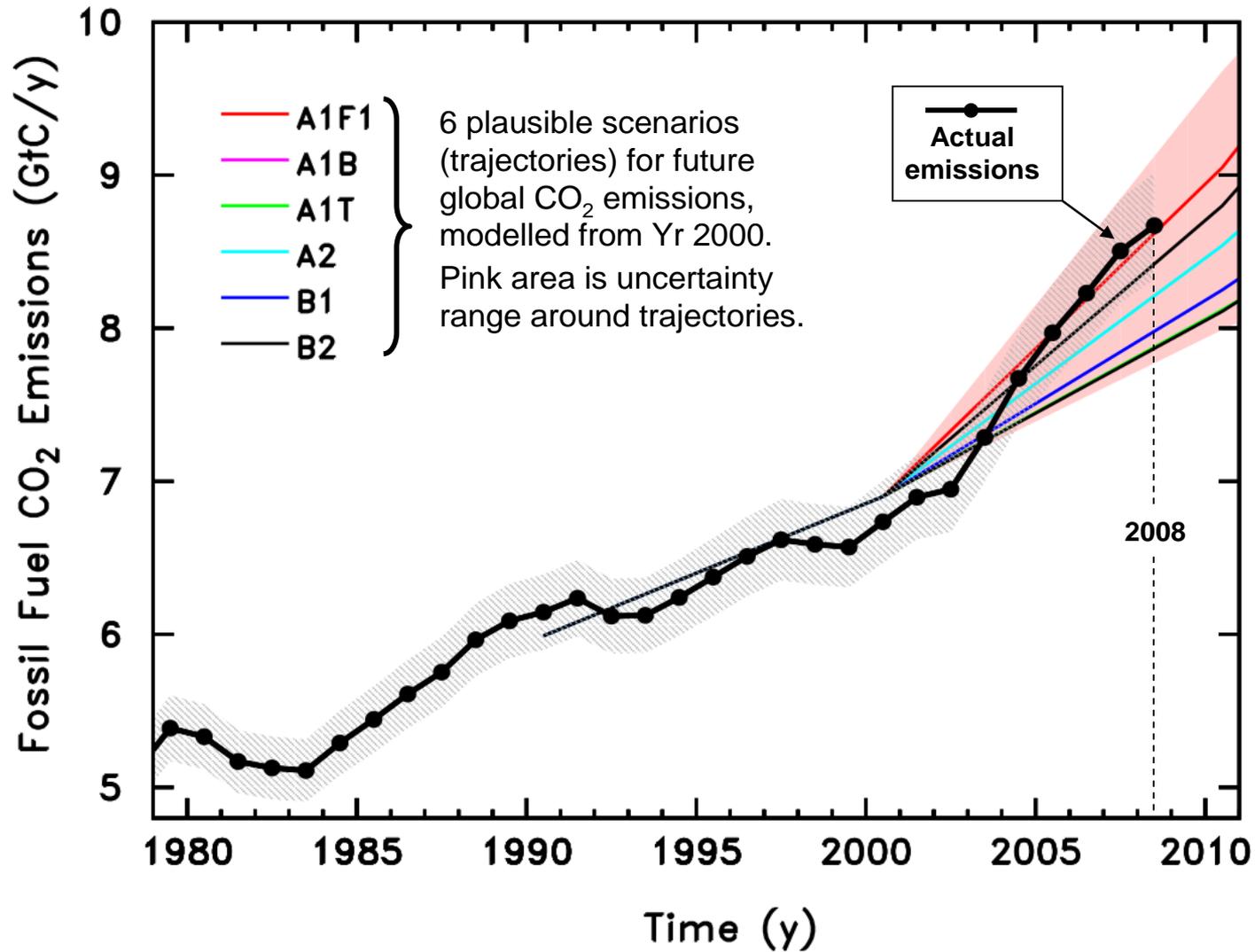
Global sea level
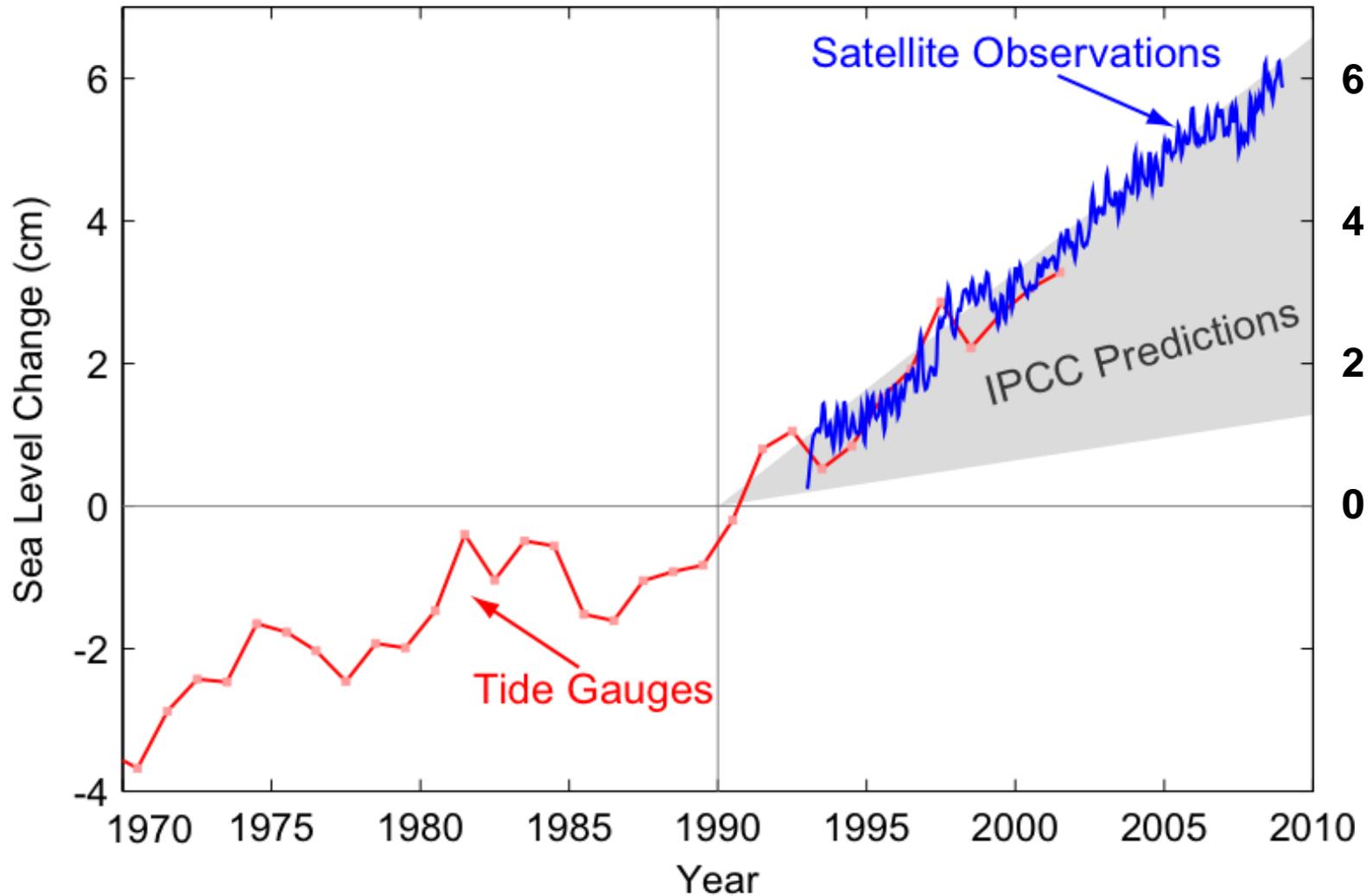
2005: Warmest year on record

(>1°C above long-term 1961-1990 average)

