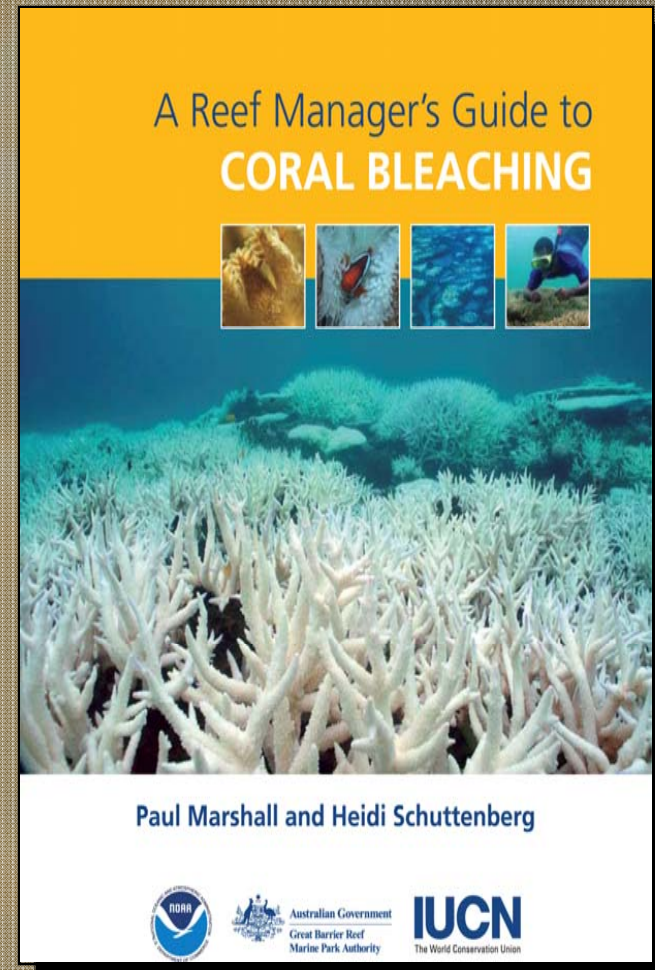




A Reef Manager's Guide to Coral Bleaching ... and Beyond

C. Mark Eakin
Coordinator,
NOAA Coral Reef Watch



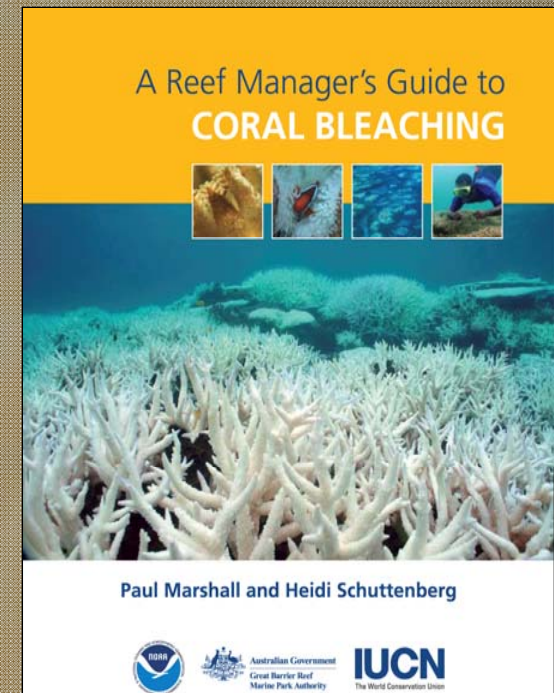
Key messages

- Climate change is real
- Coral reefs are imperilled
- Climate change is affecting reefs
- Action is urgently required:
 - *Reduce emissions*
 - *Maximize reef resilience*
- Reef Managers are taking action
- You can help



A Reef Manager's Guide

- Meaningful actions are possible in the face of climate change
- Goals:
 - A global network
 - Testing and refining ideas
 - Building a (resilient) management community
 - Reefs coping with climate change



Responding to Climate Change for Reef Managers

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William Skirving

Al Strong

Kristian Teleki

David Wachenfeld

Sue Wells



Reef Manager's Guide: Actions for Managers

Enhancing Reef Resilience

- **Reduce Bleaching**
 - Reduce light stress
 - Cool reefs, increase mixing
- **Increase Survival**
 - Improve water quality
 - Reduce disease prevalence
- **Aid Recovery**
 - Coral fragmentation
 - Encourage recruitment
 - Protect ecosystem functions (herbivory)



