

Coral reef management in a changing climate: A Reef Manager's Guide to Coral Bleaching

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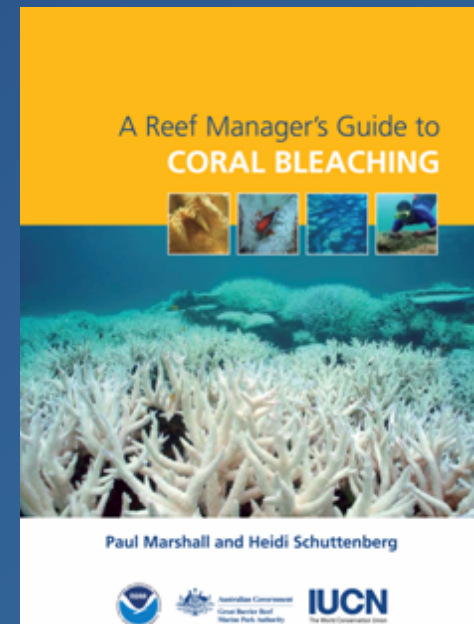
Climate Change Response Program
Great Barrier Reef Marine Park Authority

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James Cook University
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Billy Causey

Southeast regional director
NOAA Marine Sanctuaries Program



The Great Barrier Reef

World's largest

- coral reef ecosystem
- World Heritage Area



Introduction to GBRMPA

- Federal Authority
- Partnership with Queensland
- Multiple use
- Mission:
protection, wise use, understanding and enjoyment

ACTIVITIES GUIDE
(see Zoning Plan for details)

| | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 | Zone 6 | Zone 7 | Zone 8 |
|--|--------|--------|----------|--------|--------|--------|--------|--------|
| Aquaculture | Permit | Permit | Permit 1 | X | X | X | X | X |
| Swimming | ✓ | ✓ | ✓ | X | X | X | X | X |
| Snorkelling, diving, photography | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Crabbing | ✓ | ✓ | ✓ | X | X | X | X | X |
| Harvest fishing for aquarium fish, coral and sea cucumbers | Permit | Permit | Permit 1 | X | X | X | X | X |
| Harvest fishing for sea cucumbers, tridacna, tridacna rock lobster | Permit | Permit | X | X | X | X | X | X |
| Limited collecting | ✓ | ✓ | ✓ | X | X | X | X | X |
| Limited impact research | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Permit |
| Limited spearfishing (snorkel only) | ✓ | ✓ | ✓ | X | X | X | X | X |
| Line fishing | ✓ | ✓ | ✓ | X | X | X | X | X |
| Netting (other than ball netting) | Permit | Permit | X | X | X | X | X | X |
| Research (other than limited impact) | Permit | Permit | Permit | Permit | Permit | Permit | Permit | Permit |
| Shipping (other than in a designated shipping area) | ✓ | Permit | Permit | Permit | Permit | Permit | Permit | X |
| Tourism program | Permit | Permit | Permit | Permit | Permit | Permit | Permit | Permit |
| Traditional use of marine resources | ✓ | ✓ | ✓ | X | X | X | X | X |
| Trawling | ✓ | X | X | X | X | X | X | X |
| Trailing | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

PLEASE NOTE: This guide provides an introduction to Zoning in the Great Barrier Reef Marine Park.



Debate heats up over global warming

Questions on climate change and its effect on hurricanes are starting to surface in the US.

Report Peter Huck

Financial Review 03/09/2005

Climate change hits ACT

Canberra Times
22/08/2005

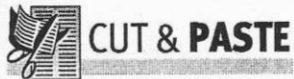
dependence
emigrate respected
politically inconvenient opinion

... fear as ... wait for ... lock at the door

Canberra Times
1/11/2005

So much for global warming's capacity

The Melbourne Herald Sun's Andrew Bolt takes issue with scientist and activist



The Age

Climate change hits ACT
Winter wetter
over 20 years
2005

MATT PRICE

Why minister makes sceptics see green

Weekend Australian 29/10/2005

It's climate change, as forecast

A year of climatic disasters is now persuading politicians to accept the warnings of 20 years ago, writes Geoff Strong.

The Age 31/10/2005

Scientists forced into climate climbdown

ZEEYA MERALI

New Scientist 20/08/2005

Why all the green panic?

Our new
Environment
Minister has wasted
no time leaping on to
the global warming
bandwagon. Why
he's been ill-
informed

The Sunday
Mail
14/08/2005

Planet not too hot to handle

No, minister, the climate change science is far from settled, argues Bob Carter

THE debate on climate change is over, says Ian Campbell. Claiming to be speaking on behalf of the Howard Government, and expressly in opposition to the Environment Minister, Campbell's opinion according to the front page of this paper yesterday, said "he agreed with the contention promoted by in ... Tim Flannery's book *The Weather Makers*". The report summarised Campbell's opinion as follows: "As far as the Howard Government is concerned, Australians must accept that humans contribute to global warming and adapt their behaviour to save the planet."

Officials contradict minister on global warming

Matt Price
Ian Gerard

FEDERAL Environment Minister Ian Campbell's view that global warming

and Sonoma coalmines to the Environmental Protection and Biodiversity Conservation Act

ing greenhouse emissions.

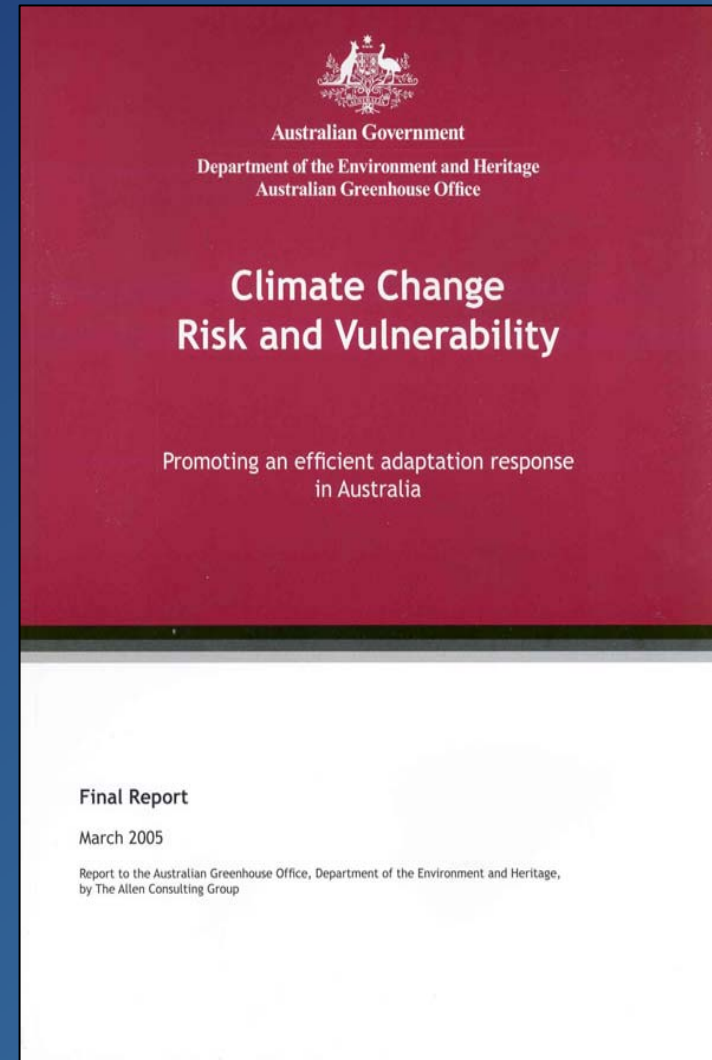
Kirsty Ruddock, a solicitor acting for Wildlife WhiteSunday said the legal

The Australian 28/10/2005

The Australian 28/10/2005

Risk and Vulnerability Report

Launched by Australian
Government Environment
Minister mid 2005



COAG National Adaptation Framework

- 2006/07 Framework to identify key national actions
- Implemented by State & Federal govts
- 5 year Plan

Australia's Vulnerability to Climate Change

IPCC Third Assessment Report

•Climate Change: An Australian Guide to the Science and Potential Impacts (2003)

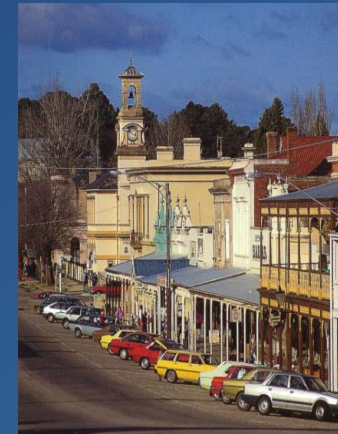
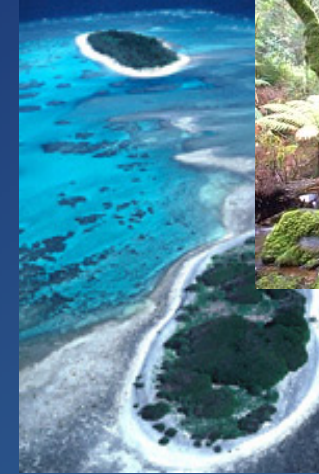
•Water (Quantity and quality)

•Agriculture (pests & weeds, trade, water, soil)

•Ecosystems & links to degradation processes

•Regional impacts (Socio-economic)

•Built environment and infrastructure



Australia – perhaps a relatively greater level of vulnerability than other developed countries

Assessment – Great Barrier Reef

| Vulnerability Criterion | Findings |
|-------------------------|--|
| Exposure | Increased sea, land and air temperatures Increase number and severity of storms Changes to spread of pests |
| Sensitivity | Very High |
| Adaptive Capacity | Very Low |
| Adverse Implications | Loss of Reef Loss of Tourism |
| Potential Benefit | Best Management is to reduce stresses Settlements could benefit from better planning |