Mean Temperature Anomaly ($^\circ$C)
1 January 2005 to 31 December 2005

	2.5℃
	2.0℃
	1.5℃
	1.0℃
	0.5℃
	0.0℃
	-0.5℃
	-1.0℃
	-1.5℃
	-2.0℃
	-2.5℃
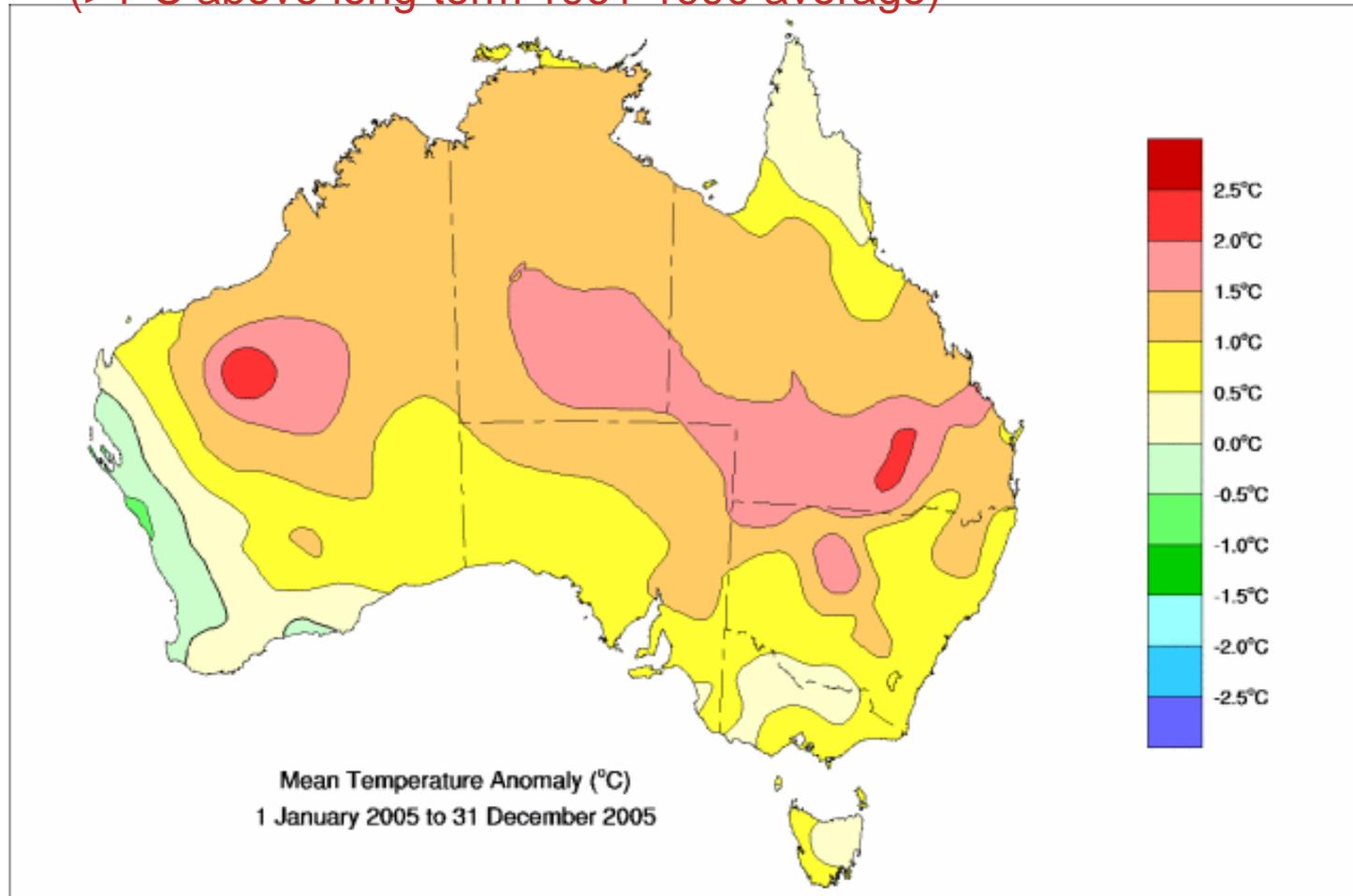
2009: 2nd warmest year (0.09°C above average)
2010" equal warmest year globally

Rainfall

Australian Government
Bureau of Meteorology

Trend in Annual Total Rainfall
1950-2008 (mm/10yrs)

50.0
40.0
30.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-30.0
-40.0
-50.0
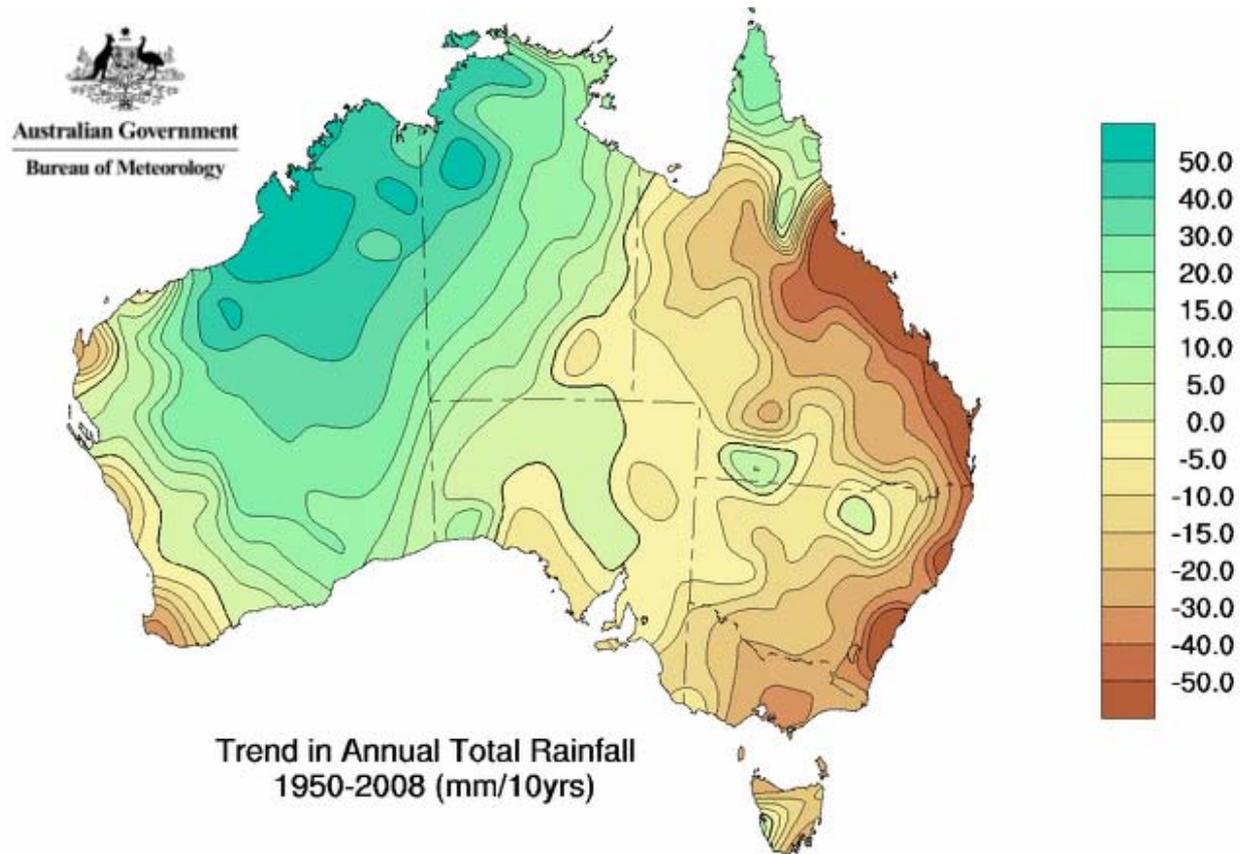
© Commonwealth of Australia 2009, Australian Bureau of Meteorology

Issued: 07/01/2009

- General drying trend in east
- Rainfall decreased 14.3 mm/ decade since 1950 in NSW
- Heavy rainfall events increased, particularly since 1960s

Vulnerability of biodiversity cf other sectors
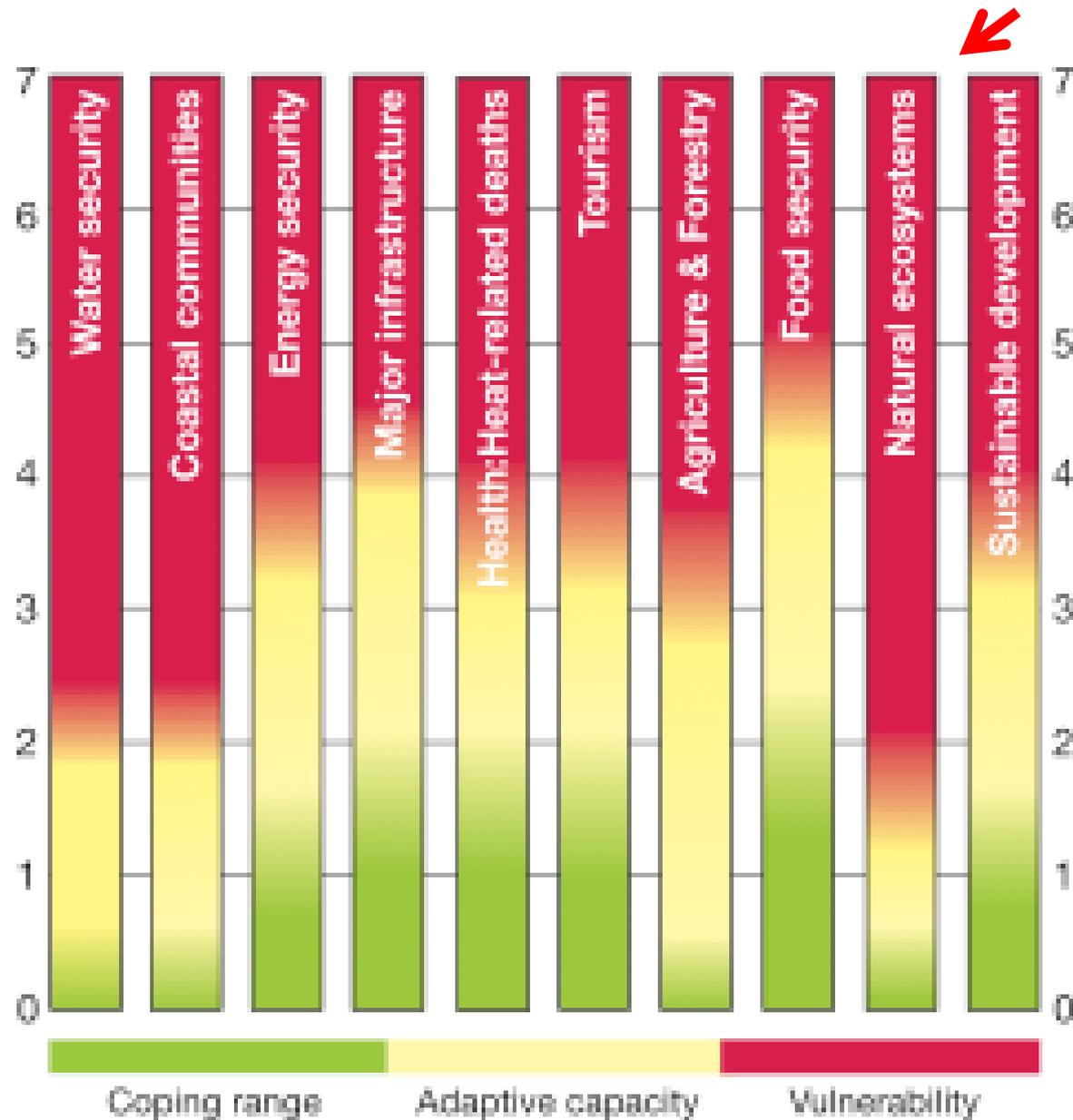
IPCC 2007

