

# Marine management in a changing climate: the Great Barrier Reef Experience

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**Australian Government**

**Great Barrier Reef  
Marine Park Authority**















## Climate change issues for coral reefs

Storm frequency & intensity

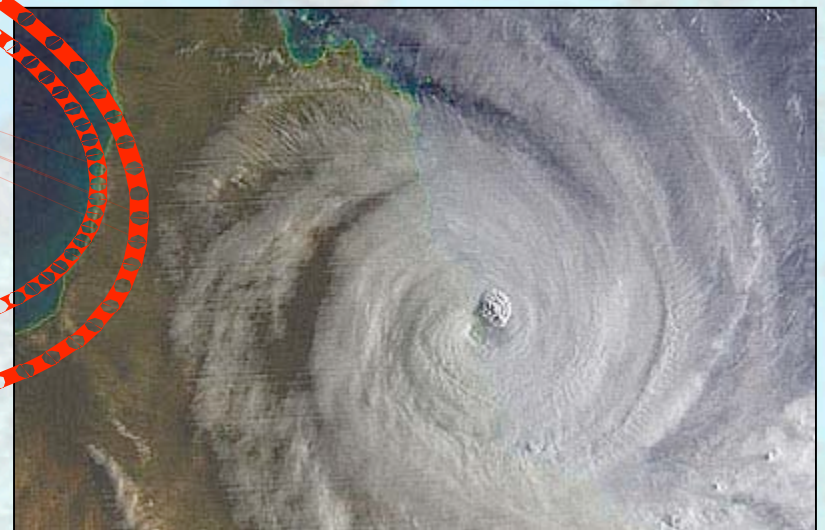
Precipitation, drought & run-off

Changing circulation

Sea level rise

Sea temperature

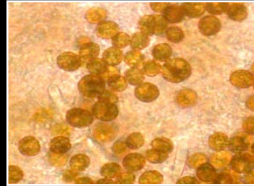
Ocean chemistry





## Critical temperature sensitivity

Corals live in  
symbiosis with  
zooxanthellae



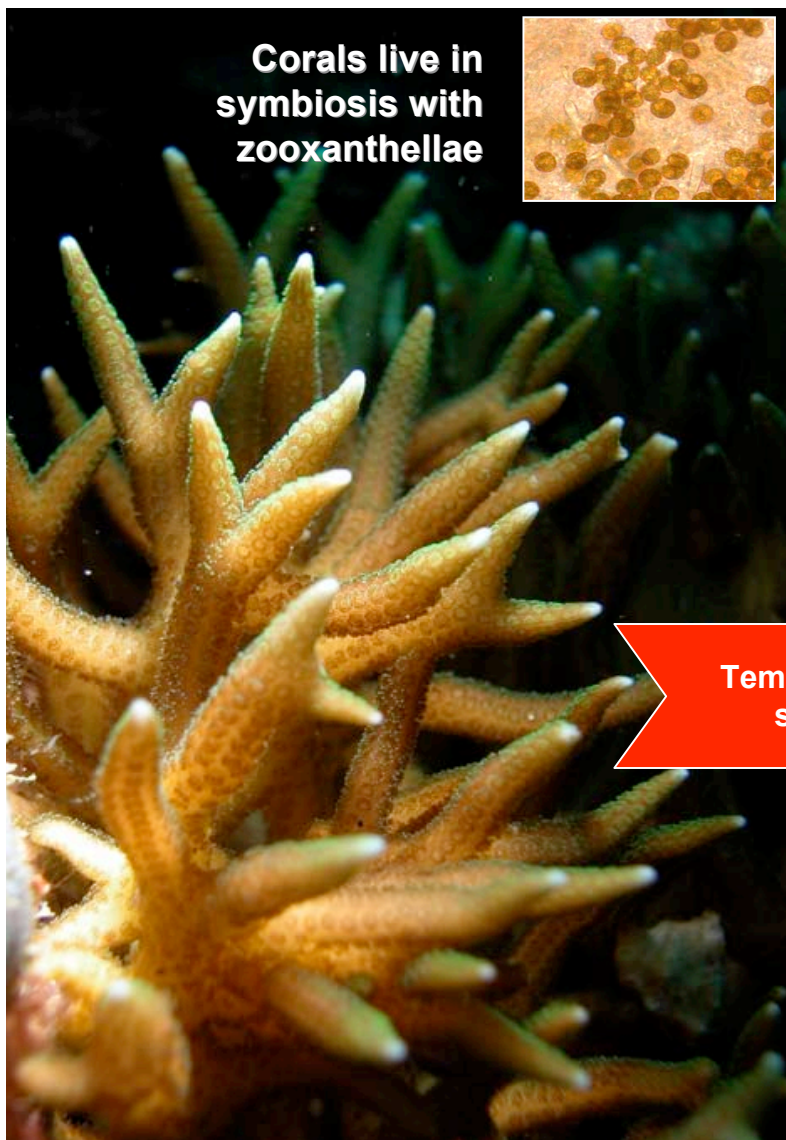
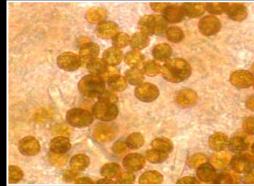
Biological  
structures visible  
from space