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

Bleaching event

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

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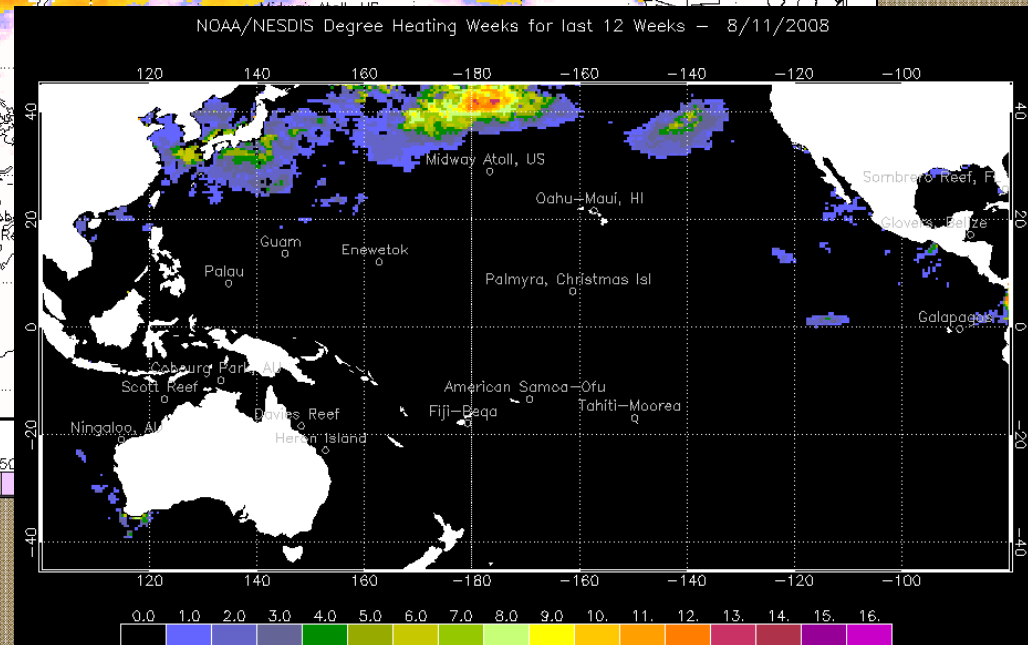
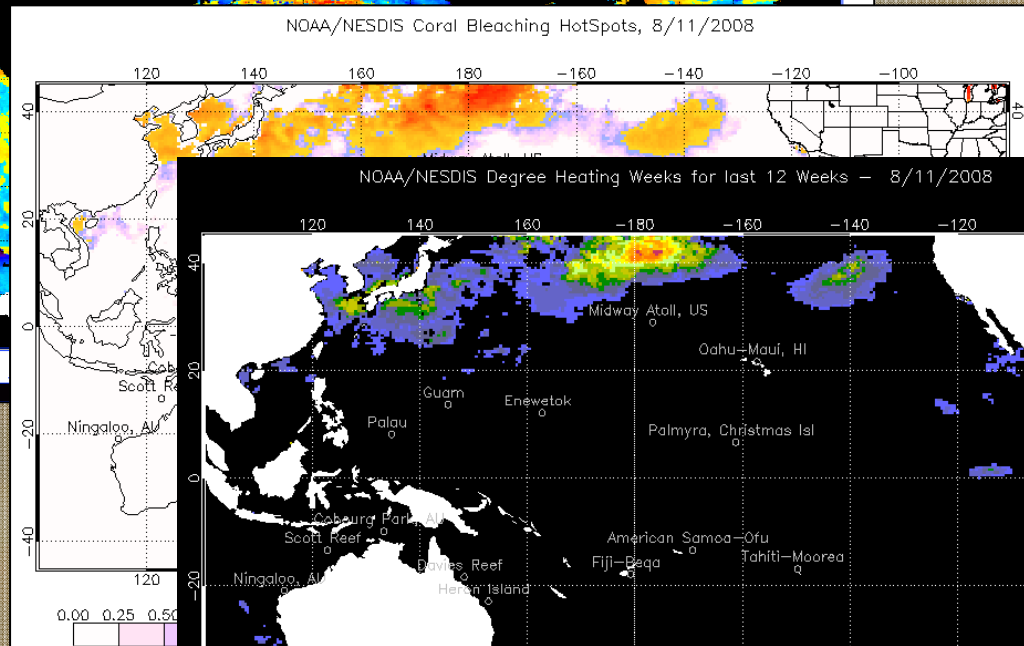
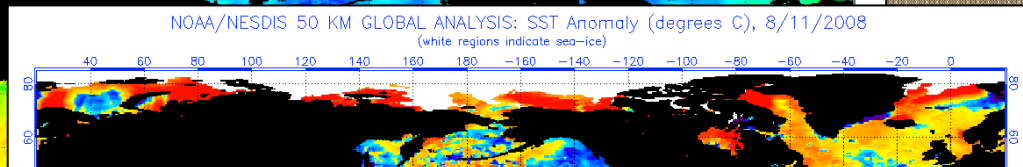