The scale of the problem for biodiversity

- Time for a species to evolve ~ 1 million years

- IPCC (2007): ~ 20-30% of species likely to be at increasingly high risk of extinction at 2-3°C above pre-industrial levels

- Global warming already implicated in species declines across marine, terrestrial and freshwater ecosystems & at least one extinction

- **Climate change will be one of the major drivers of species extinctions in the 21st century.**

Impacts of climate change on species & communities already evident

Examples include:

- Geographic range shifts (mainly south, some upwards)
- Life cycles (eg. advances in flowering, bird migration)
- Genetic change (heat shock proteins)
- Body size (latitudinal clines shifting)
- Proportions of warm-adapted species in communities increasing at expense of cool-adapted
- Increased frequency of coral bleaching
- Declining rates of calcification in corals
- Emergence of new diseases
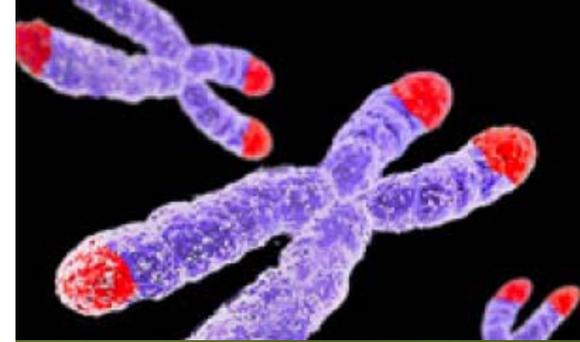
What can we do about minimising the impacts of global climate change on biodiversity?

Need for mitigation
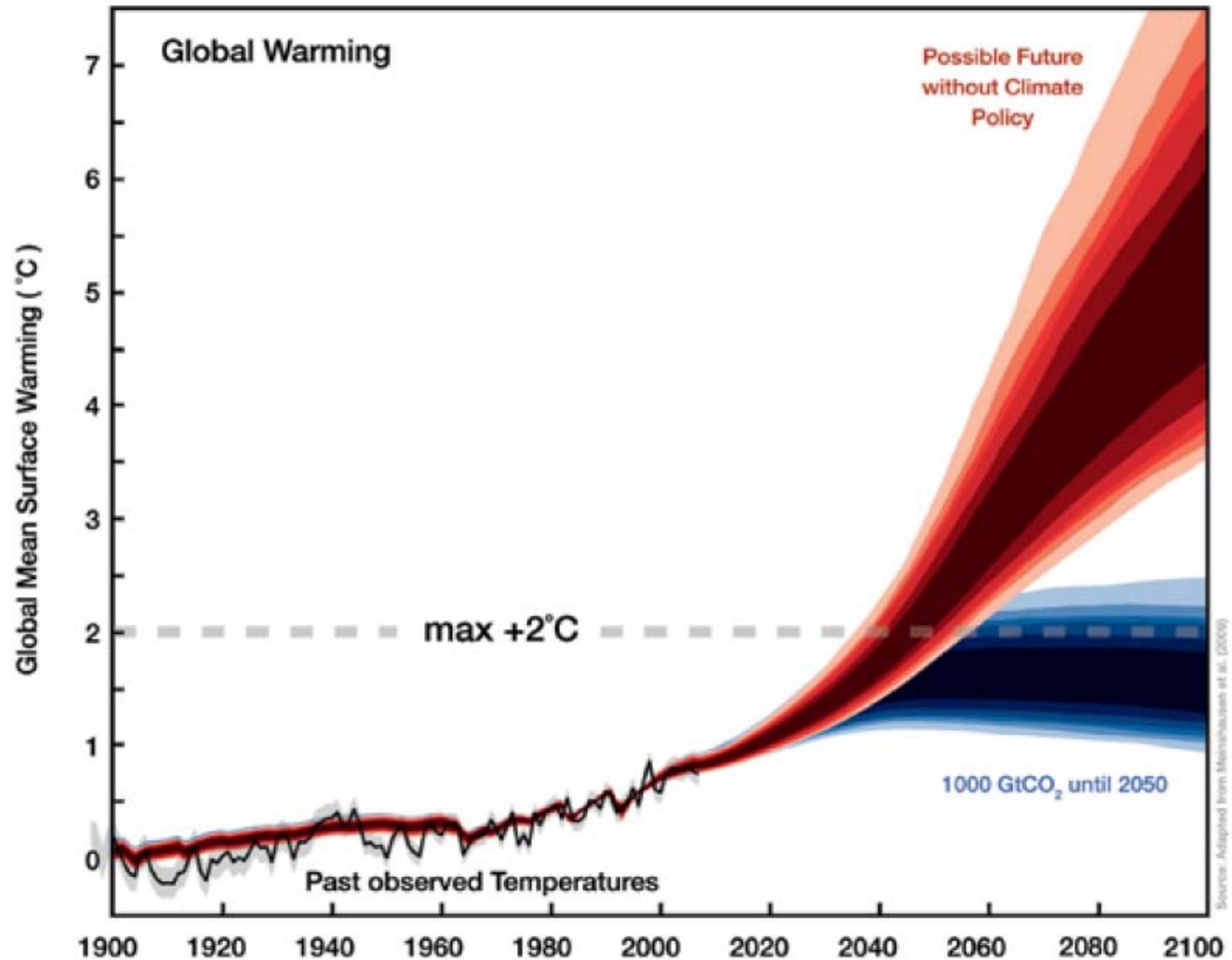
Need for mitigation
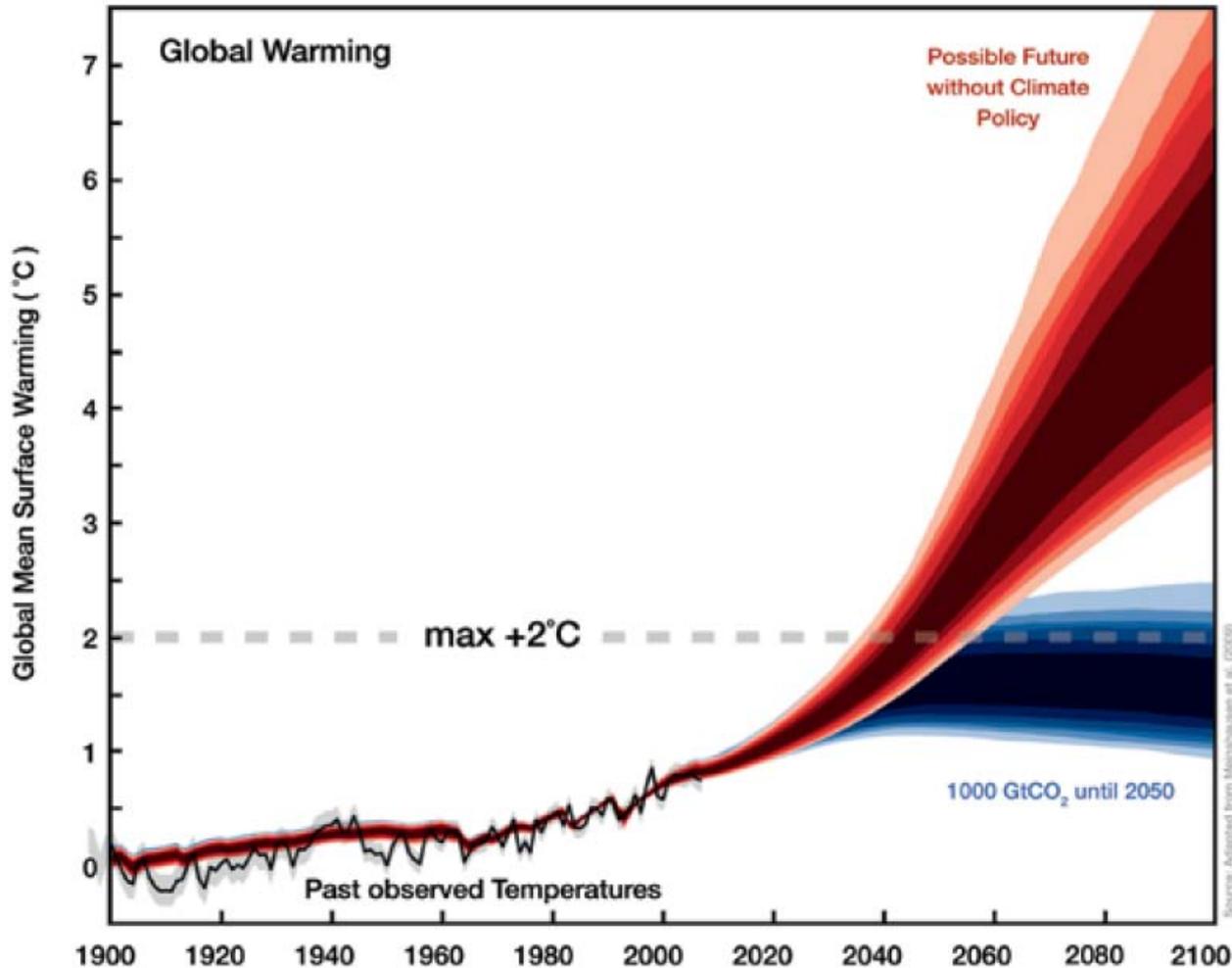
No mitigation – Adaptation not possible

Some mitigation – Adaptation very important

Strong mitigation – Adaptation not needed

Can biodiversity adapt autonomously?