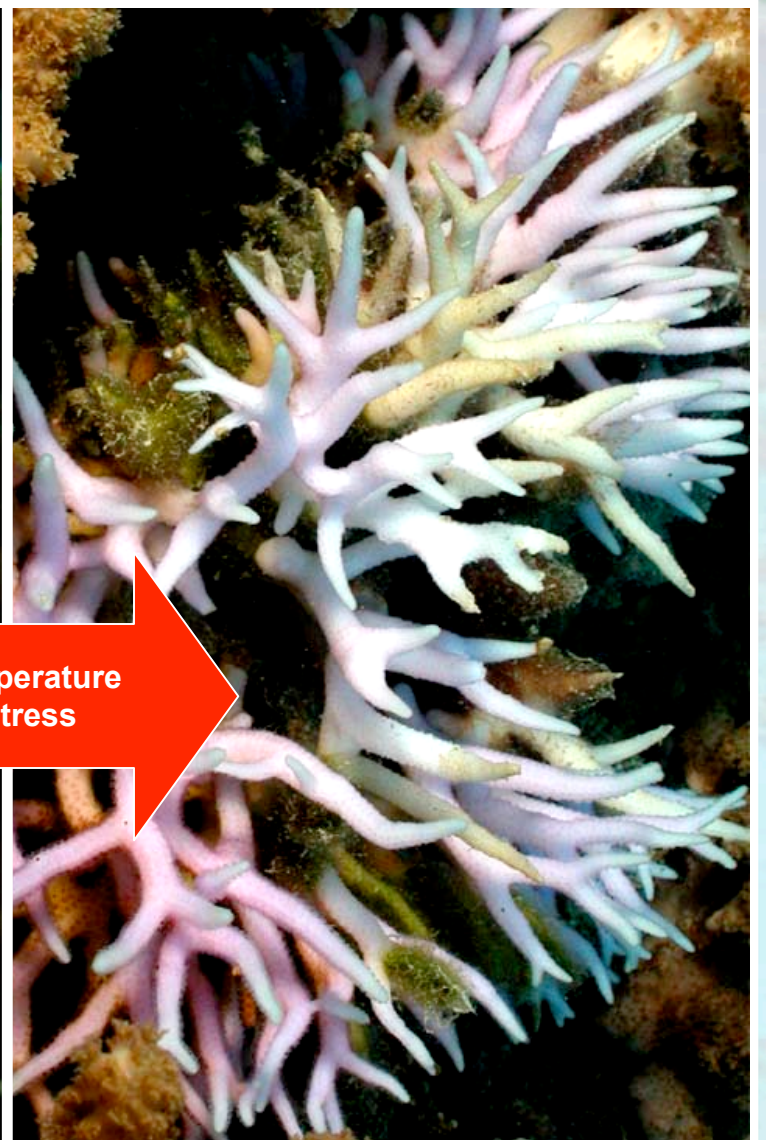


## Critical temperature sensitivity

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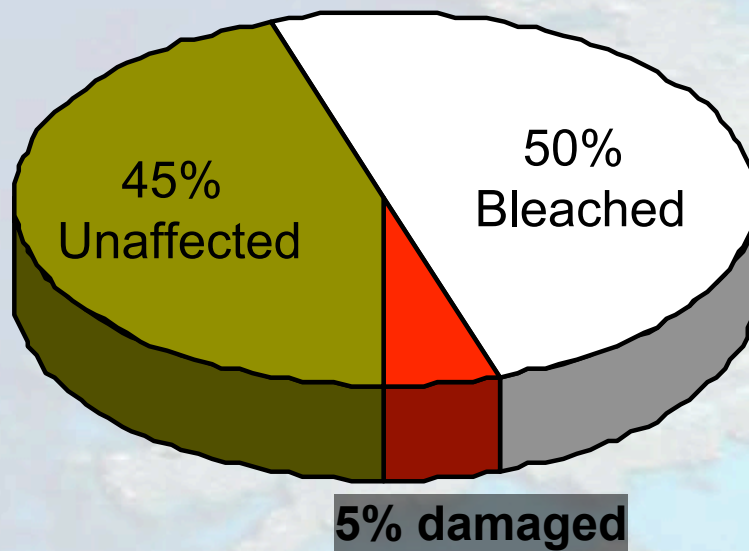