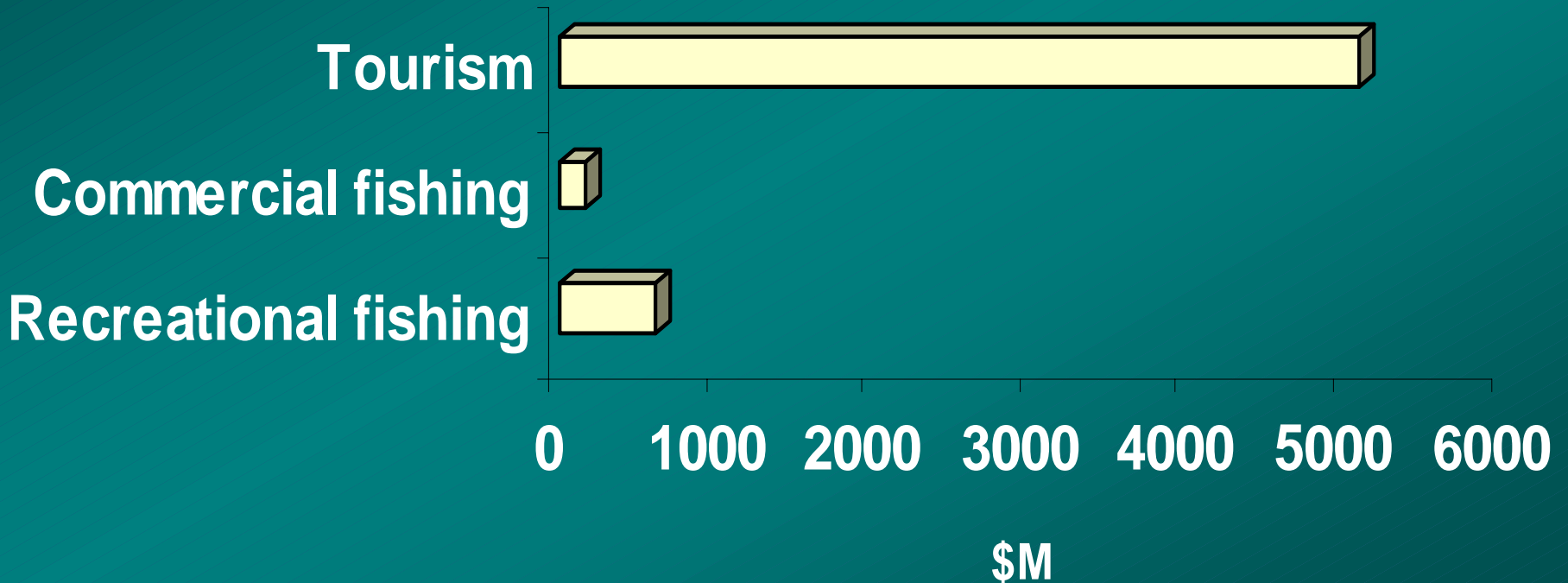
The Reef is under pressure

- Water quality
- Fishing
- Climate Change



Value of Industries

Economic Contribution of Industries in the Great Barrier Reef Catchment



GBR Resilience strategies

- Reef Water Quality Protection Plan
- Rezoning the GBR
- Climate Change Action Plan

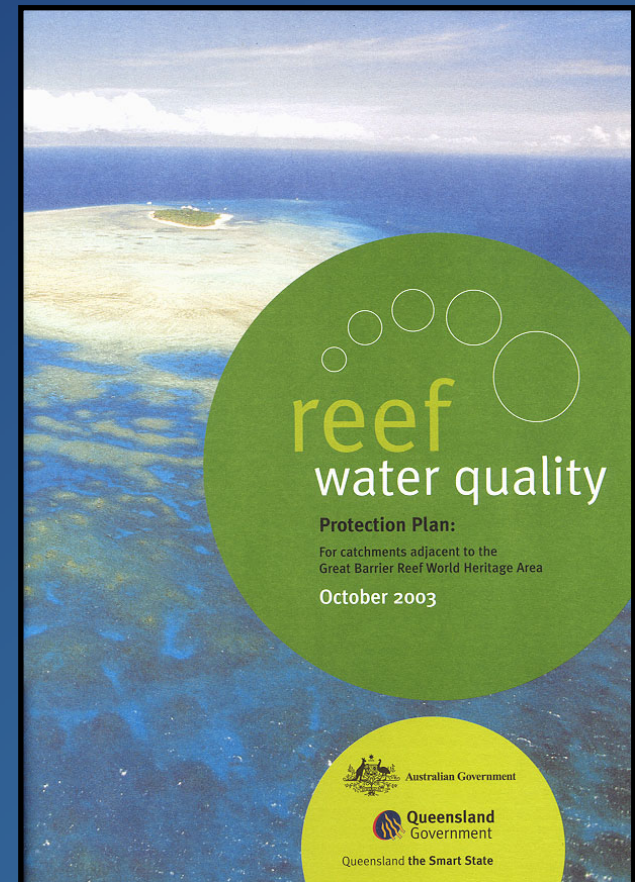


Reef Water Quality Protection Plan

Released December 2003

Goal:

To halt and reverse the decline in water quality entering the Reef within 10 years

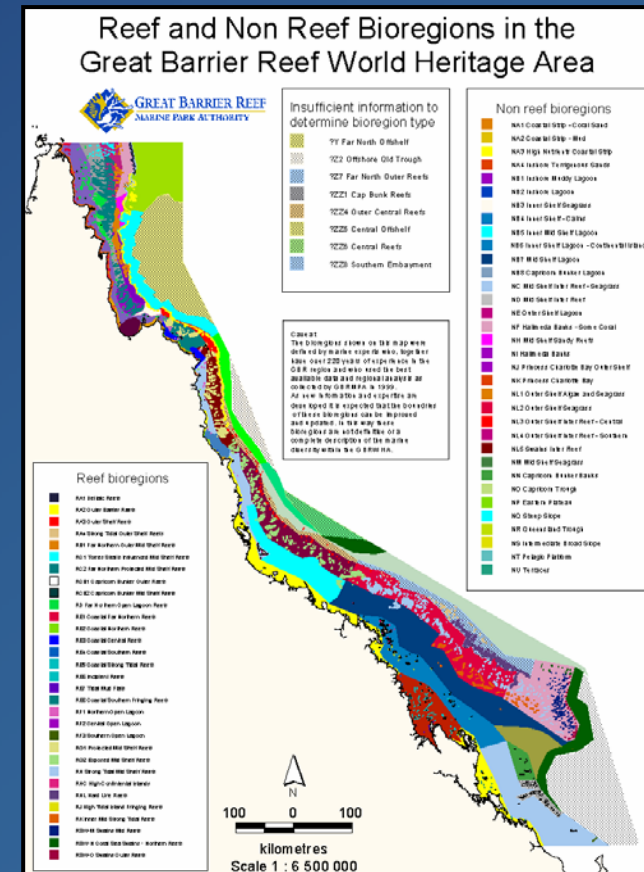


Rezoning the GBR

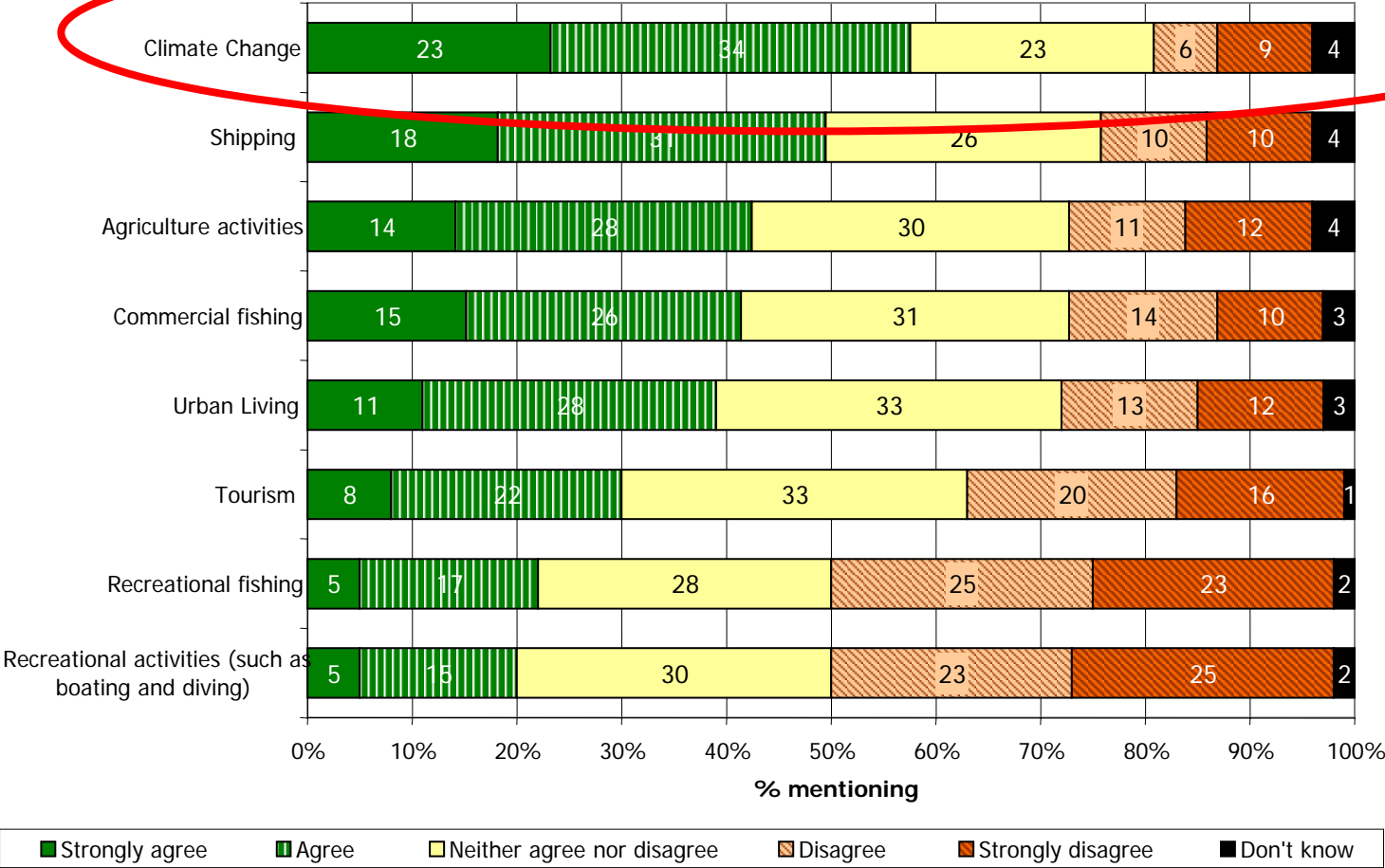
Outcomes for the reef

- At least 20% protected for each bio-region
- “No-take” Areas increased 4.6% to 33%

➤ Support ecosystem resilience



Perception of threats to GBR 2006



Managing for climate change

Climate Change Action Plan

- A. Sustaining Ecosystems
- B. Sustaining GBR Industries & Communities
- C. Supportive Policy & Collaborations