1. Geographic change:

    -   Possible for highly mobile taxa, but rate of change too rapid for most

    -   Flat topography, fragmentation of landscape & lack of habitat presents substantial challenges

2. Phenotypic (including behavioural) plasticity:

    -   Likely to be most common response
    -   Changes in timing of life cycles likely to lead to significant changes in species interactions

3. Genetic change:

    -   Few species studied but limited evidence so far

→ Need for human-mediated adaptation

• Implementation of strategies that enhance the ability of species, communities or ecosystems to cope with climatic changes

Aim: to maximise adaptive ability and increase resilience

Landscape management
- habitat protection
- restoration
- refugia

Species management
- captive breeding
- assisted migration

Strategies

Reduction of threats
to increase resilience
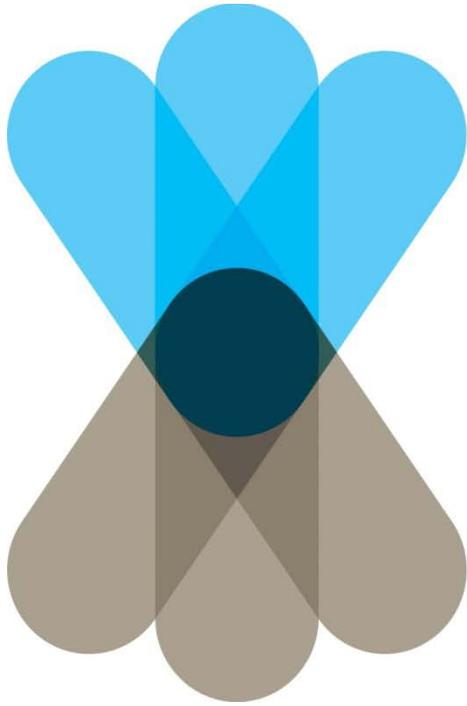
National Climate Change Adaptation Facility (NCCARF)

- An initiative of the Australian Government, based at Griffith University's Gold Coast Campus.

- ~$117 million (from 2008 to 2012) in climate change adaptation policies, programs and research through the Department of Climate Change
  - ~$10m NCCARF
  - ~$10m networks
  - ~$30m NARP research funding

The key roles of NCCARF include:

- developing National Adaptation Research Plans (NARP's) to identify critical gaps in information available to decision-makers

- synthesising existing and emerging national and international research on climate change impacts and adaptation, and developing targeted communication products

- undertaking a program of integrative research to address national priorities, and

- establishing and maintaining Adaptation Research Networks (ARN's) to link key researchers and assist them in focussing on national research priorities.

National Climate Change Adaptation Facility

Eight Adaptation Research Networks:

- **Terrestrial biodiversity**
- Water resources and freshwater biodiversity
- Marine biodiversity and resources
- Primary industries
- Human health
- Emergency management
- Settlements and infrastructure
- Social, economic and institutional dimensions.

Network Role – NCCARF Network Strategic Plan

Four key roles:

1. To promote and facilitate open exchange of information and sharing of resources.

2. To contribute to the work of NCCARF in synthesising existing and emerging research.

3. To contribute to the development and implementation of National Adaptation Research Plans.

4. To nurture the careers of young investigators and research students by promoting a sense of community, collaboration and strong, effective mentoring.

Terrestrial Biodiversity Adaptation Research Network

Providing decision makers with the information to develop and implement strategies that will promote adaptation to climate change in terrestrial ecosystems

Adaptation Research Network -Terrestrial Biodiversity

<u>Convenors</u>:

Prof Steve Williams (JCU, Nth QLD)

Prof Lesley Hughes (Macquarie, NSW)

- Co-ordinator: Dr Yvette Williams (JCU)

<u>Steering committee</u> (geographic, expertise, ecosystems):

Prof Andrew Lowe, Prof Barry Brook (SA)

Dr Dick Williams, Prof Stephen Garnett (NT)

Prof Ary Hoffmann, Dr Lynda Chambers (VIC)

Prof Roger Kitching, Prof Hugh Possingham, Prof Bob Pressey, A/Prof Jean-Marc Hero (QLD)

Dr Trevor Booth, Dr Mark Stafford Smith (ACT; CSIRO CAF)

Prof David Bowman, Dr Kerry Bridle (TAS)

Prof Richard Hobbs, Dr Grant Wardell-Johnson, Dr Nicola Mitchell (WA)

Regional Nodes

Network Structure

National Climate Change Adaptation Research Facility NCCARF

Steering Committee

External Network Links

Other NCCARF Networks
Australian Research Council Networks
Commonwealth Environmental Research Facility
Government Agencies
State Agencies
NGO's
Research Centres

Network Participants

Over ~1000 participants from 200+ institutions providing expertise across all state and major ecosystems, and in all aspects of global change biology and terrestrial biodiversity

Our Primary Goals

- Develop explicit and practical strategies to increase resilience in terrestrial ecosystems

- Maximise the adaptive potential of terrestrial ecosystems in the face of climate change

- Foster an inclusive collaborative research environment

In other words….

- Link expertise nationally
- Get people together
- Share information
- Foster collaboration
- Reduce duplication
- Facilitate exchange
- Encourage training and development
- Make a difference

Example:

Adaptation and protecting the biodiversity of Australian tropical rainforests

```
Basic biodiversity monitoring and science
                    ↓
        Understanding vulnerability
                    ↓
            Predicting Impacts
                    ↓
      Assessing Adaptation Options
                    ↓
            Implementation
```
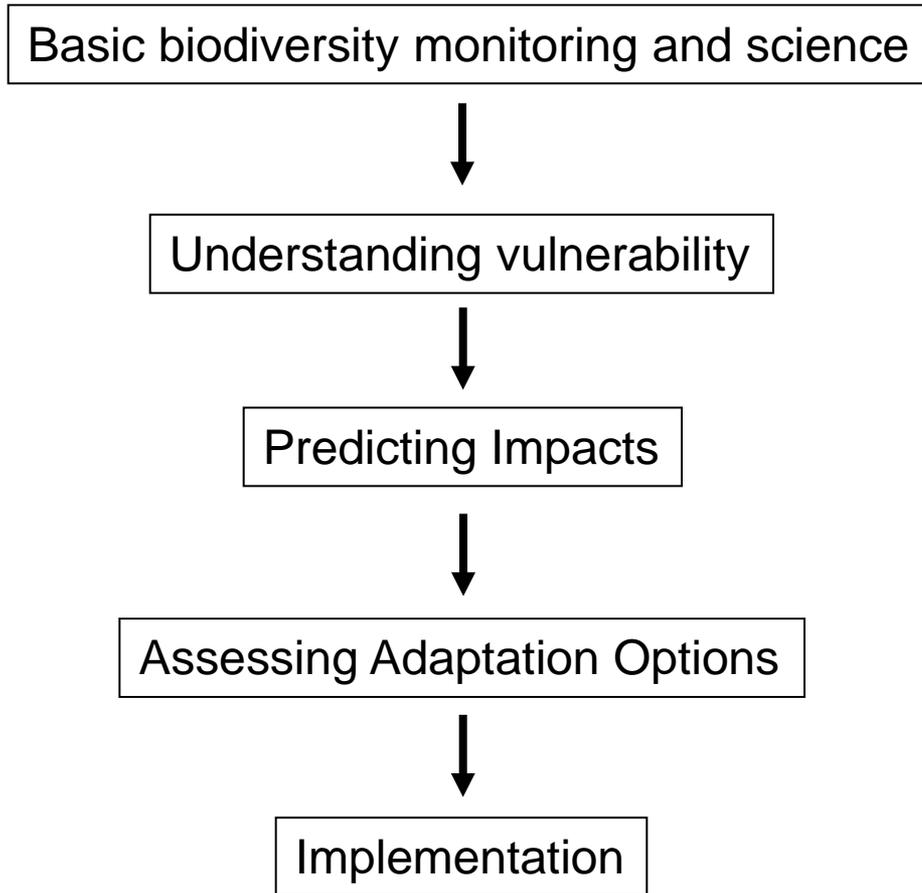
The rainforests of the Australian Wet Tropics