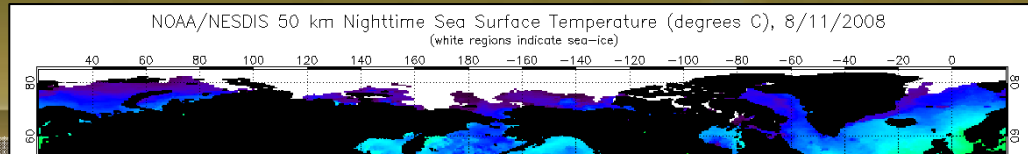
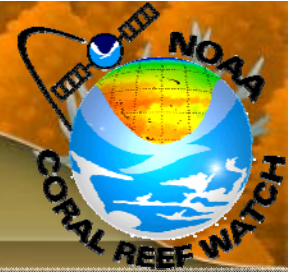
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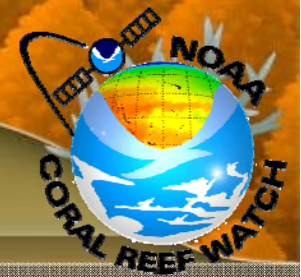
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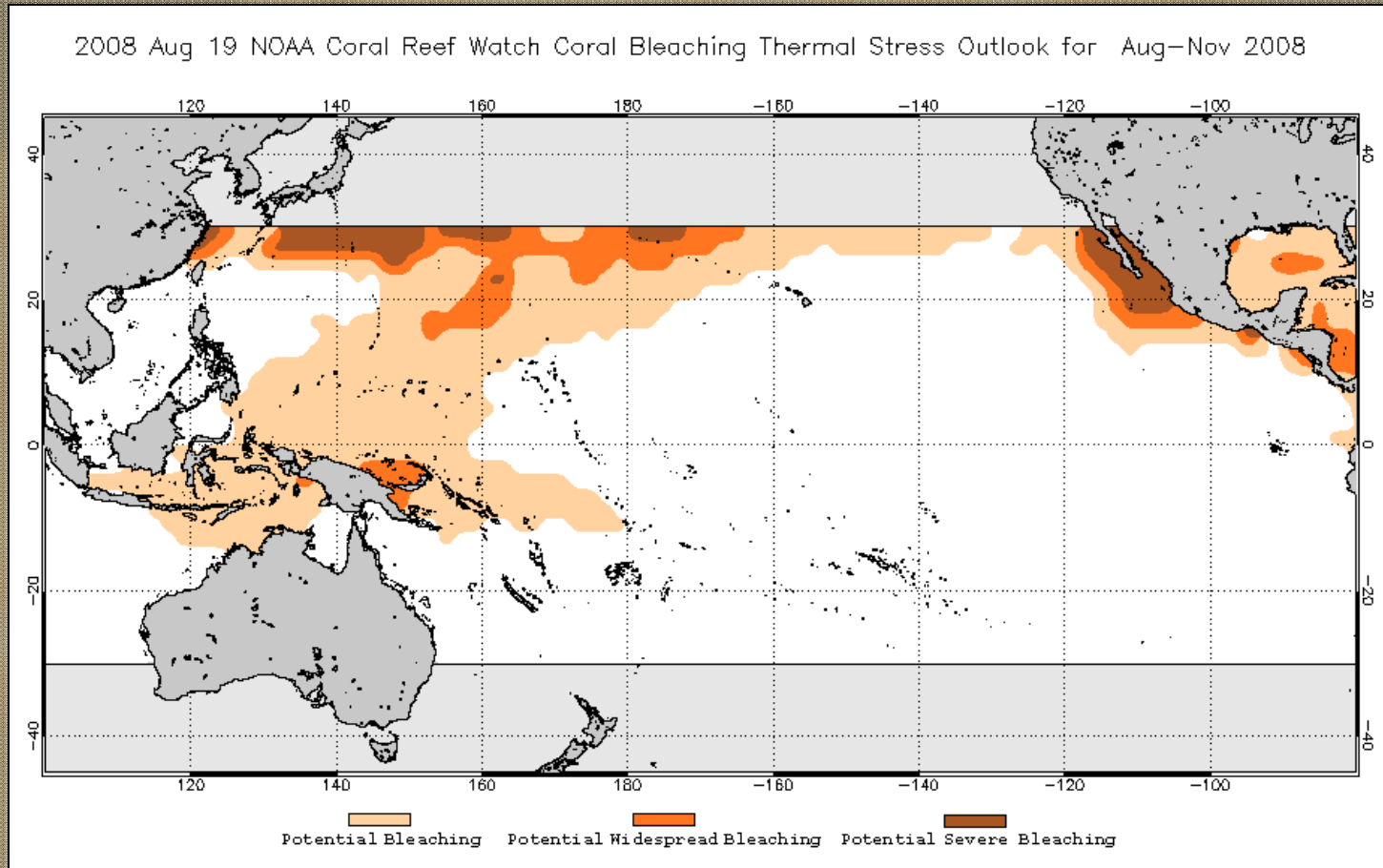
Responding to Climate Change for Reef Managers