Climate Change Action Plan

- Resilience assessments
- Adaptation strategies



Tourism Climate Action Group

Partnership with
tourism industry on
climate change



GREAT BARRIER REEF

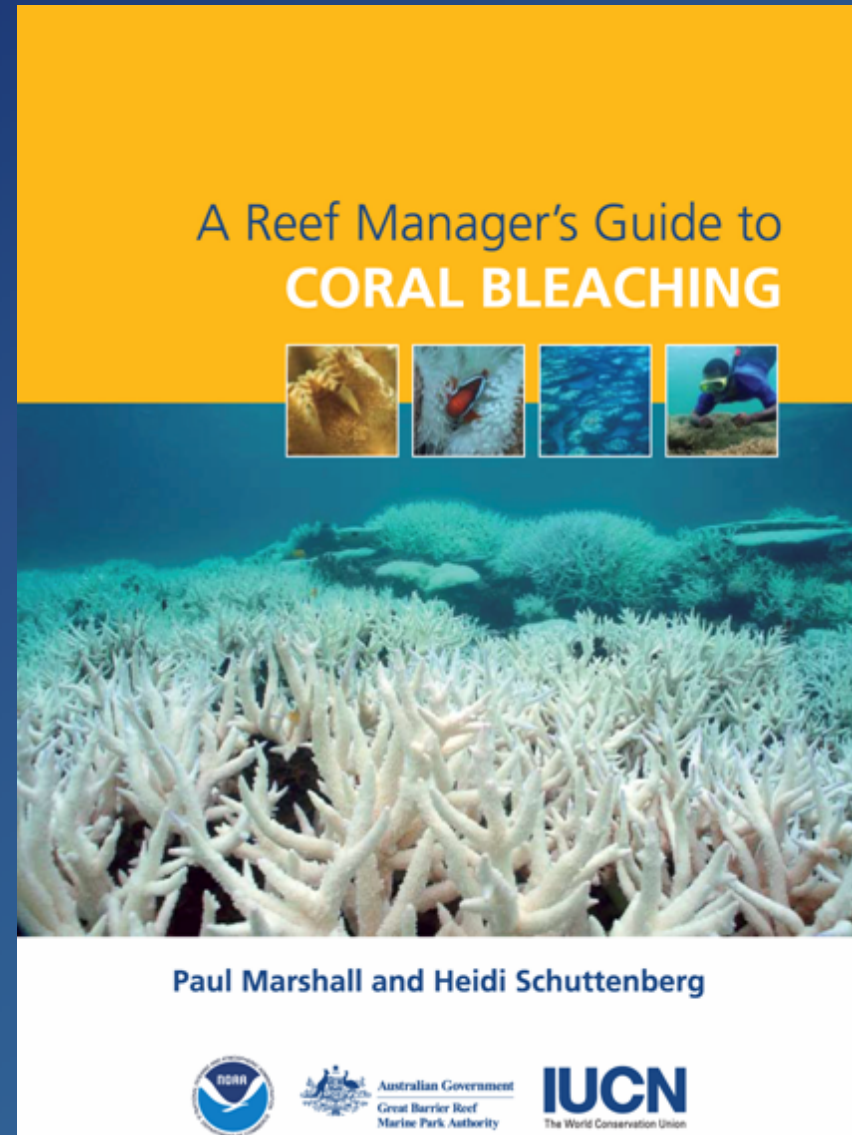
Climate Change Action Plan - 2007



Australian Government
Great Barrier Reef
Marine Park Authority

Why a manager's guide to coral bleaching?

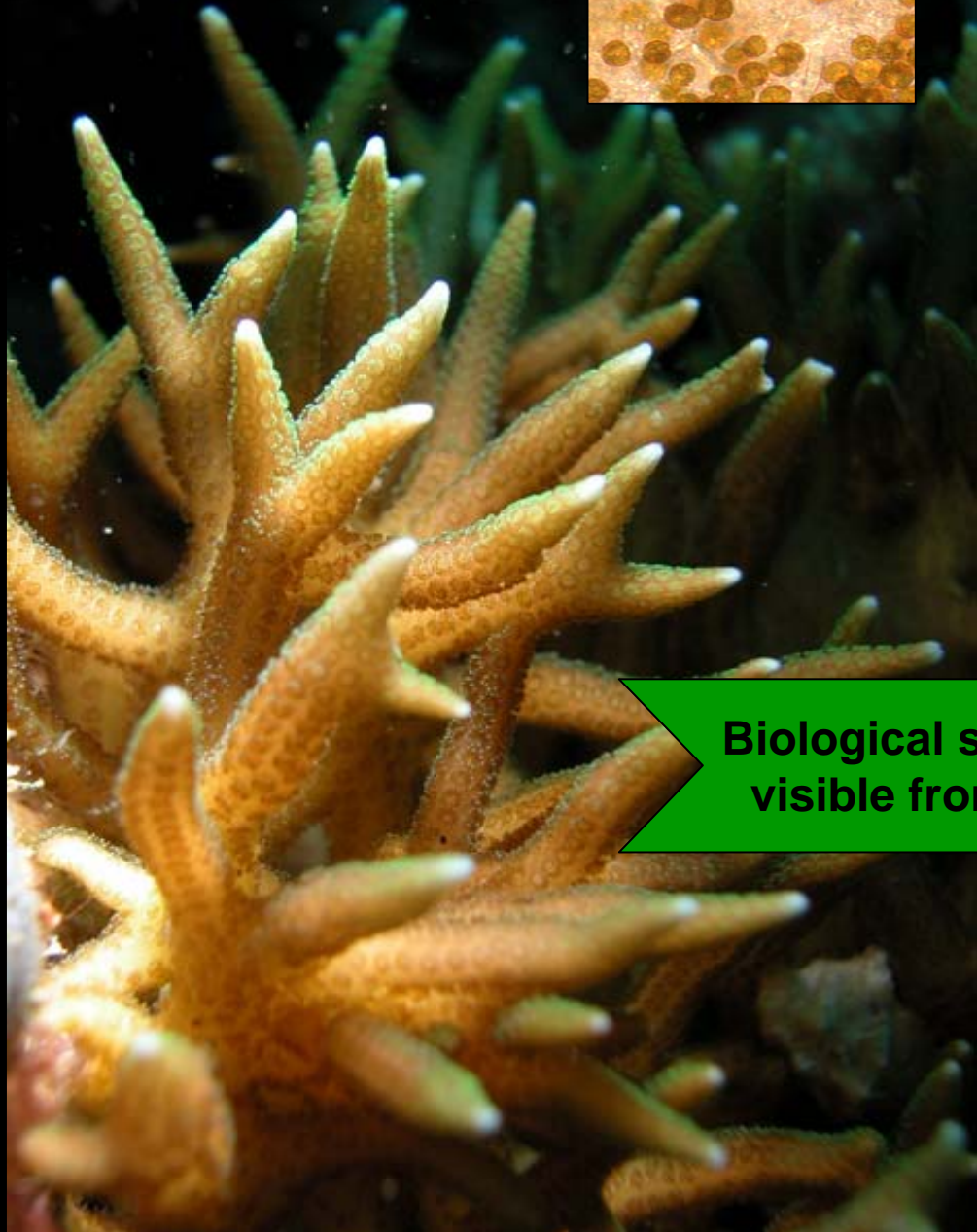
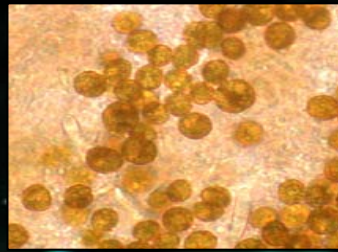
- **Climate is changing**
- **Coral reefs highly vulnerable**
- **Impacts are already occurring**
- **Meaningful actions are possible**