Most biologically rich area in Australia
with many unique species

Cooktown

Cairns

Mike Trenerry

~ 10,000 sq km rainforest

Cooktown

Cairns

Townsville

Elevational sampling at 200 m intervals
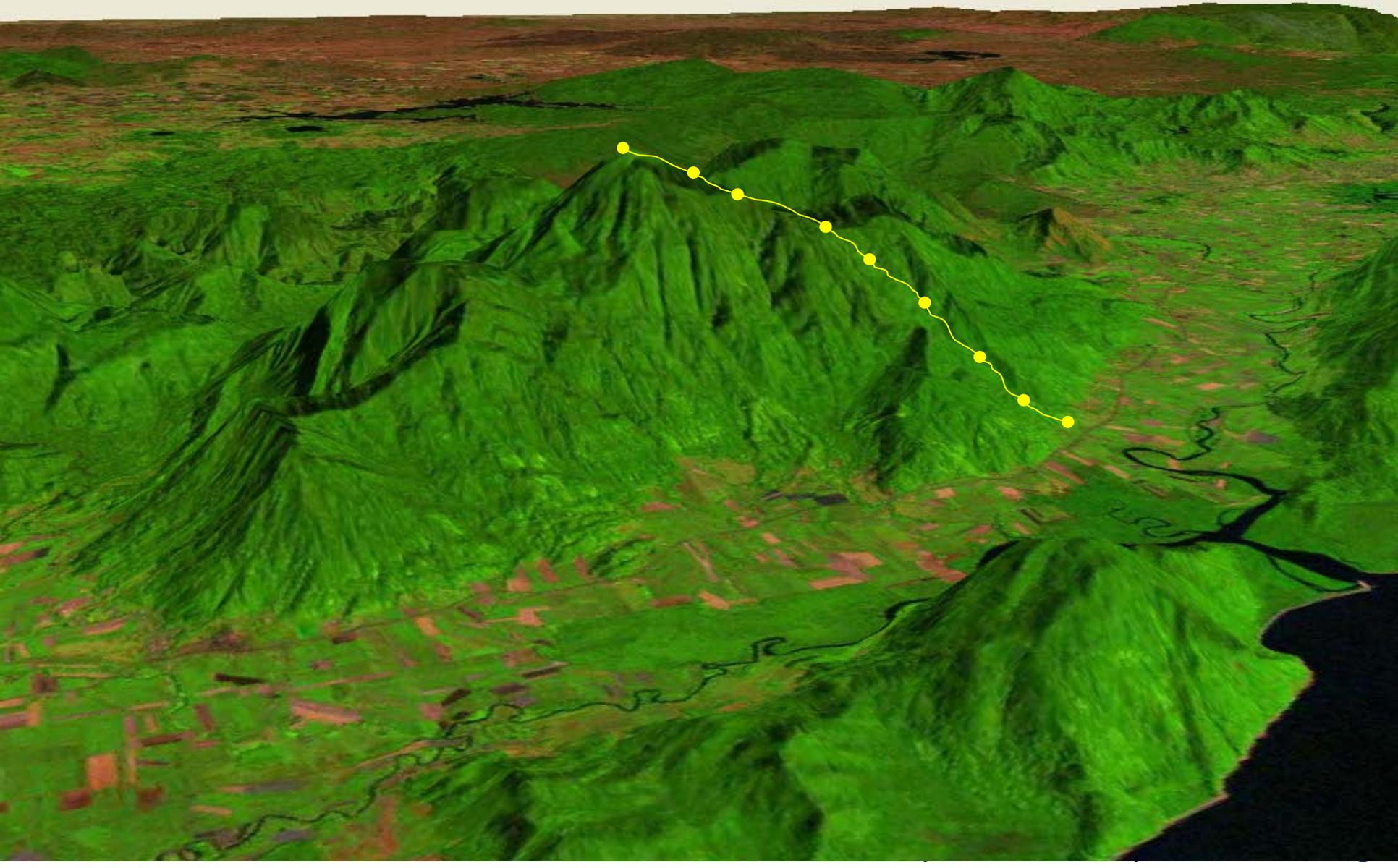
Standardized Data

Total number of surveys:

- ~2000 Bird
- ~750 Reptile
- ~350 Spotlight
- 200 Stream Frog
- 400 Microhylid frog
- 6000 Malaise trap days
- ~250 leaf litter invertebrate
- Insect pit traps (>300000 trap days)

Rainforest Species Richness (196 species)