Degree Heating Weeks



The Future: Bleaching Forecasts



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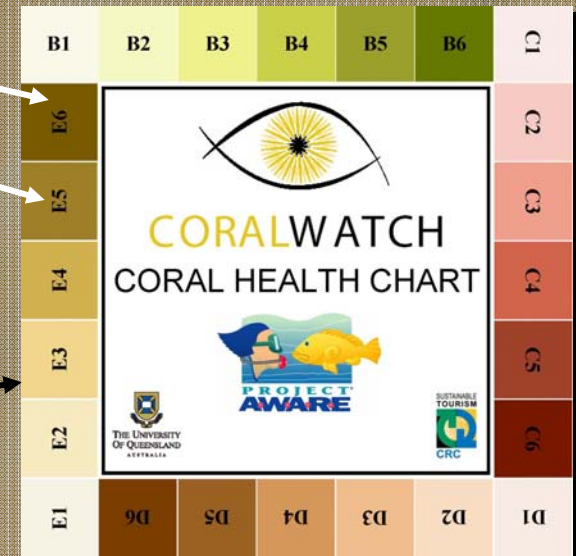
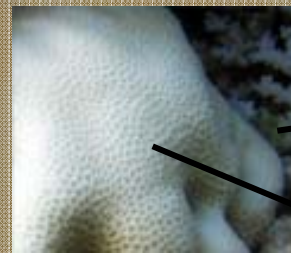
2.6 Communication

A Global Protocol for Assessment and Monitoring of

Coral Bleaching



CoralWatch and Project Aware



Source: CoralWatch Reef Education Package

2.3 Assess ecological impacts

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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



Managing Local Stressors

- Recreational Use
- Water Quality
- Fishing

Impeding the Causes

- Light
- Temperature
- Mixing

2.3 Assess ecological impacts

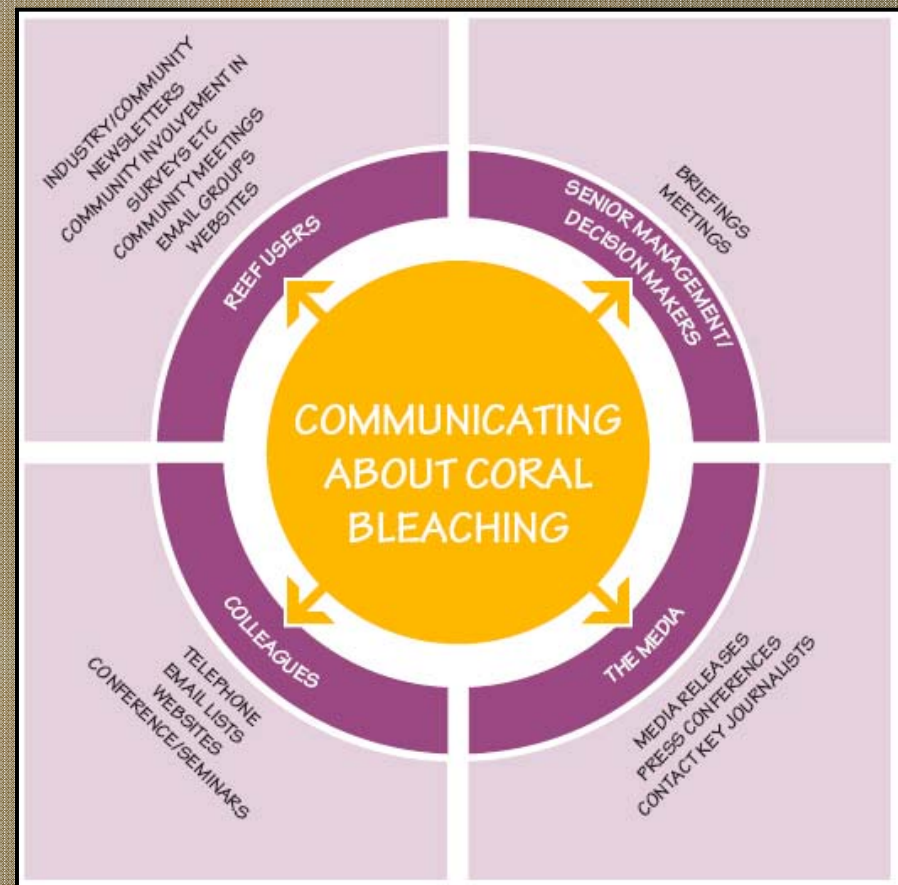
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Frequently Asked Questions