Temperature  
stress

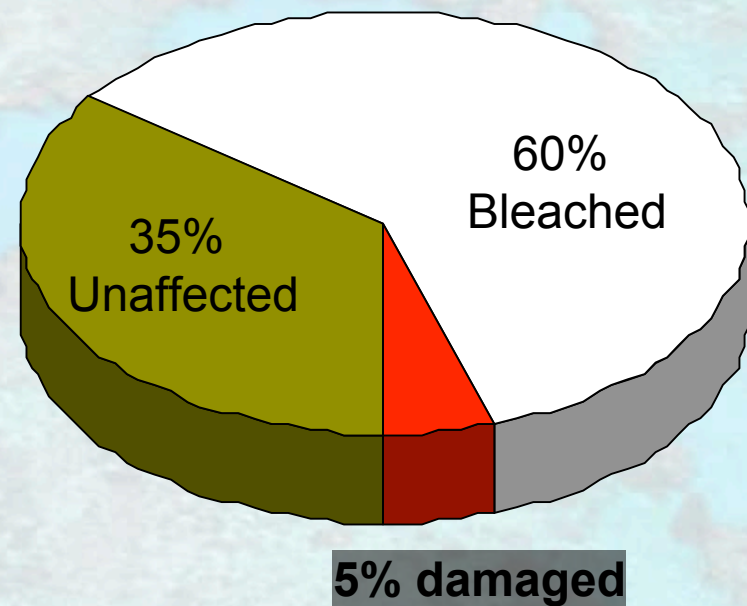


## Observed impacts on the GBR

1998



2002





## Observed impacts on the GBR

**2006**

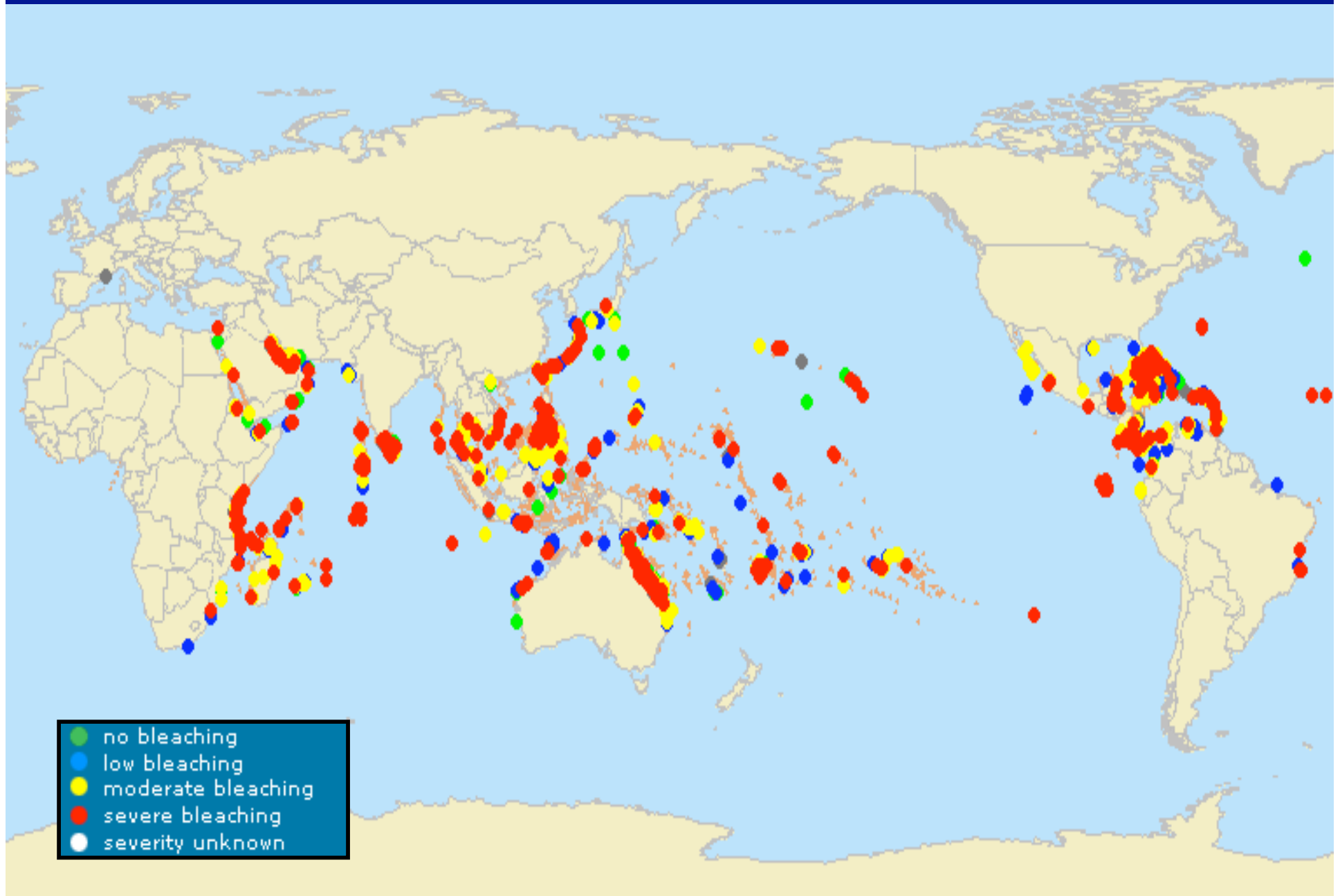
Keppel Islands

40% corals killed



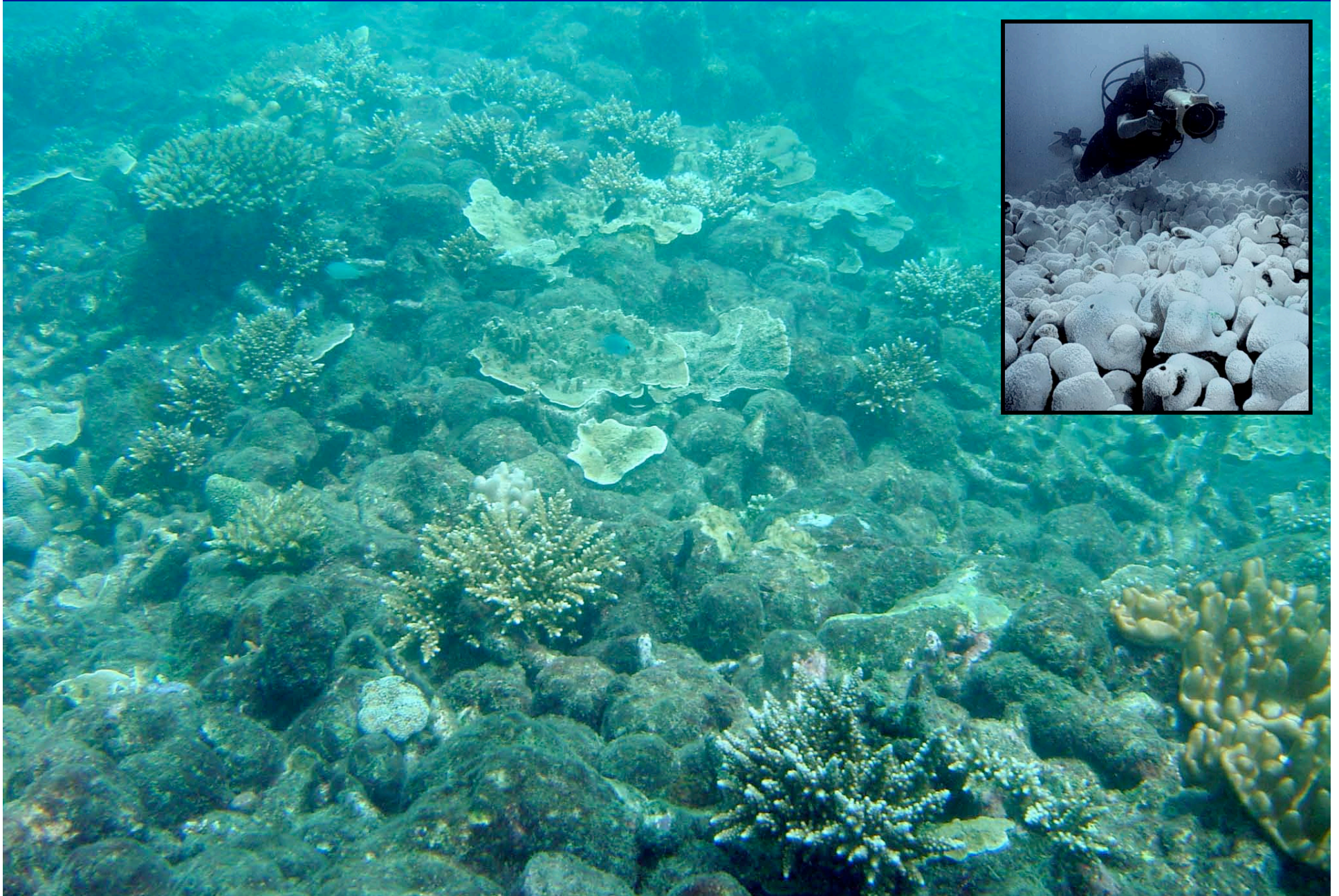


## Global impact – 16% of reefs damaged



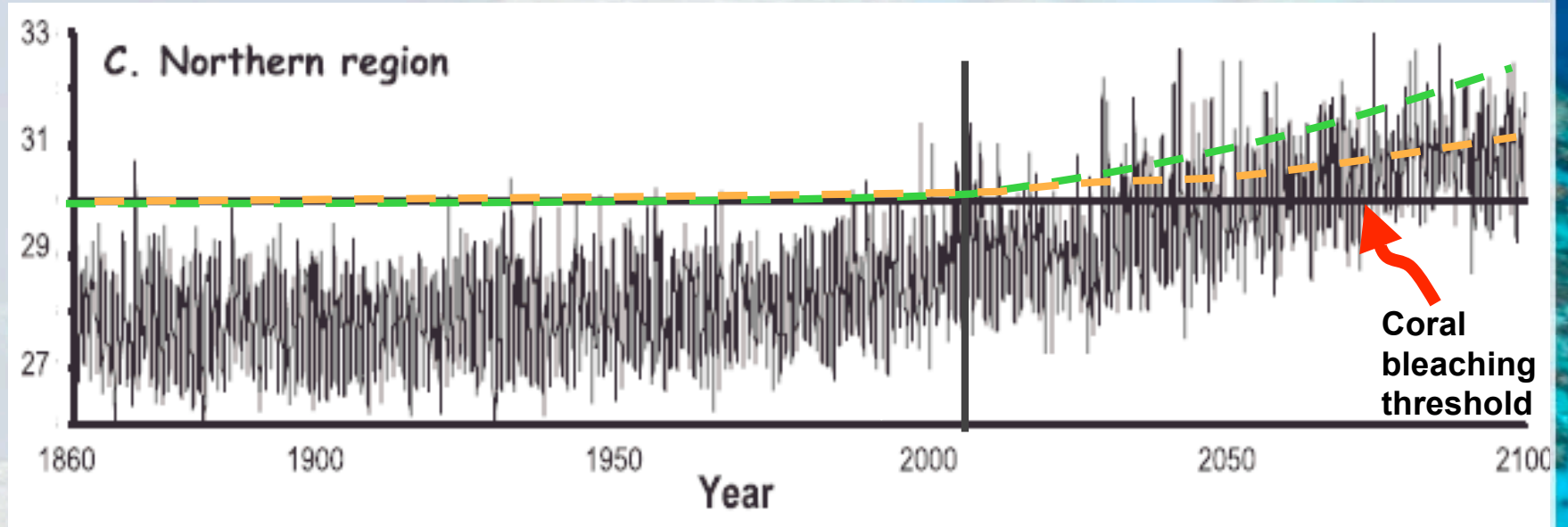