Symbiosis – vulnerability

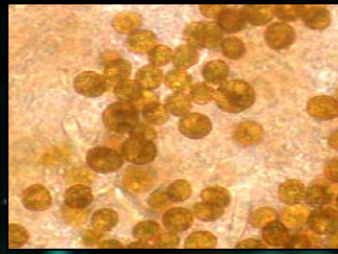


**Corals live in symbiosis
with zooxanthellae**

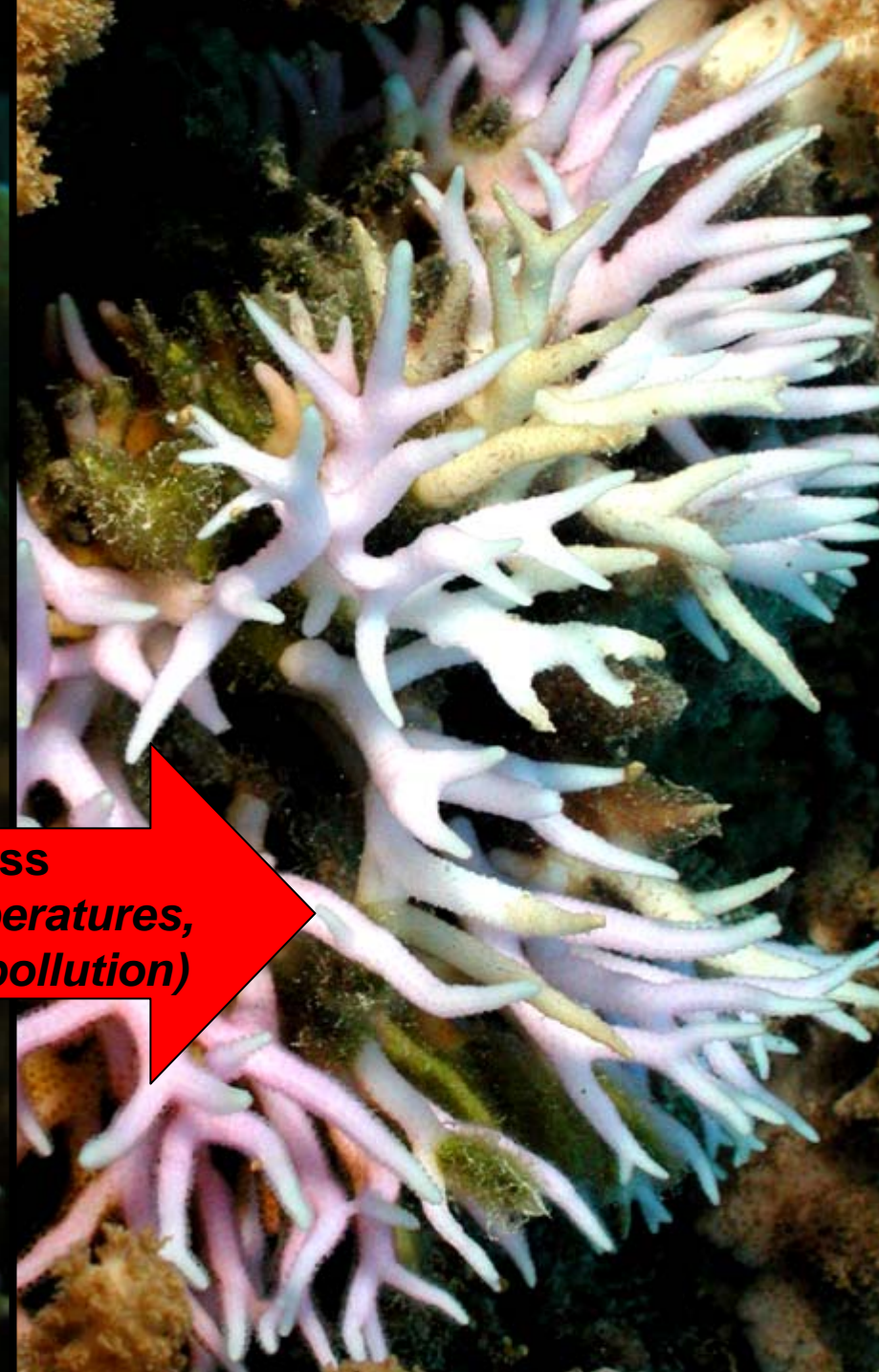


**Biological structures
visible from space**

**Corals live in symbiosis
with zooxanthellae**



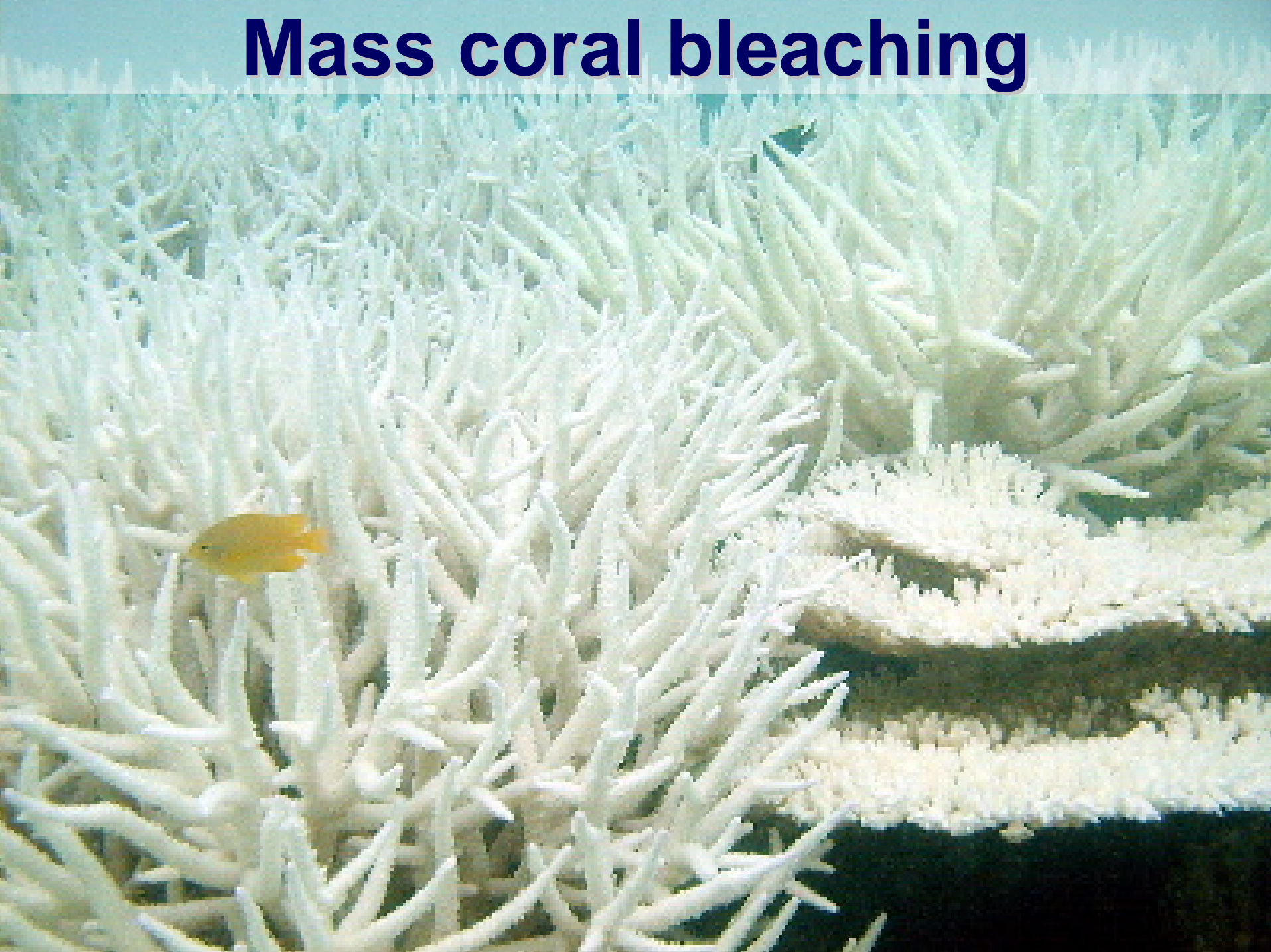
**Stress
(high temperatures,
disease, pollution)**