Worst

Average

Best

Species Richness

0   100   200
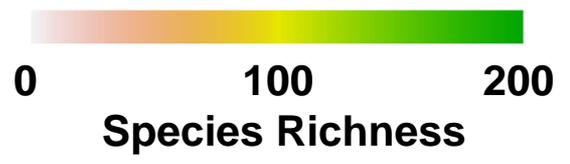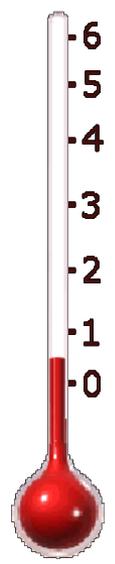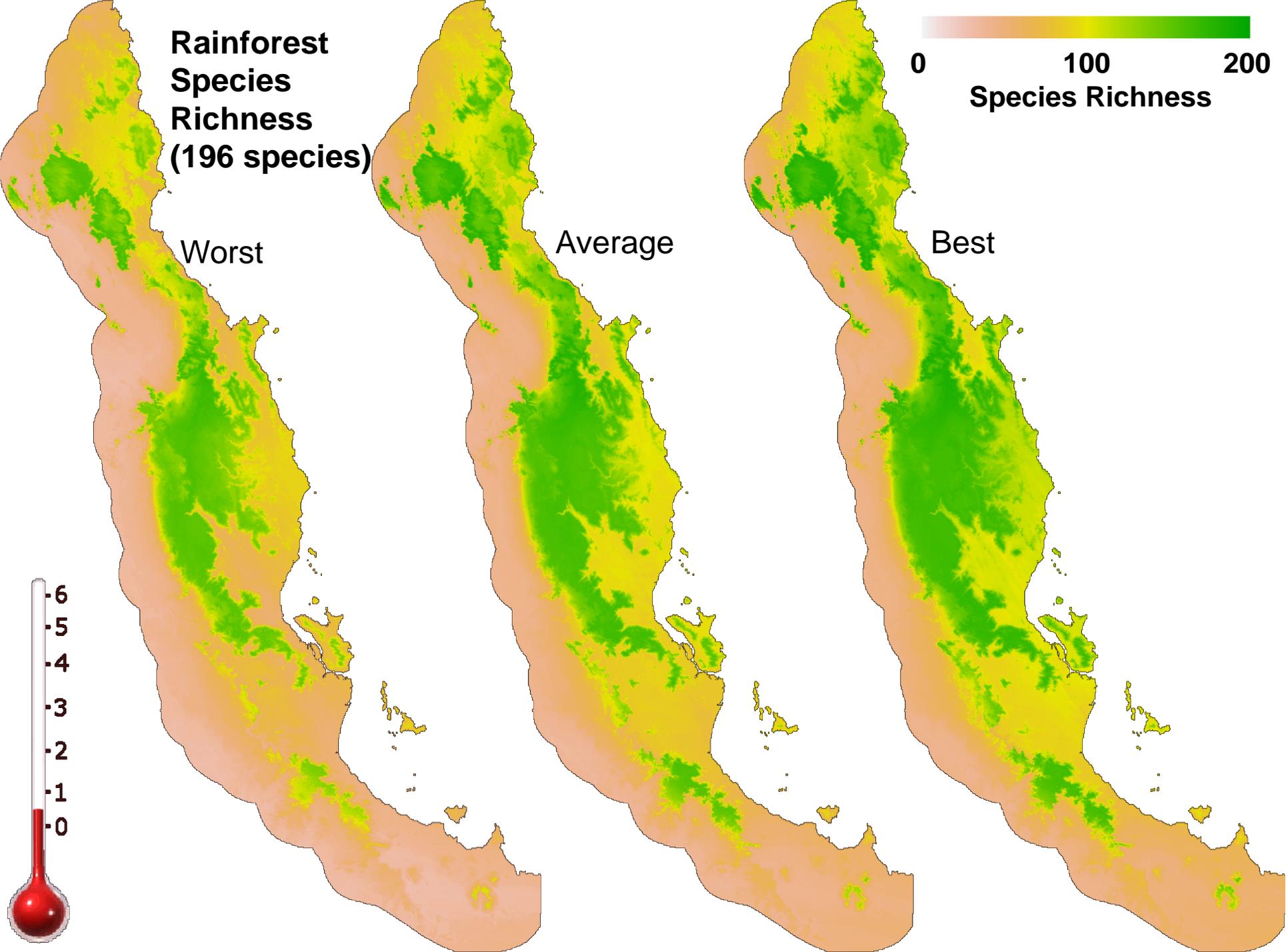
Wet Tropics biodiversity is extremely vulnerable to climate change
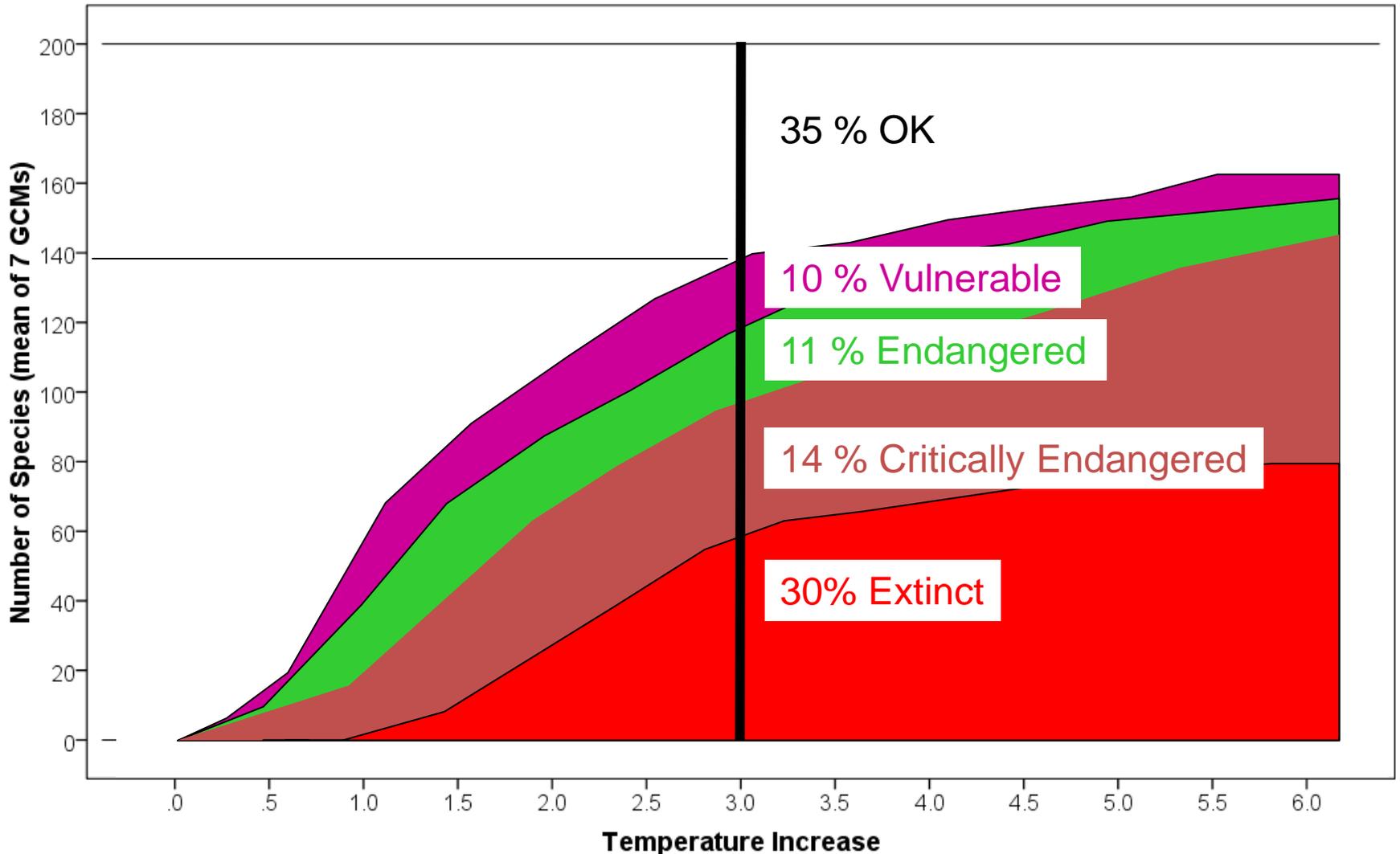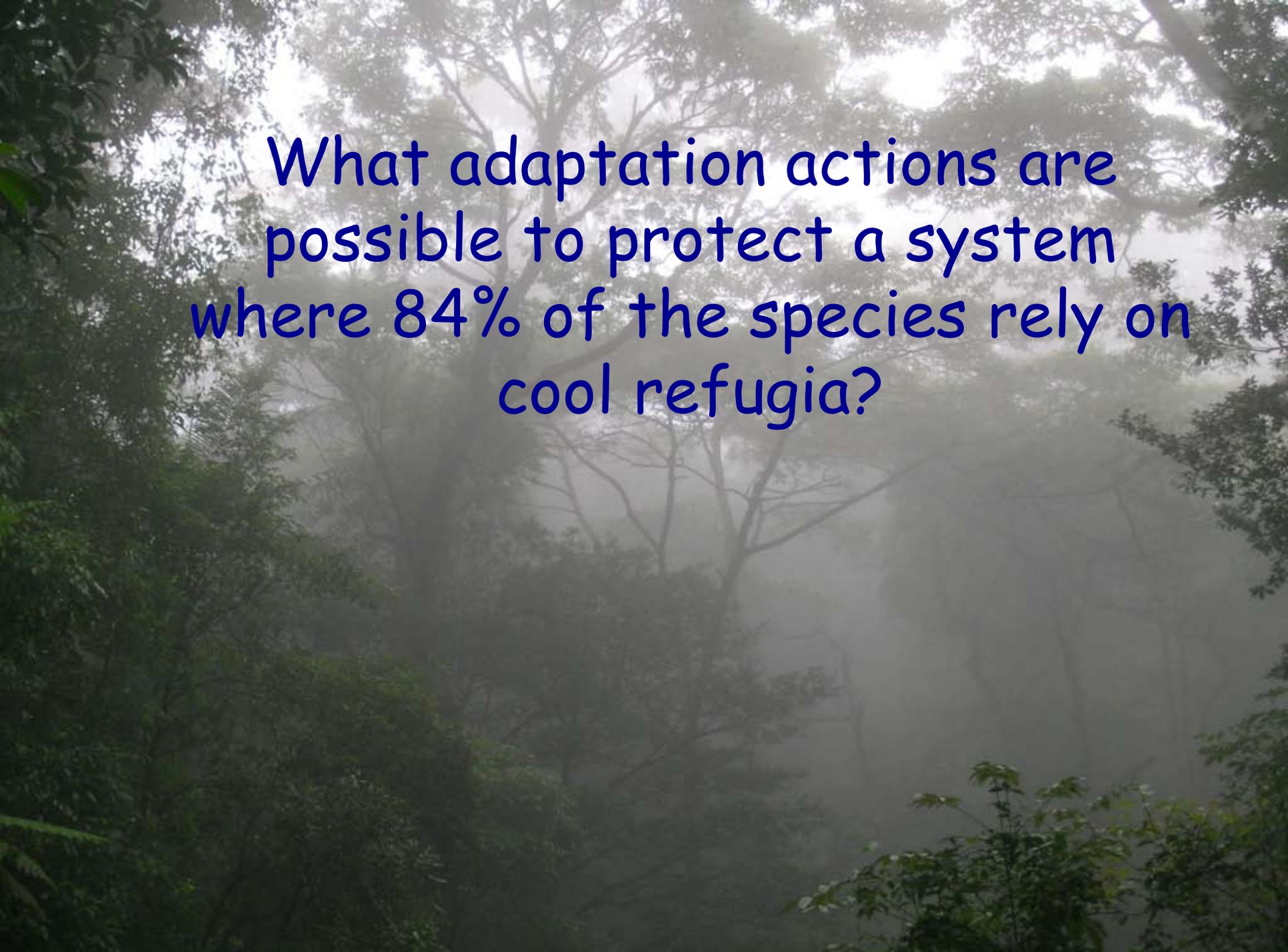
What adaptation actions are possible to protect a system where 84% of the species rely on cool refugia?

Cool Refugia

Where will they be?

How big do they need to be to be effective?

Which species will benefit?

What factors will threaten these refugia?

How do we protect, enhance and manage them?

Cool Refugia

A map showing the maximum temperature actually experienced by an organism in any part of the region