# Recovery can take decades





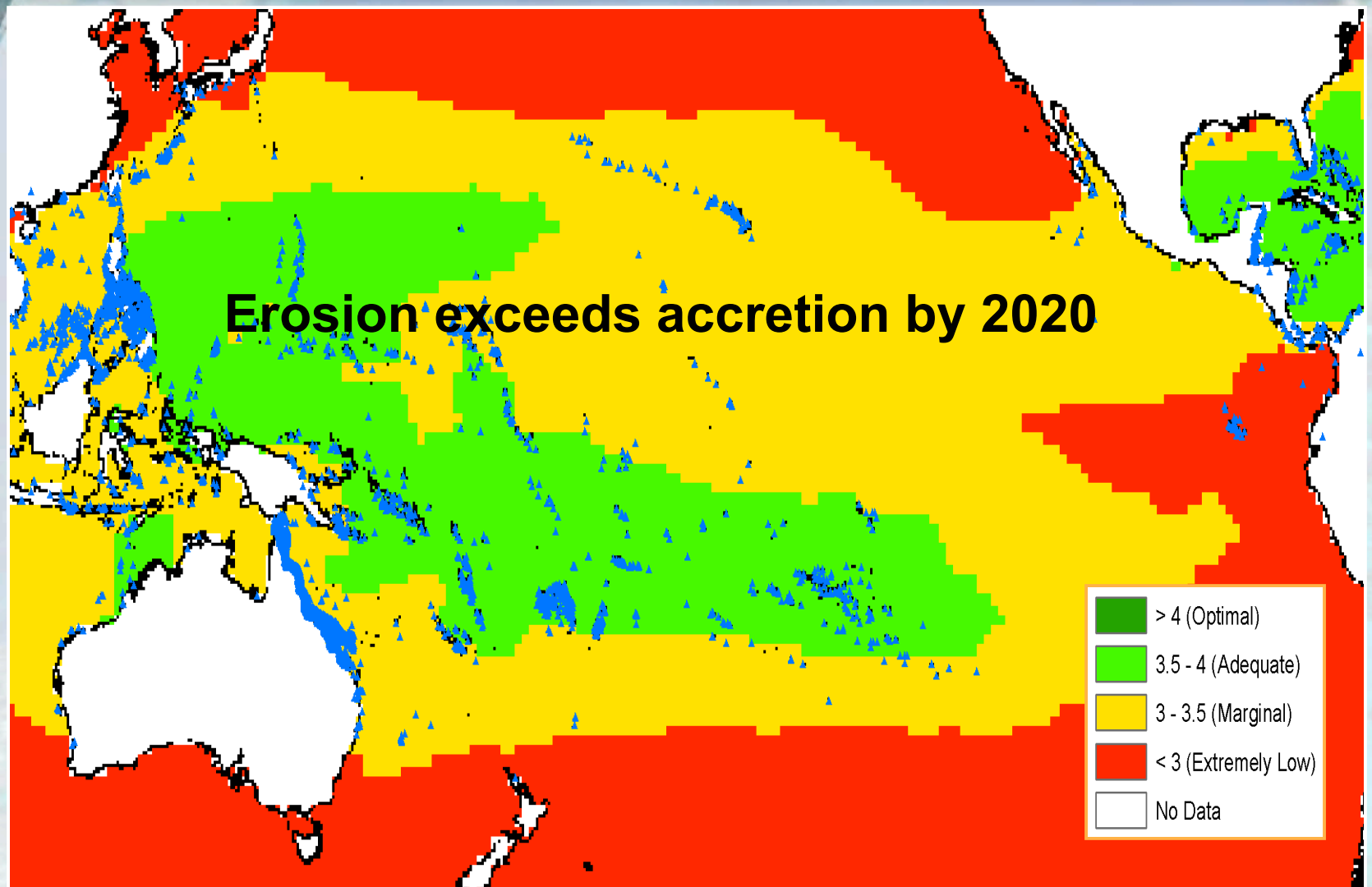
## A bleached future for reefs



*Doubling of CO<sub>2</sub> - Hoegh-Guldberg (1999)*



## Ocean acidification





## Houston, we have a problem

### Response

1. Understand problem

➤ ***Vulnerability Assessment***

2. Develop strategies

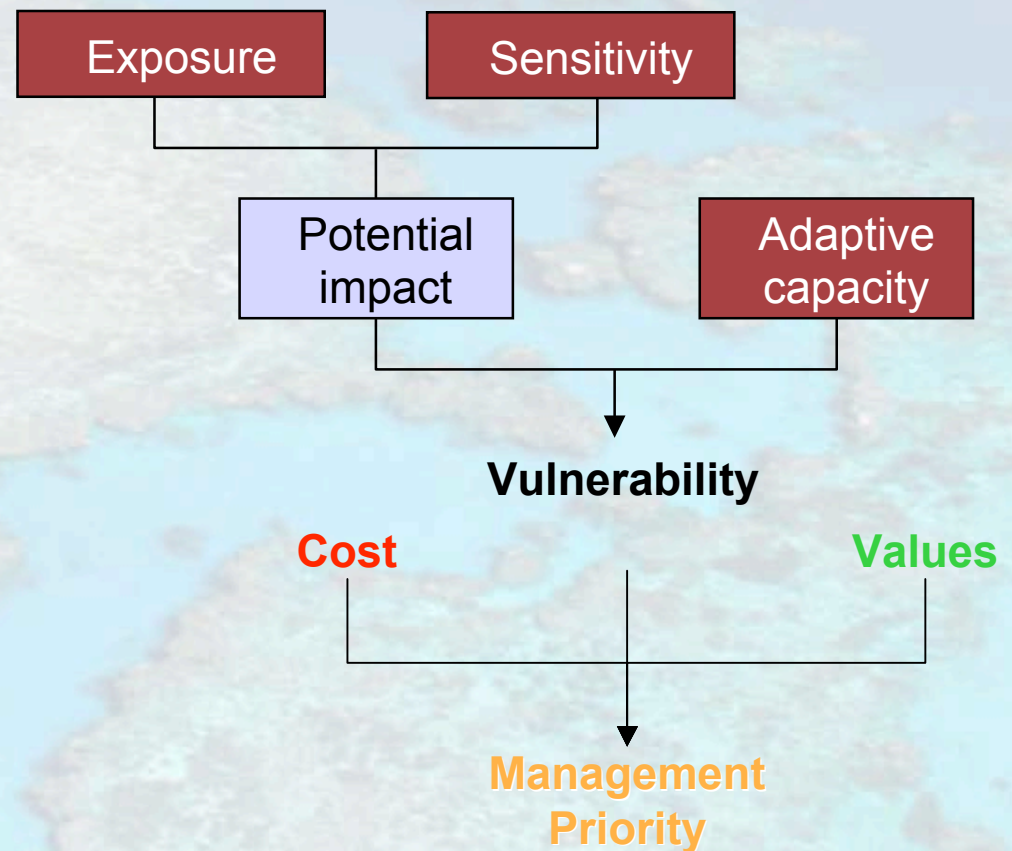
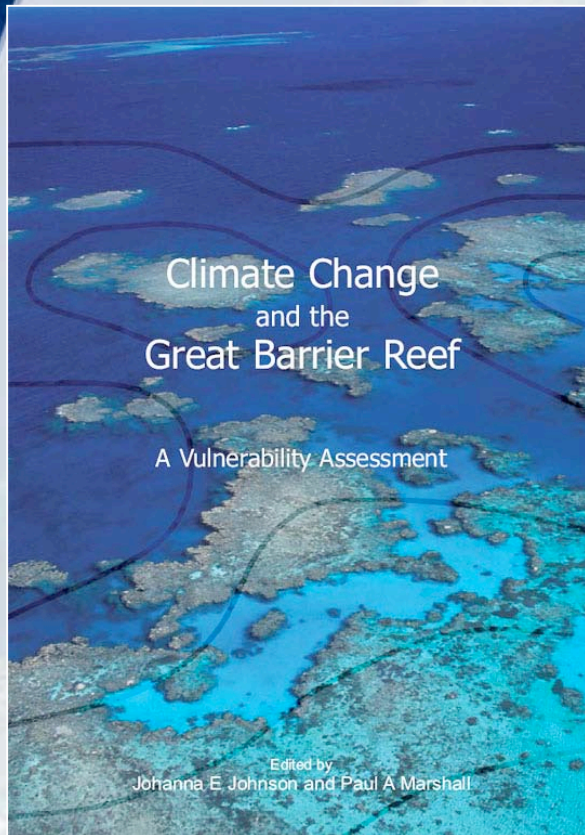
➤ ***Resilience Analysis***