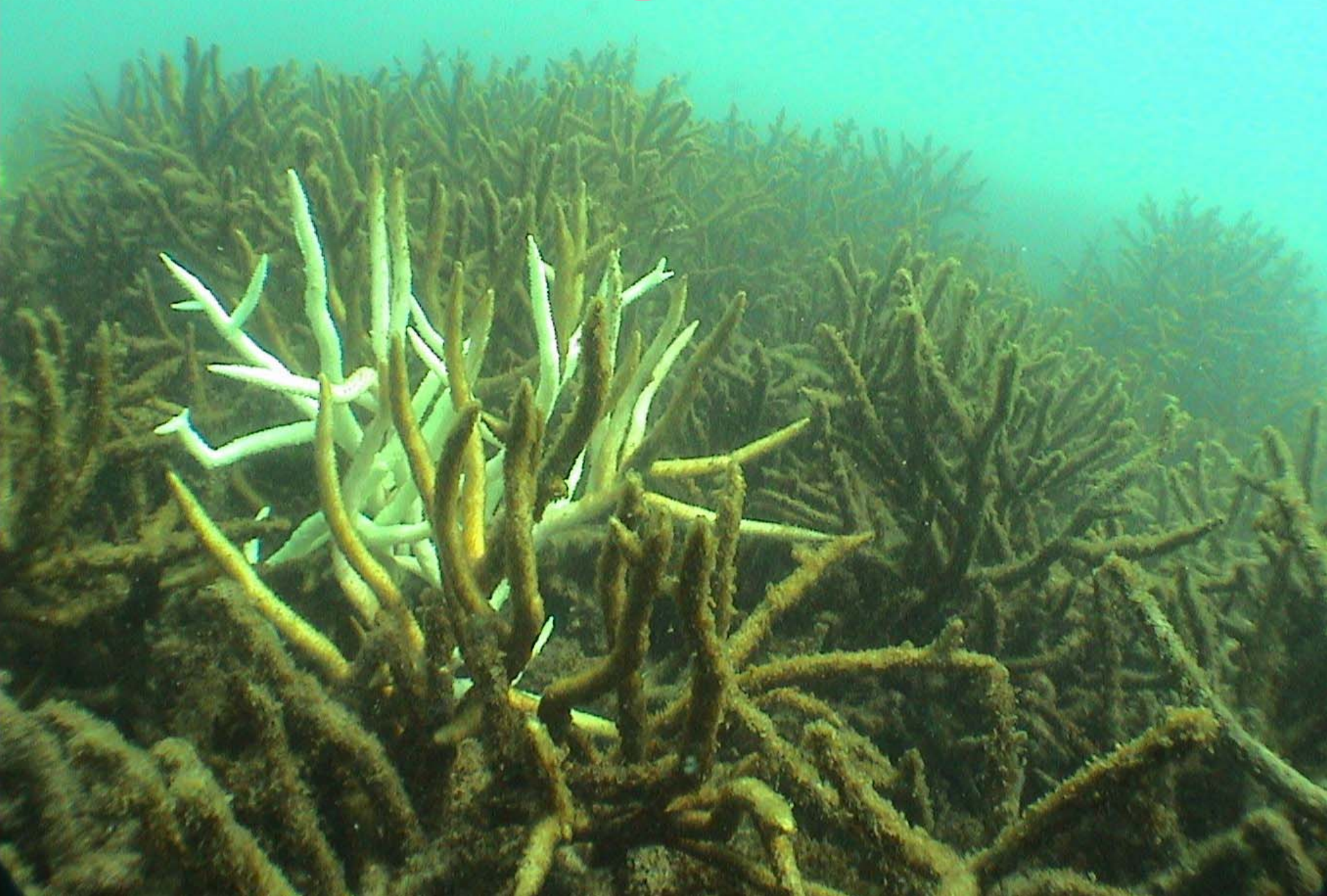
Healthy reef



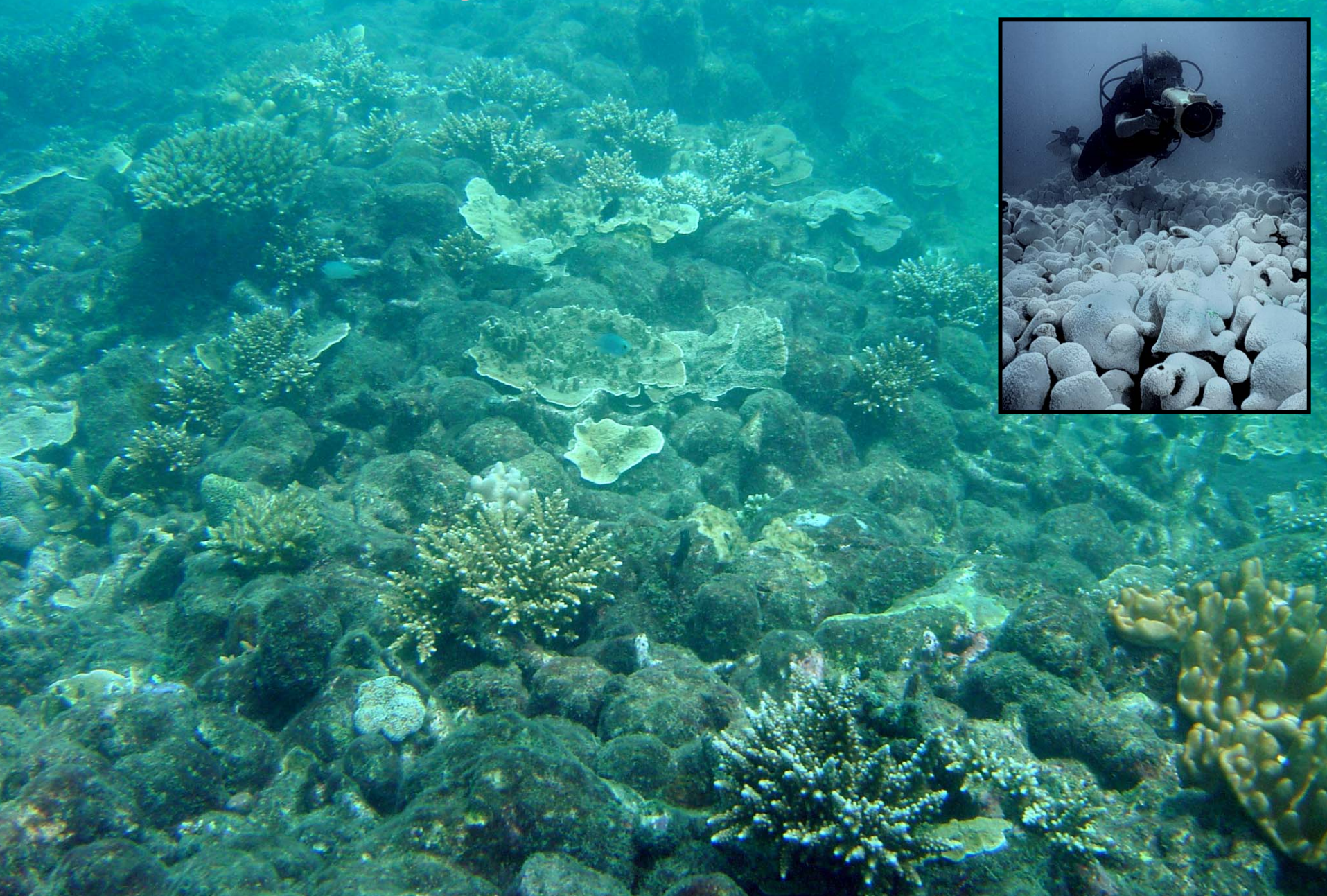
Mass coral bleaching



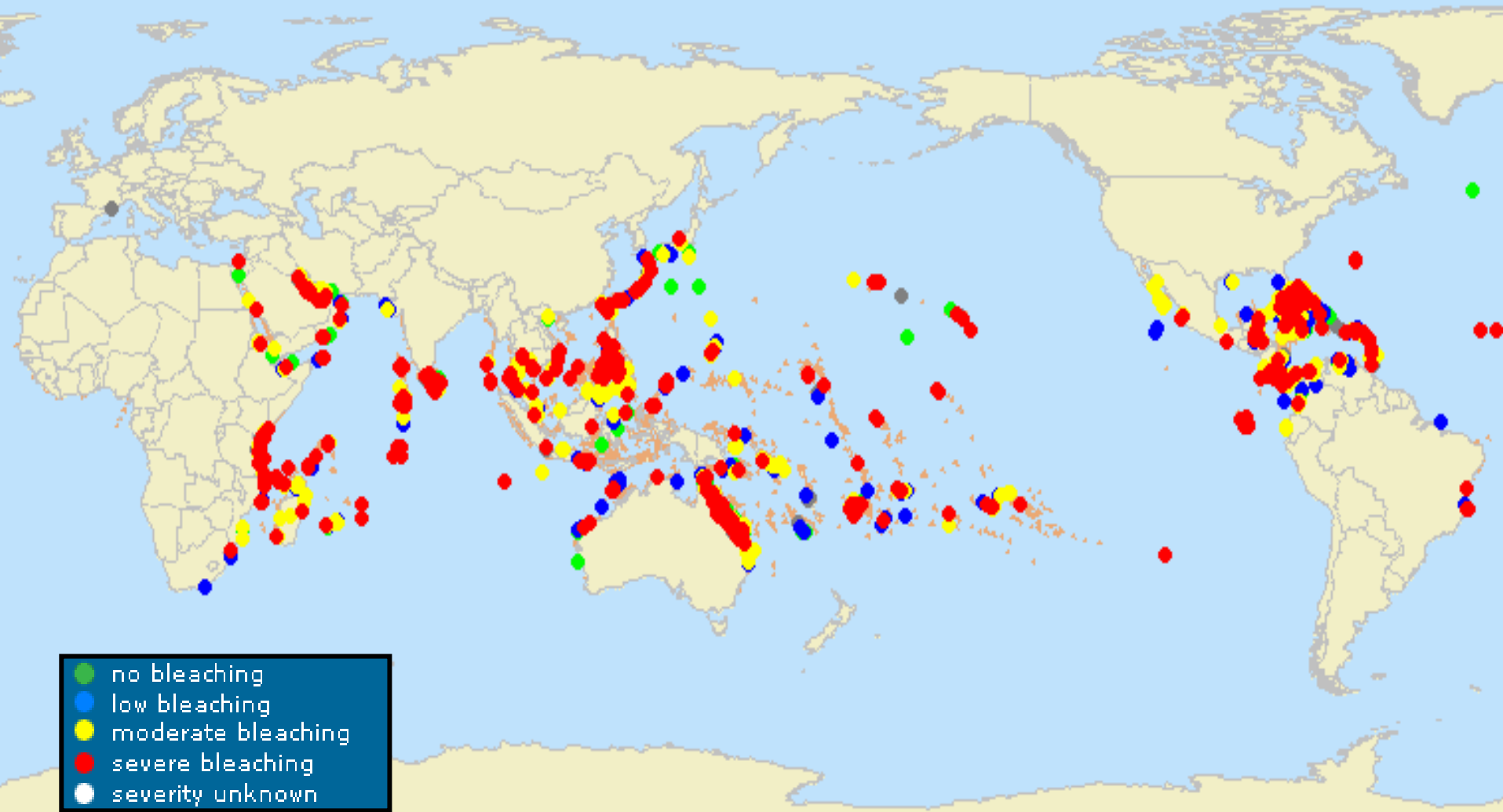
Damaged reef



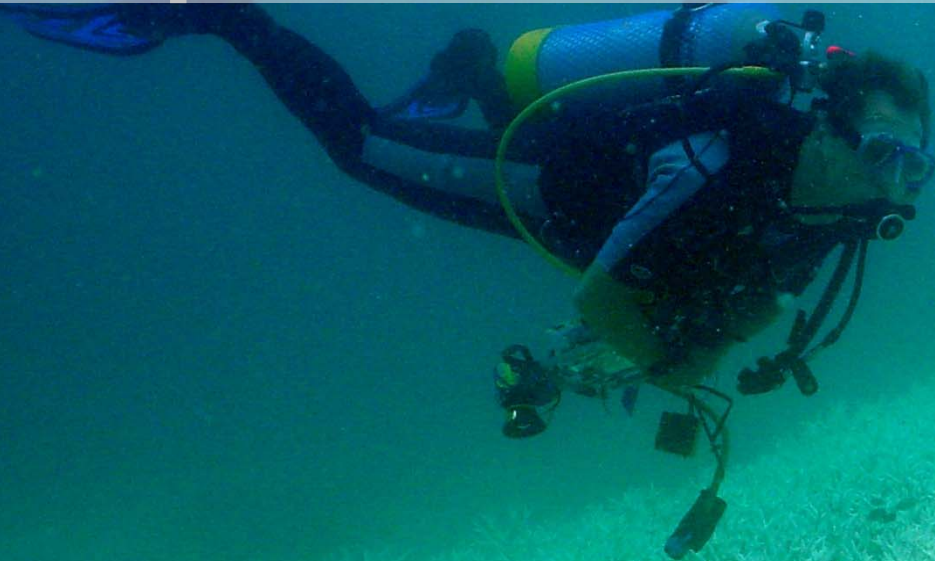
Recovery can take decades



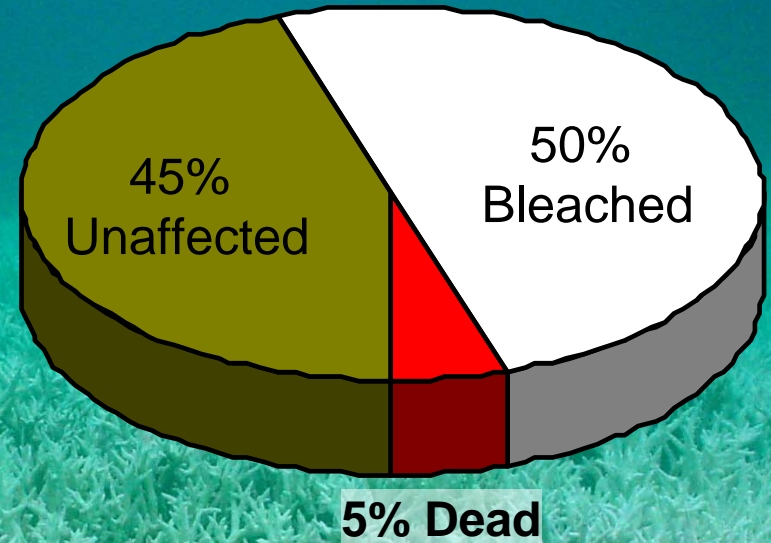
16% of world's reefs destroyed



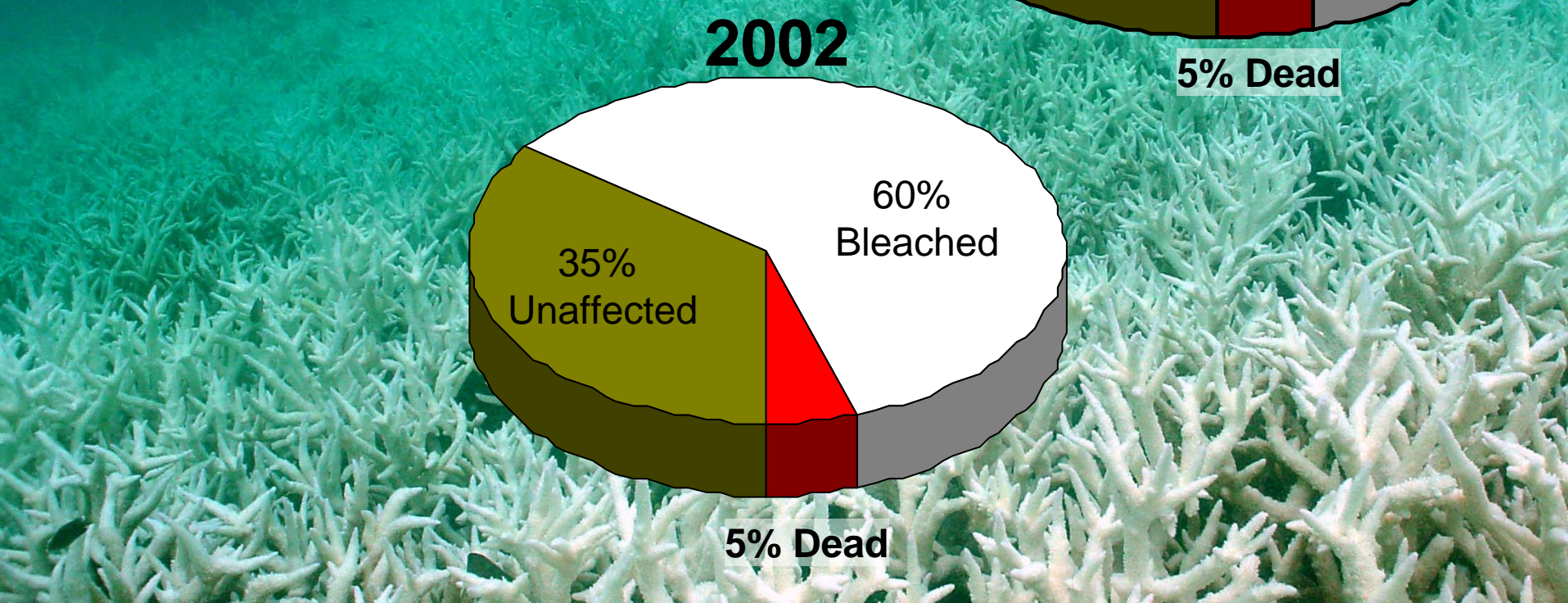
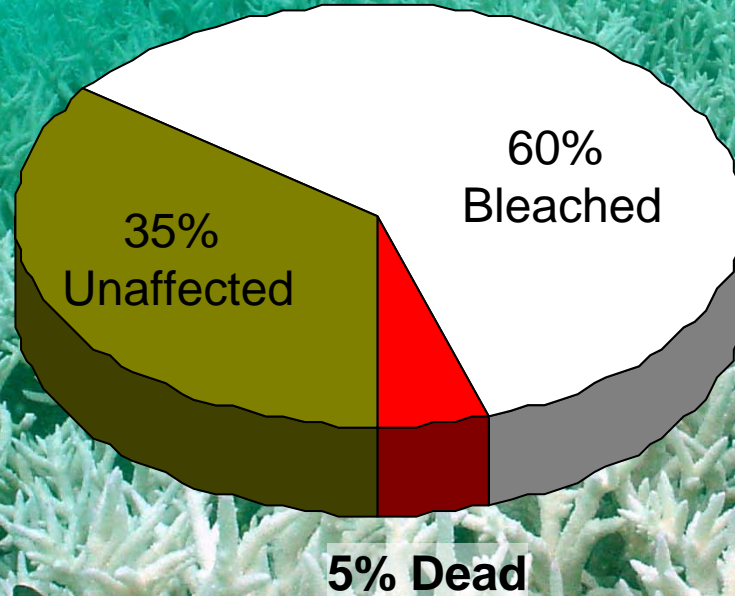
Impacts on the Great Barrier Reef