elevation + latitude + distance to stream + distance to coast + foliage cover + clear sky radiation + cloud offset + wind exposure ~ maximum temperature
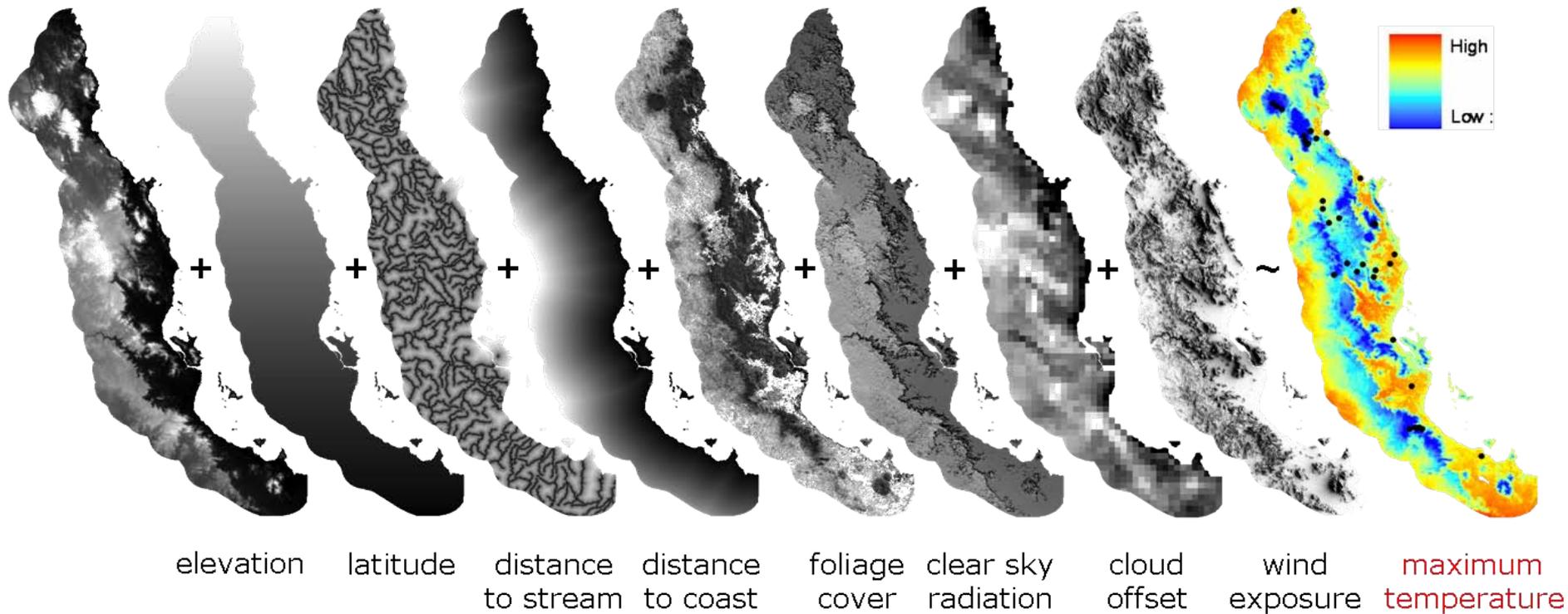
Shoo, Vanderwal & Williams. *Glob Change Biol* 2010
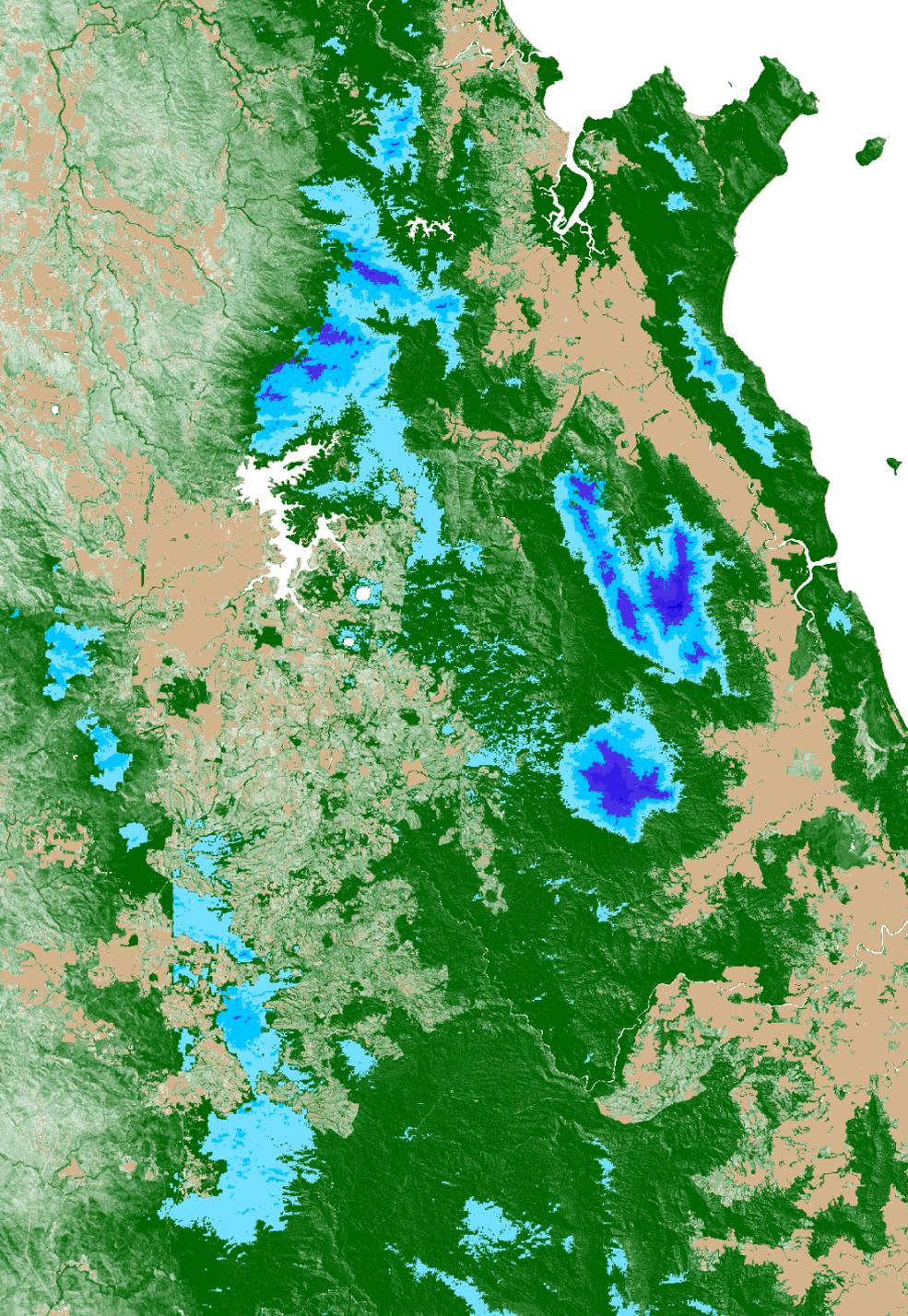
Existing thermal refugia

Adaptation Options
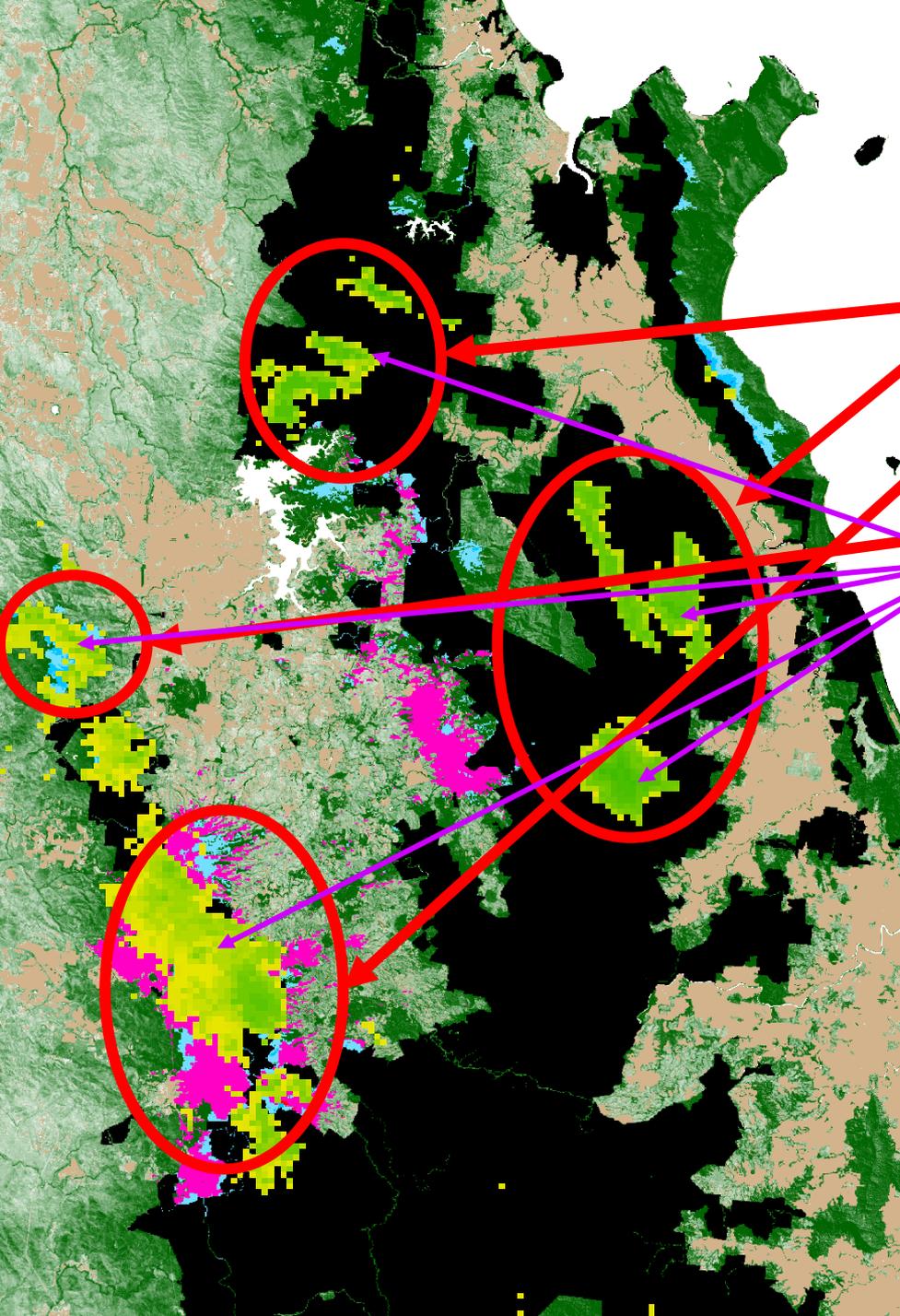
High value refugia already in protected area:

Biodiversity refugia based on overlayed distributions of all 200 rainforest verterbates modelled using averaged Maxent future distributions of 7 GCMs at 4 deg C.

Degraded landscape with potential to be high value

High value and connection to protected refugia.