3. Take action

➤ ***Adaptation Plan***

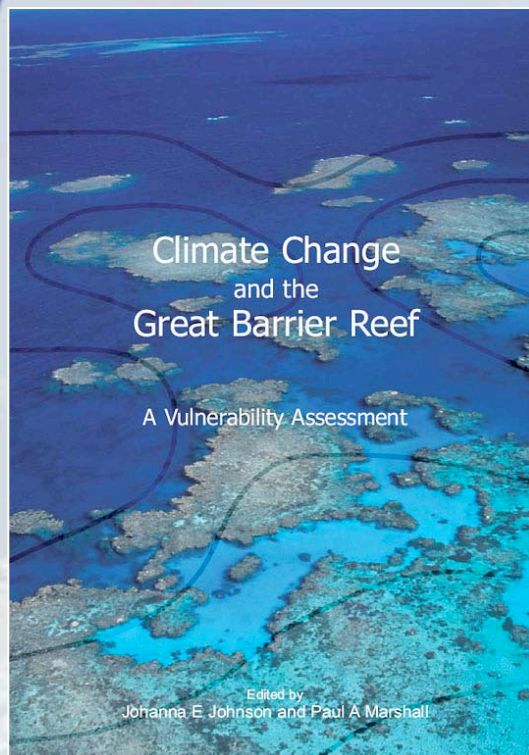


# Climate Change & the GBR: A Vulnerability Assessment





# Climate Change & the GBR: A Vulnerability Assessment



## Introduction

- The Great Barrier Reef (GBR)
- Climate and climate change on the GBR
- Oceanography and climate change
- Resilience, climate change & the GBR

## Vulnerability of species and species groups

- Marine microbes
- Plankton
- Macroalgae
- Seagrasses
- Mangroves & tidal wetlands
- Reef-building corals
- Benthic invertebrates
- Fishes
- Sharks & Rays
- Seabirds
- Marine reptiles
- Marine mammals

## Vulnerability of GBR habitats

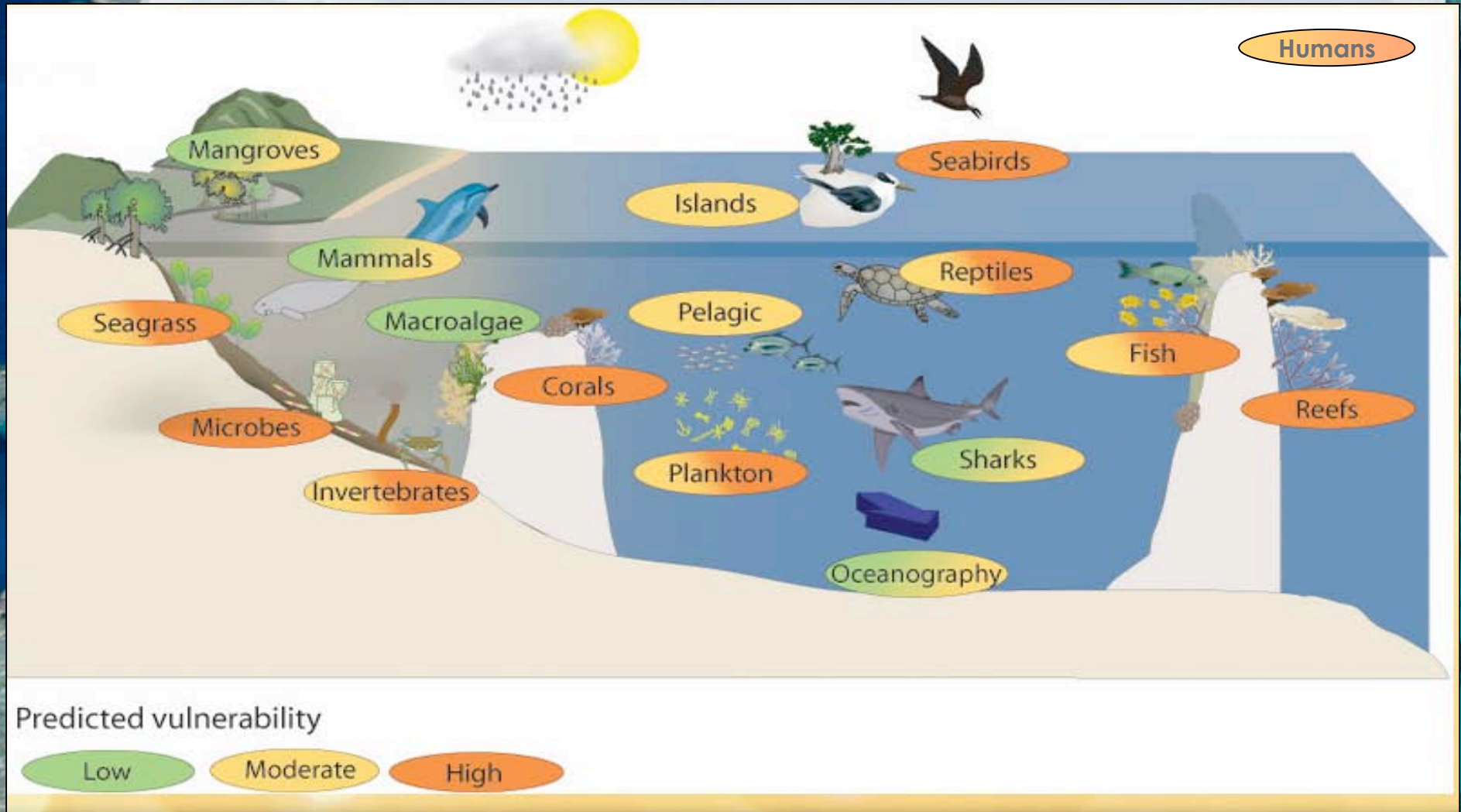
- Coral reefs
- Pelagic systems
- Coasts and estuaries
- Islands and cays
- Geomorphological features
- Palaeoecology