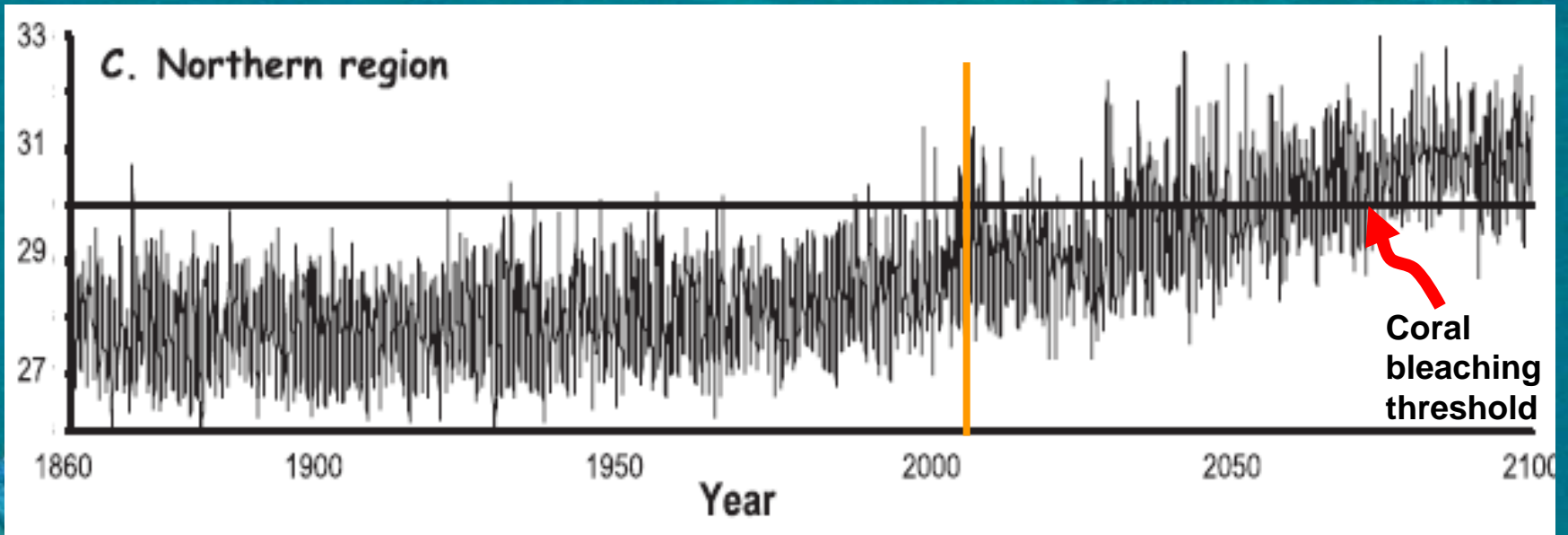
1998



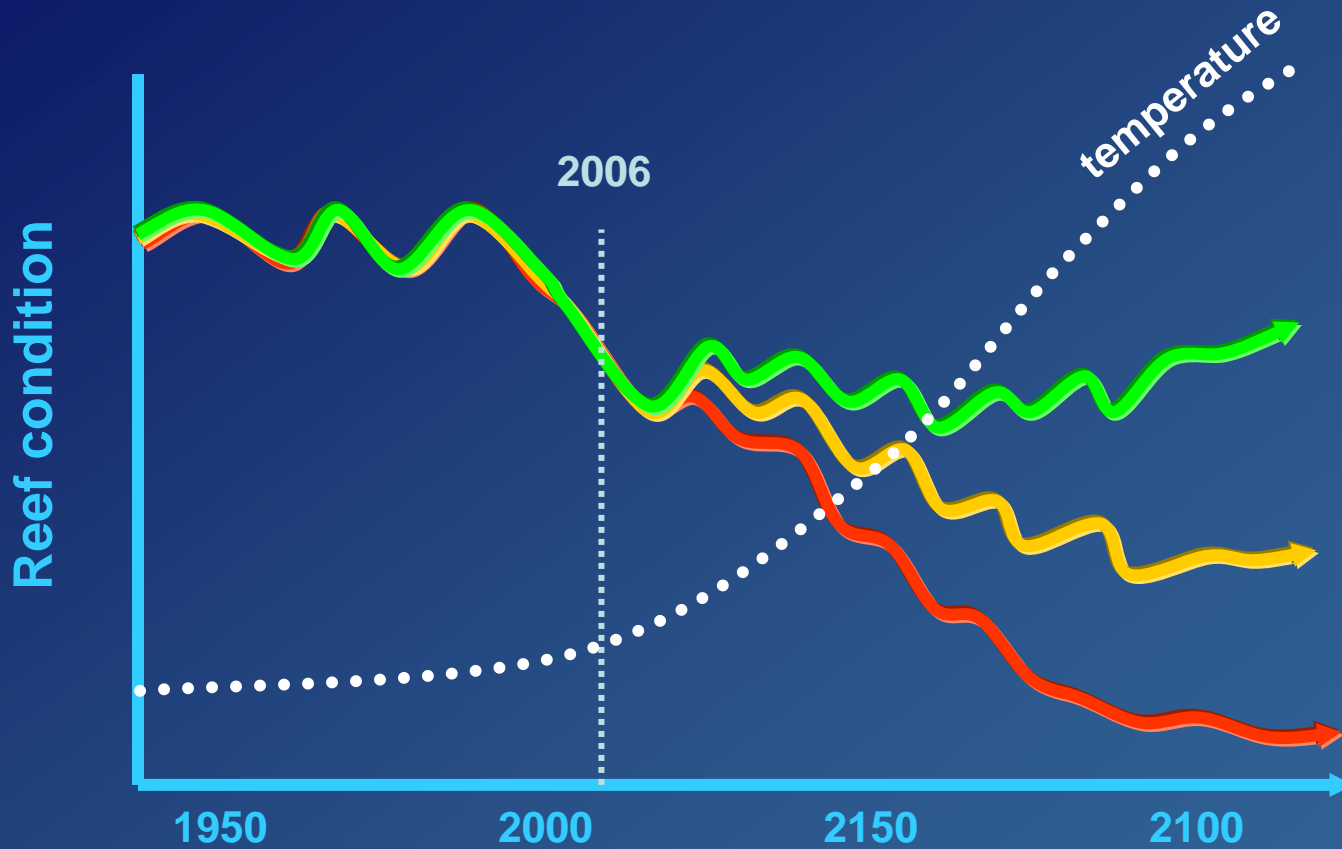
2002



Future change



Deciding the future for coral reefs



A Reef Manager's Guide

Authors:

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Major contributions:

Ray Berkelmans

Jordan West

David Bizot

Nadine Marshall

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Chris Hawkins

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Greta Aeby

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Richard Aronson

Mark Fenton

Rohan Arthur

William Fisher

Andrew Baird

Steve Gittings

Robert Buddemeier

Andrea Grottoli

Steve Coles

Lynne Hale

Nancy Dashbach

Lara Hansen

Lyndon DeVantier

Jim Hendee

Terry Done

James Innes

Tim McClanahan

Laurence McCook

John Nevill

Magnus Nystrom

Arthur Paterson

Lida Pet-Soede

Glenn Ricci

Joe Schittone

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Kristin Sherwood

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Al Strong

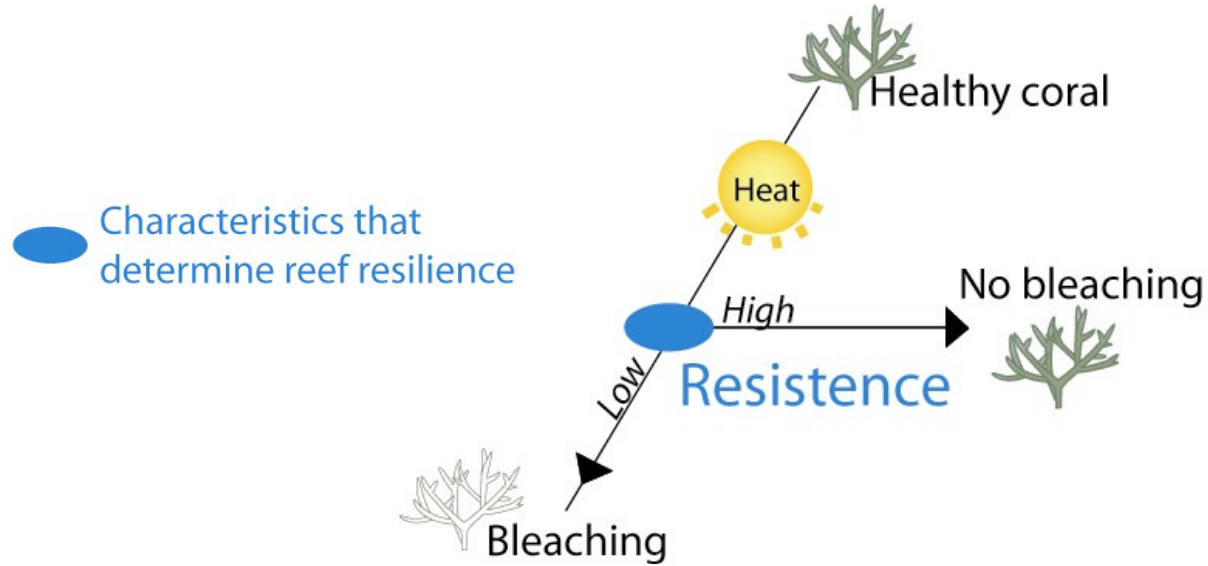
Kristian Teleki

David Wachenfeld

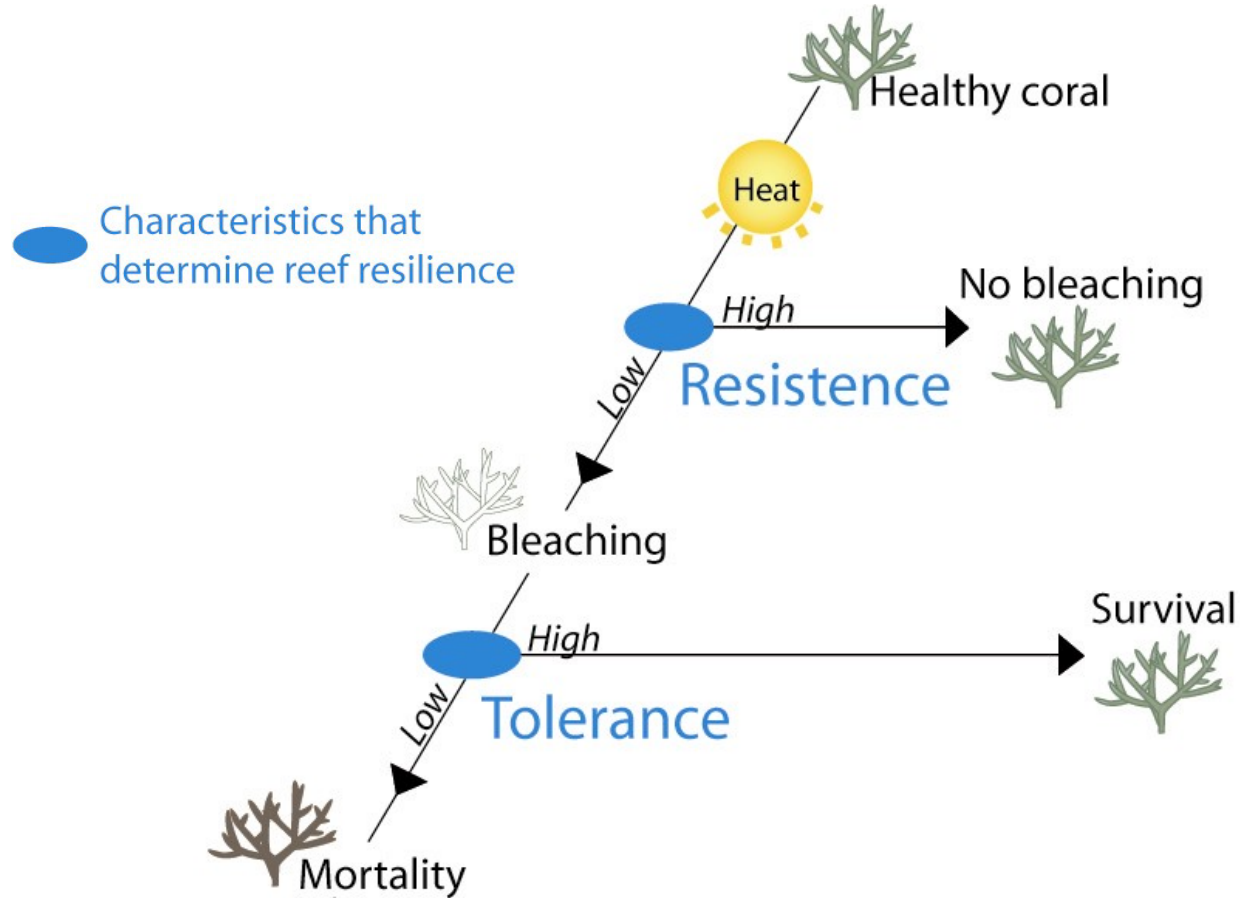
Sue Wells



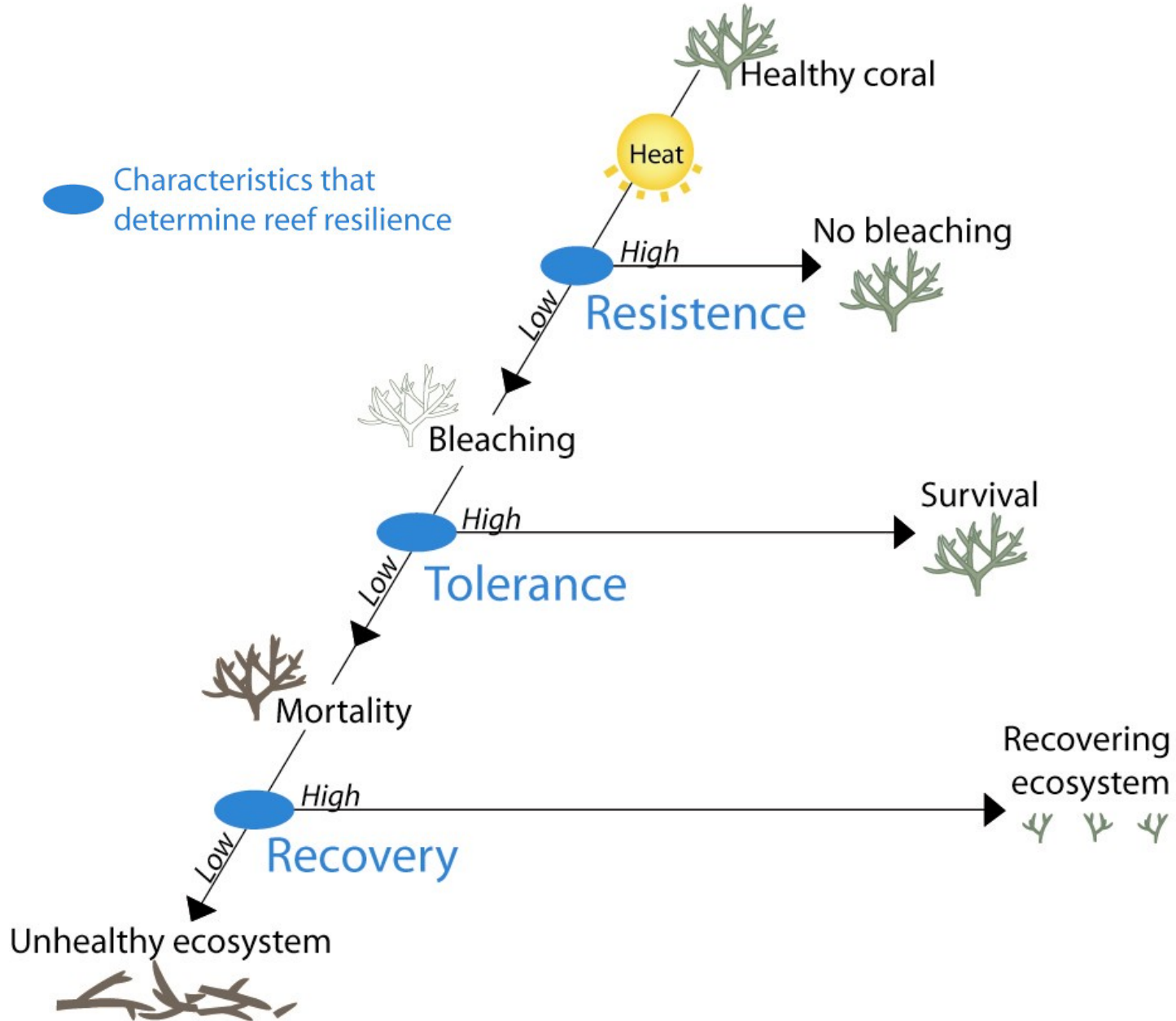
Opportunities for management



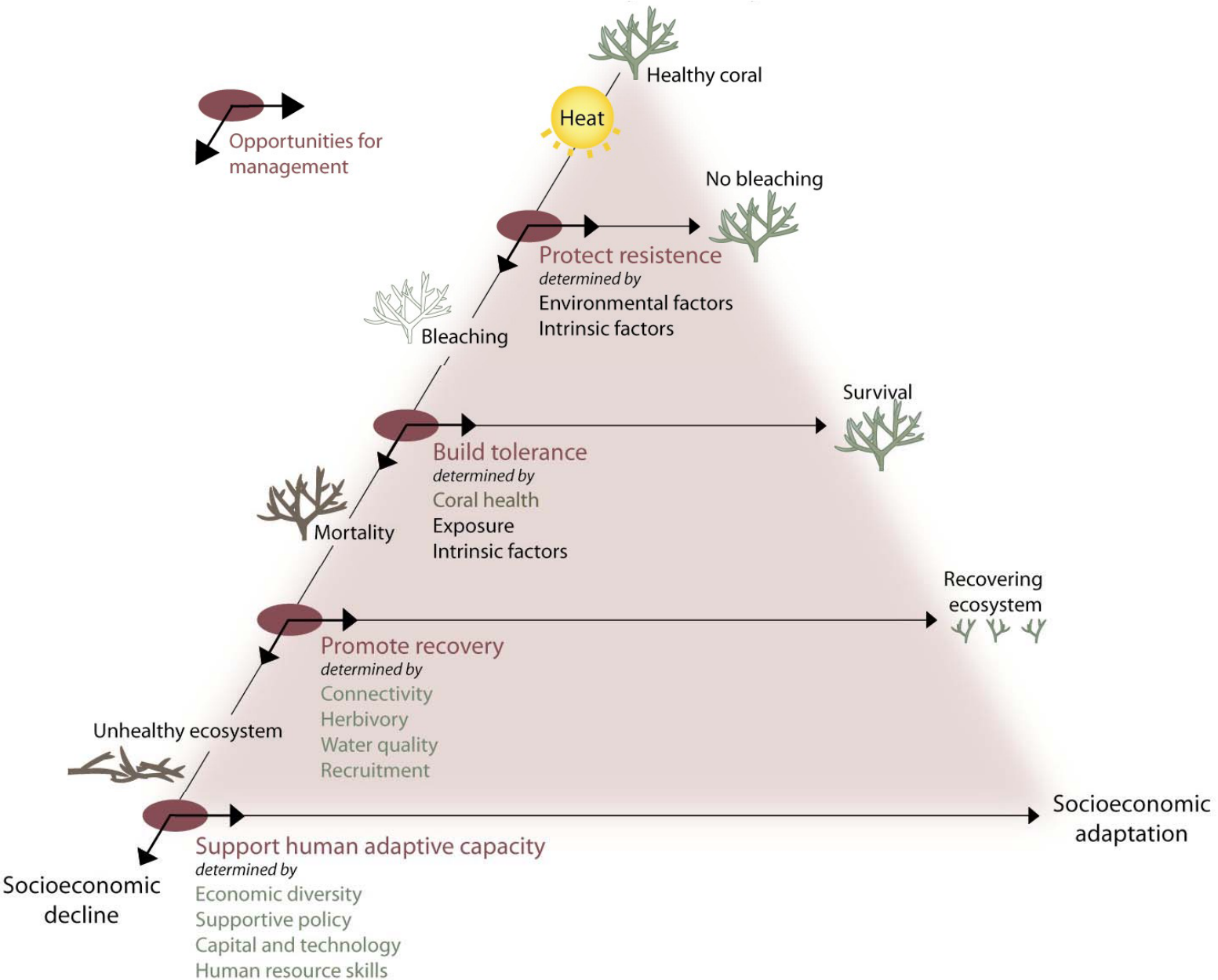
Opportunities for management



Opportunities for management



Factors that confer resilience



Guide Structure

1. Understand climate and bleaching risk & implications for reefs

2.1 Predict seasonal temperatures and bleaching risk

2.2 Establish early warning system for coral bleaching



2.3 Assess ecological impacts 2.4 Assess social & economic impacts 2.5 Identify management interventions 2.6 Communication