- Potential for assisted adaptation and to off increase.
- Off-reserve management agreements

- Maintain corridors to refugia

- Land acquisition & off reserve management agreements

- Habitat restoration

- Re-establish corridor for movement and gene flow
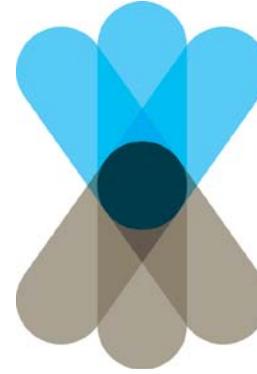
Conservation Planning & Climate Change - workshop
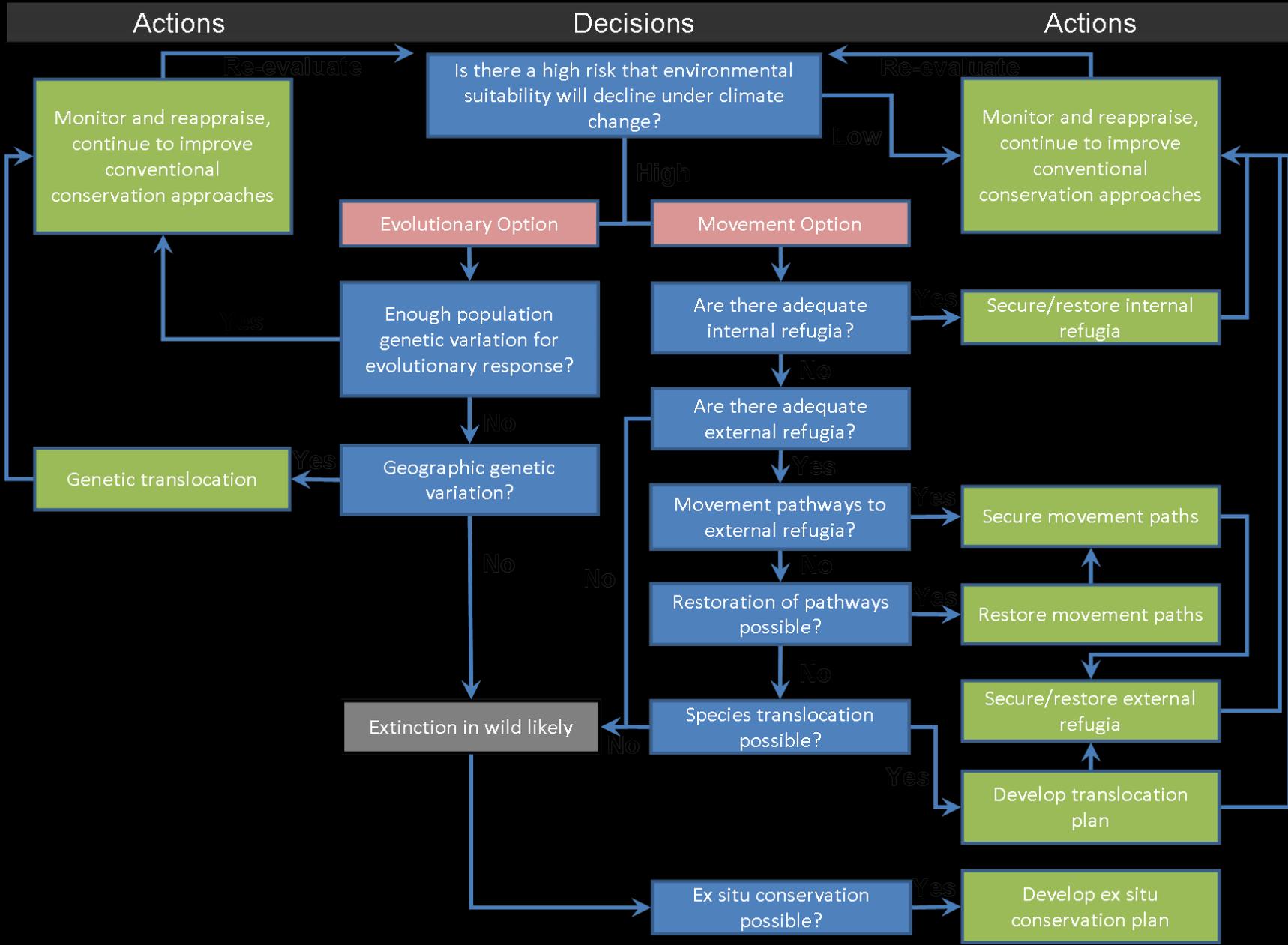
Left-side labels (blue boxes):

- Will predicted future climate affect this species?
- Is there sufficient ecological plasticity?
- Is there sufficient evolutionary potential?
- Is there useful geographic variation?
- Are there adequate internal refugia?
- Is there suitable climate elsewhere?
- Is there a suitable movement pathway?

Flowchart (decisions and outcomes):

- Will future climate affect this species? → NO → NO WORRIES
- YES → Is there sufficient plasticity? → YES → NO WORRIES
- NO → Is there sufficient evolutionary potential? → YES → NO WORRIES
- NO → Is there useful geographic variation? → YES → Gene translocaction
- NO → Are there adequate internal refugia? → YES → Refugia management and protection
- NO → Is there suitable climate somewhere else? → NO → Ex-situ conservation
- YES → Is there a movement pathway suitable for this species? → NO → Restoration
- YES → Are there biotic/abiotic impediments? → YES → Manage Impediments
- NO → Monitor and reassess

Outcome boxes: NO WORRIES; Gene translocaction; Refugia management and protection; Ex-situ conservation; Restoration; Species translocation; Manage Impediments; Monitor and reassess

National Adaptation Research Plan - NARP

National Adaptation Research Plan (NARP) for Terrestrial Biodiversity identifies research required to assist managers of the terrestrial estate prepare for the consequences of climate change

National Adaptation Research Plan for Terrestrial Biodiversity

Authors:

Prof. Lesley Hughes   (Macquarie University)
Prof. Richard Hobbs   (Murdoch University)
Prof. Jan McDonald   (Griffith University)
Dr.   Mark Stafford Smith   (CSIRO - CAF)
Prof. Will Steffen   (ANU)
Prof. Stephen Williams   (James Cook University)

National Adaptation Research Plan for Terrestrial Biodiversity

The aims of this Plan are to:

1) Identify important gaps in the information needed by sectoral decision-makers to respond to climate change in ways that reduce the vulnerability of terrestrial ecosystems;

2) Set adaptation research priorities based on these gaps; and

3) Identify capacity that can be harnessed or that needs development to perform priority adaptation research.

NARP – National Research Priorities

5.1 National/continental scale issues

- **5.1.1** How will climate change affect existing conservation goals and how should changed conservation goals be promoted and achieved?

- **5.1.2** How can the existing Australian legal, policy and institutional architecture for land management and biodiversity conservation respond to changes in conservation goals caused by climate change?

- **5.1.3** What conceptual models and long-term observation systems are needed to support the design, analysis and assessment of active adaptive management and policy experiments at regional and national scales under climate change?

NARP – Regional Research Priorities

5.2 Regional issues

- **5.2.1** What designs of landscapes in intensive and extensive land-use zones confer maximum resilience for biodiversity in the face of climate change, including the uncertainty associated with future climate scenarios?

- **5.2.2** How will climate change interact with other key stressors such as fire, invasive species, salinity, disease, water extraction, climate hydrology, grazing and clearing and what are the implications for ecosystem structure and functioning?

- **5.2.3** How can large-scale carbon mitigation initiatives such as revegetation and forest-related mitigation be designed to avoid adverse impacts on biodiversity and to maximise biodiversity conservation benefits?

- **5.2.4** How can major socio-economic trends occurring in many regions of Australia contribute to effective climate change biodiversity adaptation responses?

NARP – Local Research Priorities

5.3 Local land management issues

- **5.3.1** What are the costs and benefits of different climate change adaptation measures in key vulnerable communities and ecosystems?

- **5.3.2** How should fire management adapt to climate change?

- **5.3.3** How can management of local protected areas incorporate and adapt to climate change?

- **5.3.4** How can we better integrate conservation plans and actions across landscapes, incorporating protected area management, off-reserve conservation measures and other land-uses, to maximise biodiversity conservation benefits/outcomes under a changing climate?

NARP – Species Research Priorities

5.4 Managing key species

- **5.4.1** Which species should be the focus of investment in climate change adaptation?

- **5.4.2** How will climate change affect current management actions for protecting priority species and what management changes will be required?

- **5.4.3** How will climate change affect current or potential problem species and what management responses will be required?

Some common themes and priorities for biological research across NARP, BVA, Protected areas:

1) Develop planning strategies and policy that recognise novel ecosystems, shifting climates and conservation paradigms

2) Understand, and predict, responses and vulnerability

3) Identify refugia – both internal and external

4) Understanding the influence of extreme events

5) Interactions between climate change and other stressors

6) Protect more habitat & greater environmental diversity

7) Manage habitat to reduce threats and maintain resilience

8) Manage landscape-scale issues such as connectivity

How do YOU think the national priorities fit your ecosystem / region / sector?

- Are there any serious omissions?

- What are the priorities / challenges in your area of interest ?

- What research is needed to have the knowledge to make the best possible choices about adaptation?

- What are the main impediments?

Impacts:

What are the main impacts of climate change on terrestrial biodiversity in

Tasmania? Rank at afternoon tea

- Examples:

  - Direct temperature impacts
  - Biogeographic barriers to movement
  - Changing rainfall
  - Sea level rise
  - Extreme events:
    - Fire
    - Drought
    - Cyclones
    - Floods
    - Storm surges
  - Interactions
    - Invasive species
    - Habitat Fragmentation

Local / Regional / Sectoral

Sector	Area	Ecosystem	Impacts	Ideas to manage	Adaptation Research	Impediment
National Park	Bogong High Plains	Alpine/ subalpine	• increased fire risk	•control burning	•Which species most threatened •	•Money •Changing ideas and attitudes to Climate Change •skills
National Park	Bogong High Plains	Alpine/ subalpine	• increased incidence of drought	•artificial structures to provide micro refugia / feeders	•Would the animals use structures	
National Park	Bogong High Plains	Alpine/ subalpine	•increased threat of invasives	•Sterilize vehicles	When to act	