## Enabling management

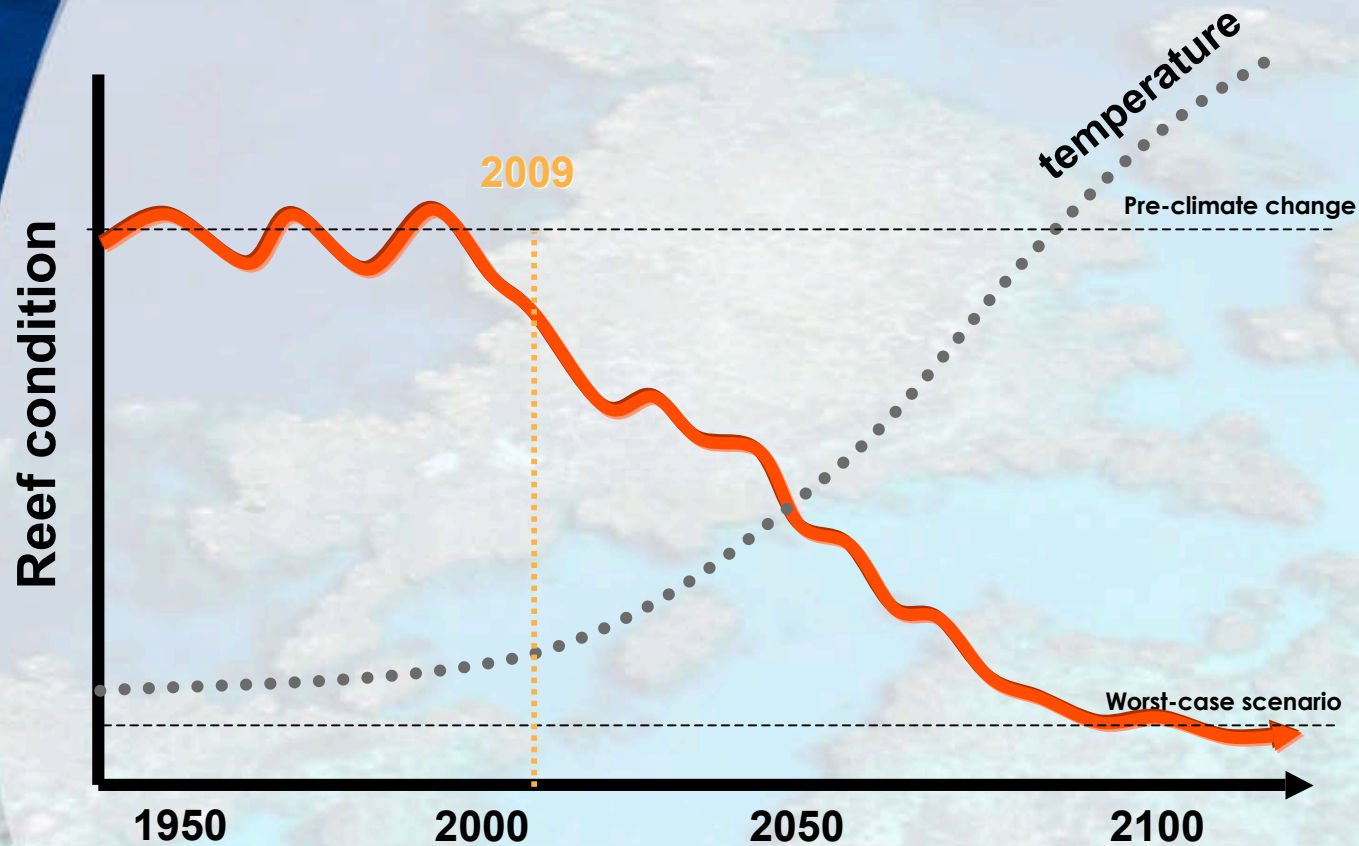
- Industries and communities
- Vulnerability & management implications