3.1 Identify factors that confer resilience

3.2 Predict future resilience

3.3 Design & manage MPAs to maximize resilience

3.4 Manage local stresses to increase resilience

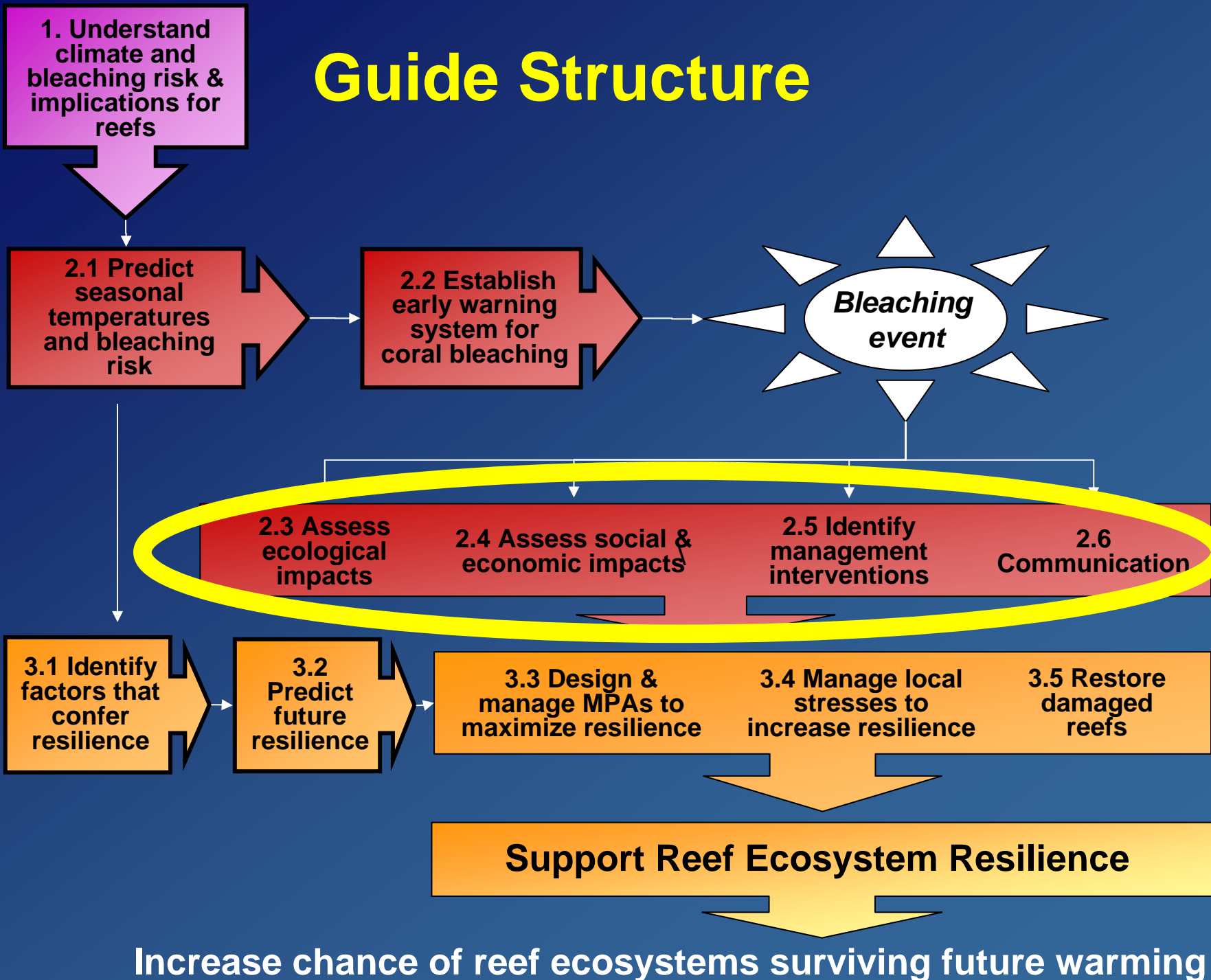
3.5 Restore damaged reefs

Support Reef Ecosystem Resilience

Increase chance of reef ecosystems surviving future warming

5. Policy
4. Science

Guide Structure



2.3 Assess ecological impacts

2.4 Assess social & economic impacts

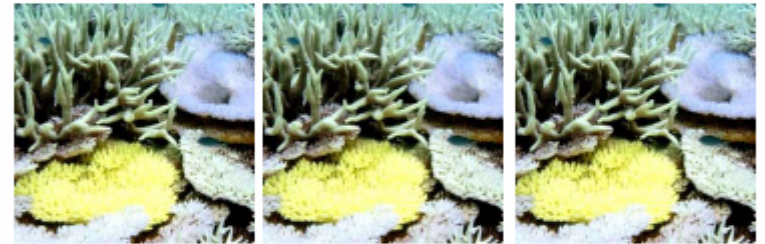
2.5 Identify management interventions

2.6 Communication



A Global Protocol for
Assessment and Monitoring of

Coral Bleaching



Jamie Oliver

Paul Marshall

Naneng Setiasih

Lara Hansen



2.3 Assess ecological impacts

2.4 Assess social & economic impacts

2.5 Identify management interventions

2.6 Communication

Socio-economic Impacts

- Tourism Impacts
- Fishing Impacts
- Indirect Impacts



Framework for assessing bleaching impacts

- What are the social and economic impacts?
- Who is likely to be affected?
- How can management minimise impacts on reef users?

2.3 Assess ecological impacts

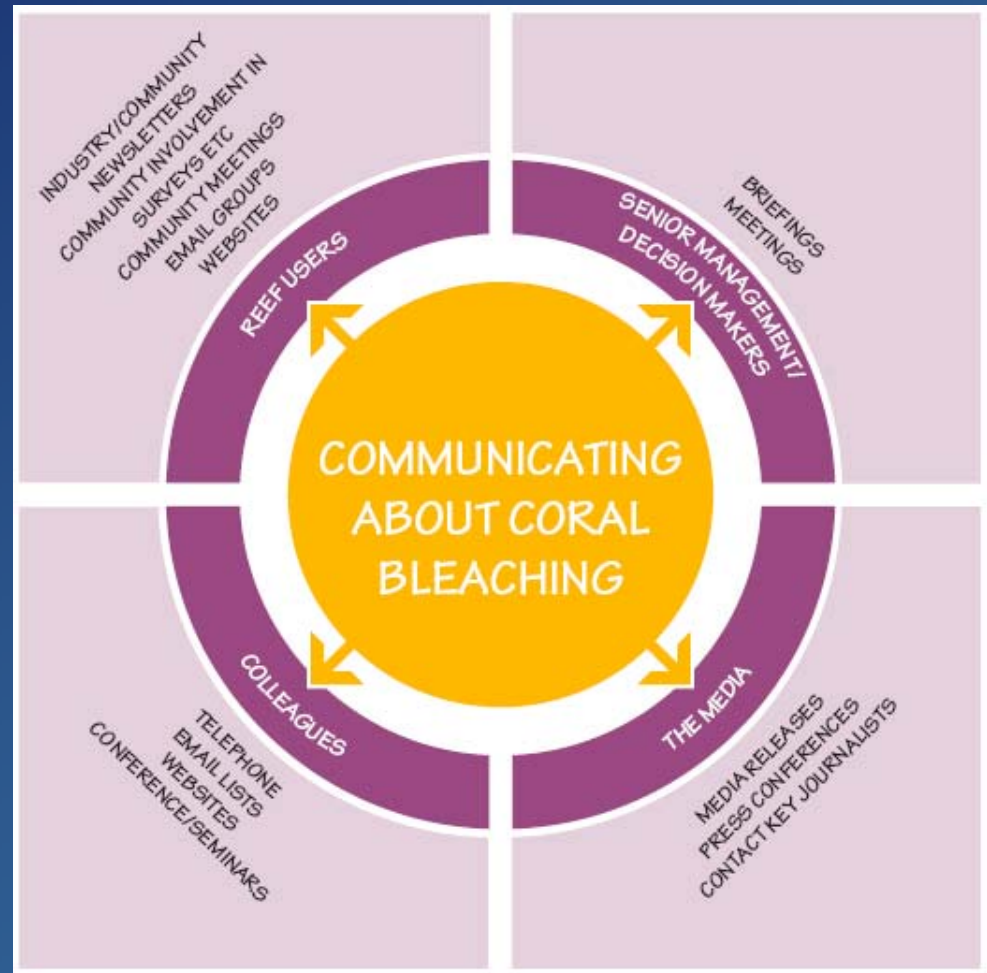
2.4 Assess social & economic impacts

2.5 Identify management interventions

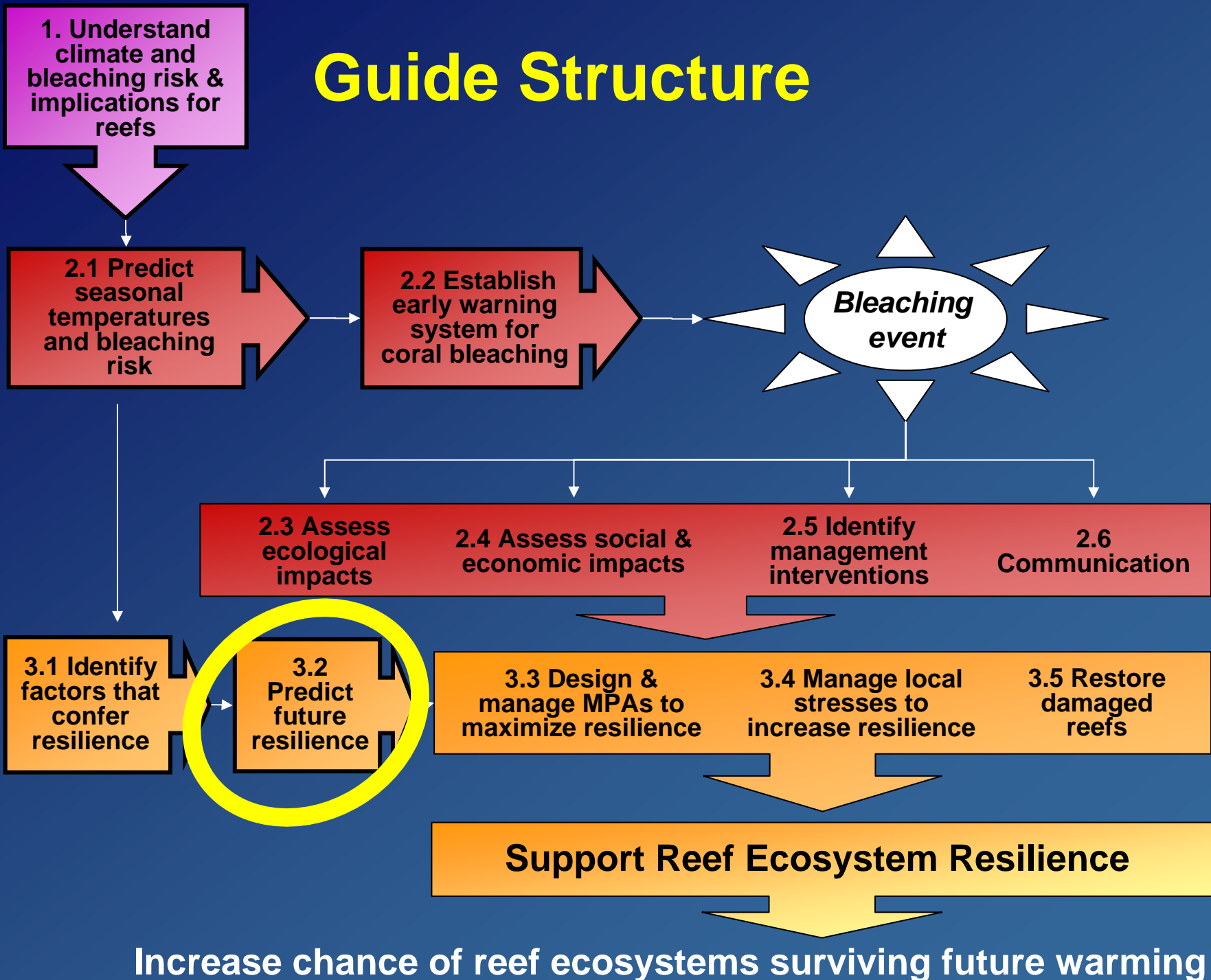
2.6 Communication

Frequently Asked Questions

- Why should people care about mass bleaching?
- What does the future look like?
- Can anything be done?



Guide Structure



5. Policy

4. Science



- ### Guiding Principles
1. **Protect resilient areas**
 2. **Build tolerance to bleaching by decreasing local stressors**
 3. **Promote recovery**
 - **Water quality**
 - **Herbivory**
 - **Connectivity**
 - **Biodiversity**