## Summary of GBR vulnerability

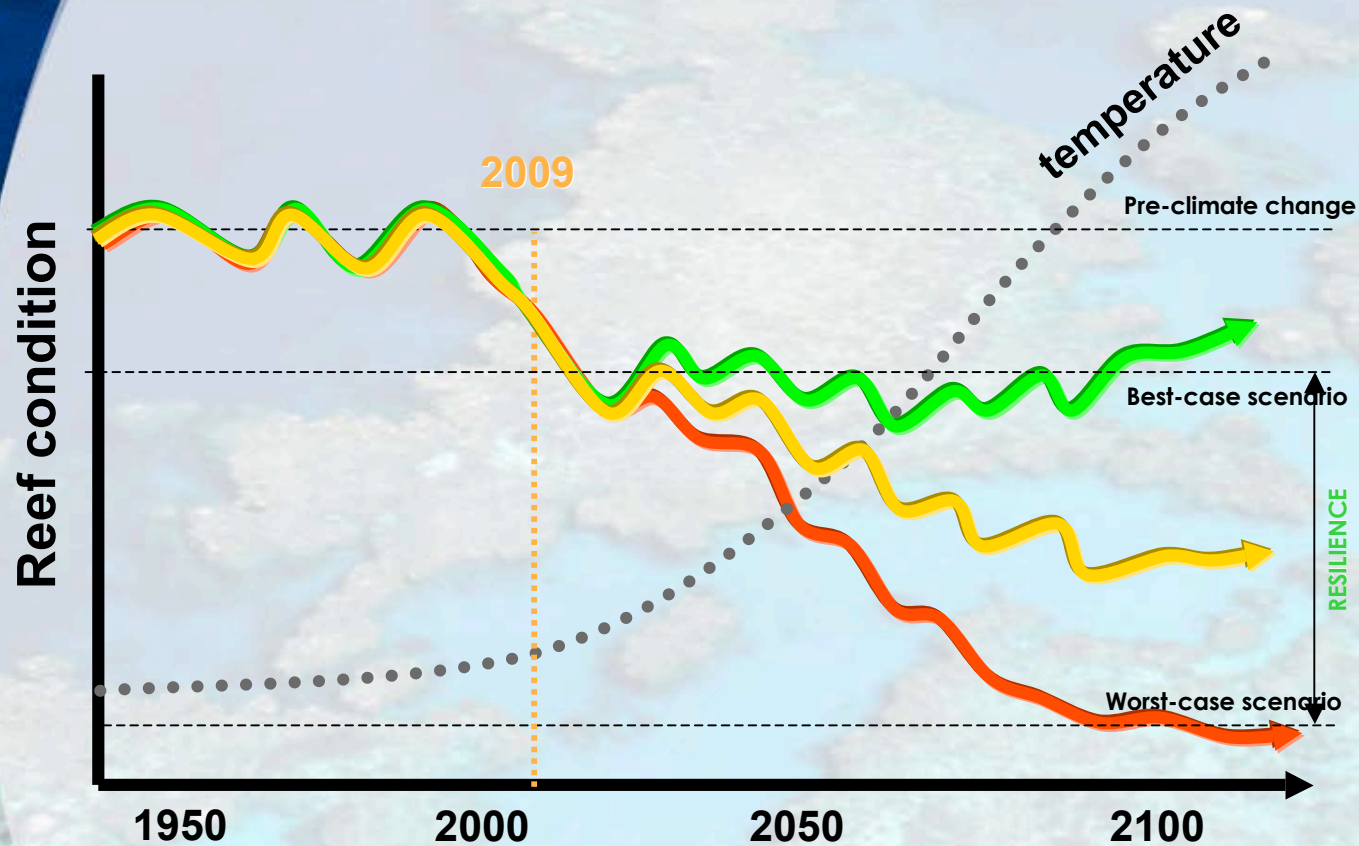


## But isn't management futile?

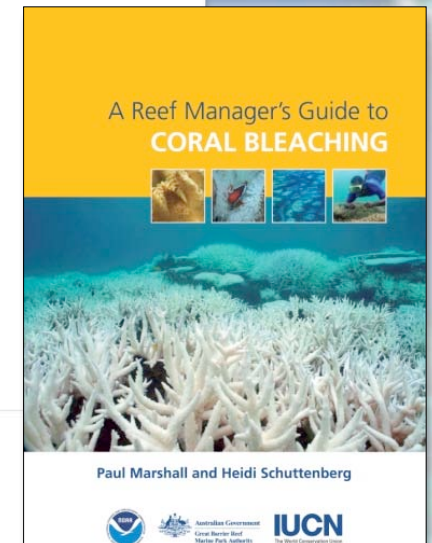
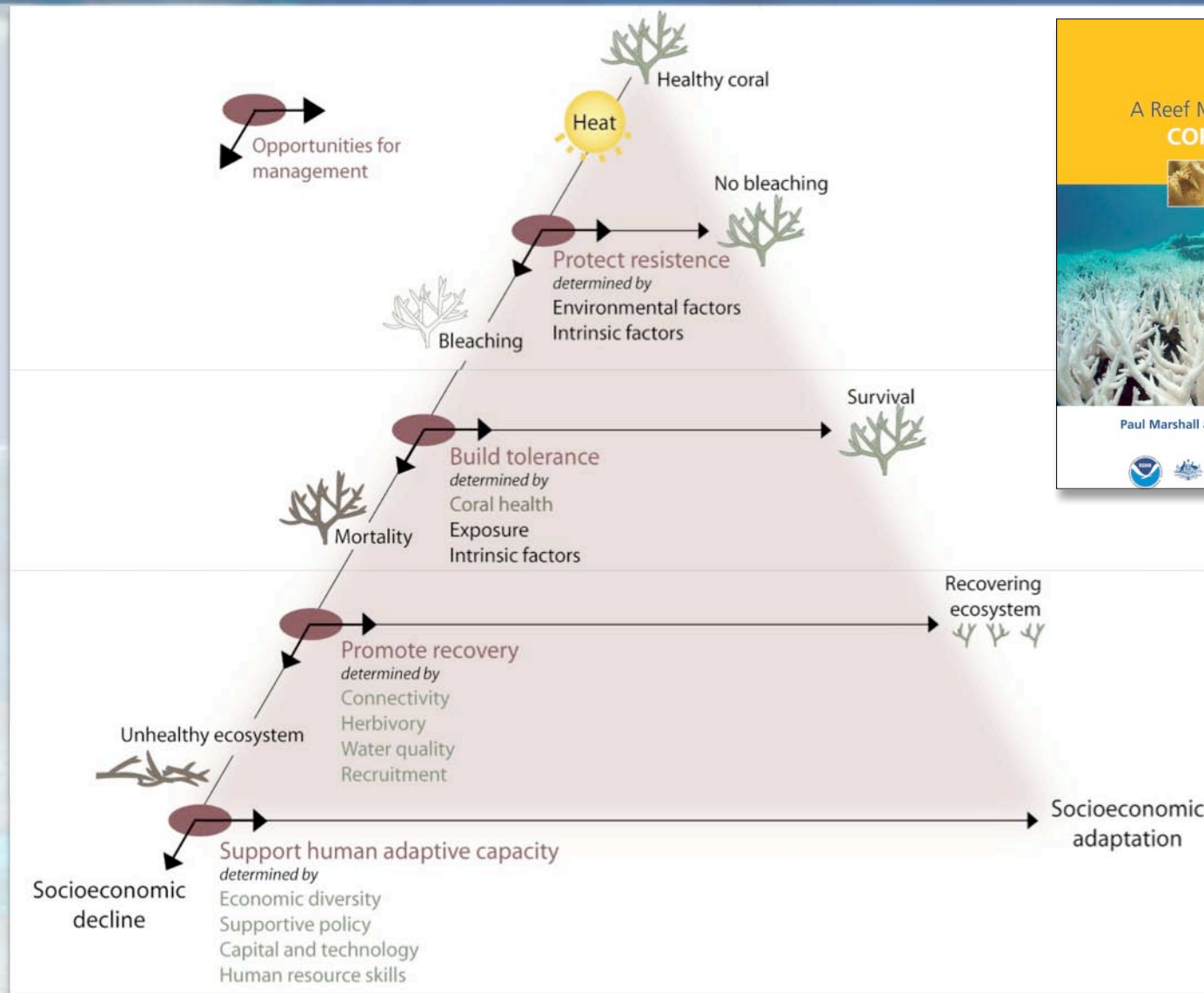




## But isn't management futile?

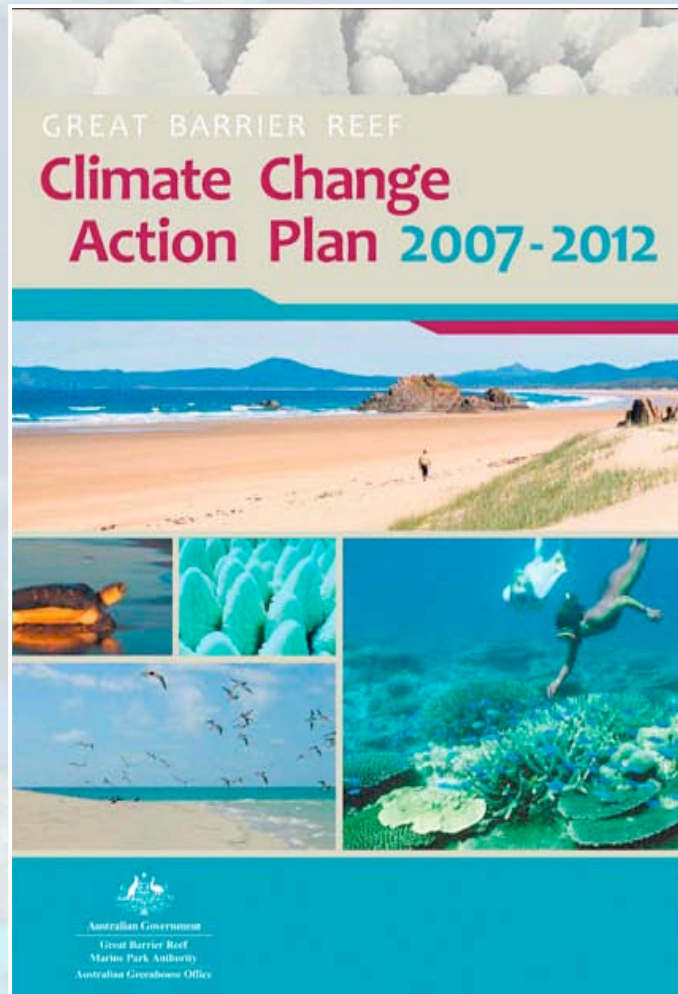


## Resilience Analysis - Corals





## Adaptation Plan



### Goal:

To increase chances of the GBR coping with climate change.

### How:

- Targeted science
- A resilient GBR ecosystem
- Adaptation of industries and communities
- Reduced climate footprints

## Targeted science

- Vulnerability Assessment – priority gaps
- CC Knowledge Acquisition Strategy
- Optimising decision-making (AEDA)
- Understanding thresholds & irreversible change
- Measuring resilience





## Resilient ecosystem

- Policy review
- Identifying & protecting refugia
- Resilience analysis for priority components
- Adaptation plans
- Risk & Resilience Atlas
- Prioritising resources



## Adaptation of industries & communities

### GBR Tourism

- Tourism Leader's Forum
- Climate Change Action Group
- Climate Change Action Strategy



### GBR Fisheries

- Climate Change Liaison Officer
- Climate Change risk assessment





## Reduced climate footprints

- Low Isles Climate Friendly destination
- GBRMPA Climate Neutral strategy
- Climate Change accreditation program
- Community-Based Social Marketing



## Capacity building

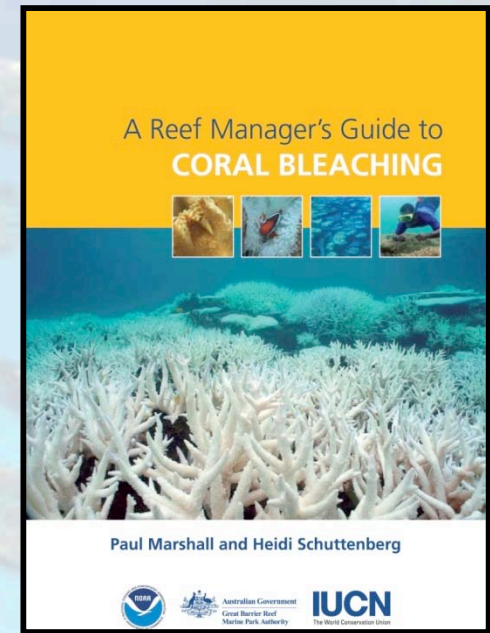
### Internal

- Awareness raising
- Communication tools
- Sharing ownership
- Building capacity

### External workshops

- Responding to bleaching events
- Resilience-based management
- Vulnerability assessments & adaptation planning

### IUCN Working Group





## Adapting management

PA Marshall & JE Johnson, Chapter 24, VA

### Mitigation

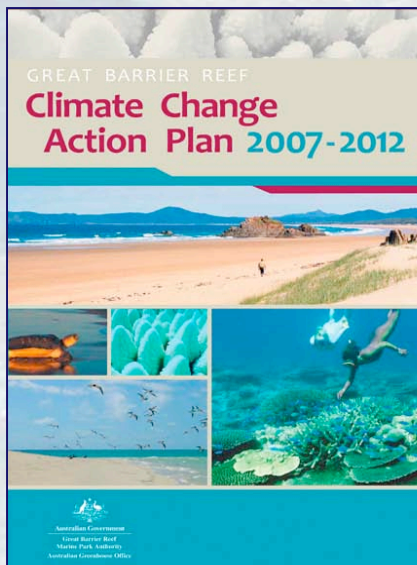
Reduce GHG emissions:

Communication

- Information & awareness

Demonstration

- Reduce climate footprint of activities on the GBR



### Resilience building

Reduce other stressors:

Improve water quality

Protect key functional groups

Protect refugia/critical habitats

Restore resilience of particular species groups



### Facilitating social and economic resilience

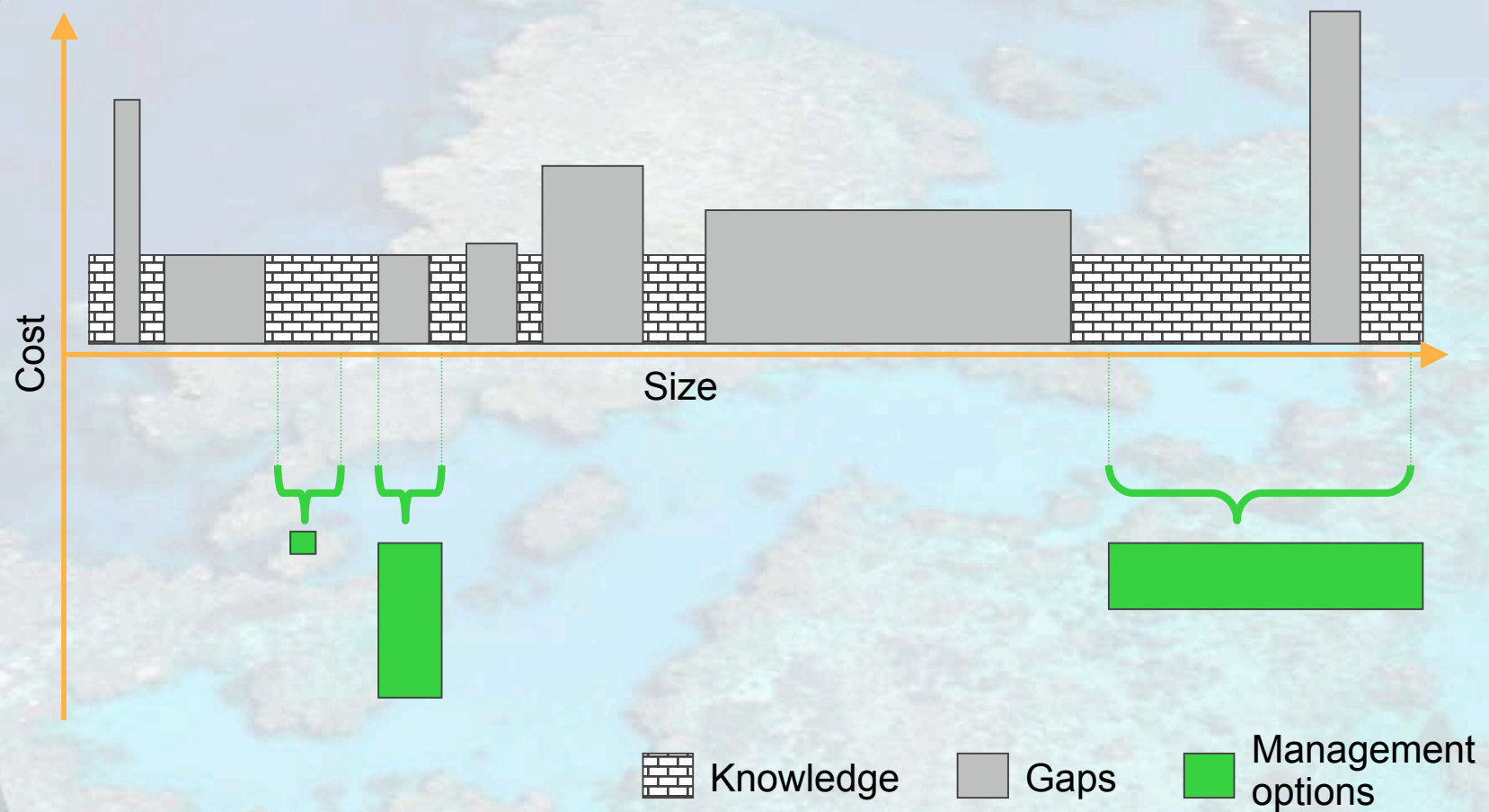
Build adaptive capacity:

Personalise climate issues

Effective partnerships and coordination of efforts

## Obstacles and opportunities

- ***Targeting science to management needs***





## Obstacles and opportunities

- ***Barriers to change***
  - Ignorance
  - Fear
  - Change
  - Identity
  - Politics
  - politics
  - Ownership
  - Structure
  - Resources
  - Expectation management

## Obstacles and opportunities

- ***Political support***
  - Provide solutions – not just problems
  - Be first
  - Iconic values
  - Real benefits
  - Transferability
  - Expectation management



## Obstacles and opportunities

- ***Conservation must change***

### Interactions between stresses

- *Management beyond MPAs*

### Thresholds, complexity and non-linearity

- Anticipating & preventing damage

### Range shifts

- Migratory MPAs?

### Conservation status

- Closer to the brink?

## Obstacles and opportunities

- ***Conservation must change***

### Conservation goals

- *Biodiversity vs ecosystem goods & services*

### Networks of MPAs

- *Changing connectivity*

### Resilient socio-ecological systems

- *Resource users must be part of solution*
- *Supporting adaptation*



## Obstacles and opportunities

- ***Science gaps***
  - Relative vulnerabilities
  - Factors critical to resilience
  - Measuring resilience
  - Strategies for building resilience
  - Optimal decision-making
  - Monitoring and evaluation
  - Adaptation frameworks
  - Social & economic adaptation
  - Behaviour change



## Obstacles and opportunities

### Opportunities?

- *Collaboration*
- *Efficiencies*
- *Resources*
- *Conservation imperative*



Australian Government

Great Barrier Reef  
Marine Park Authority