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



Guide Structure

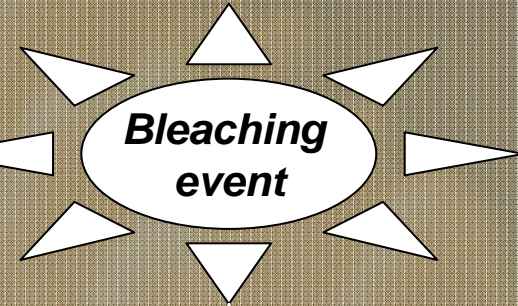
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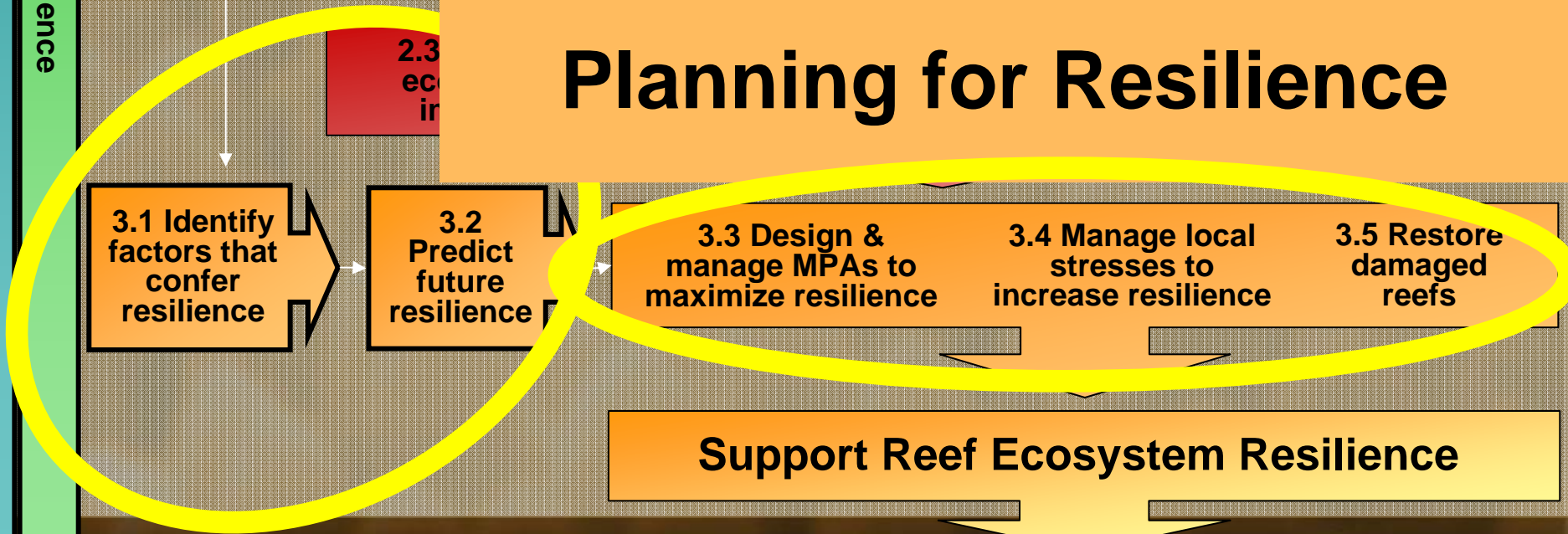
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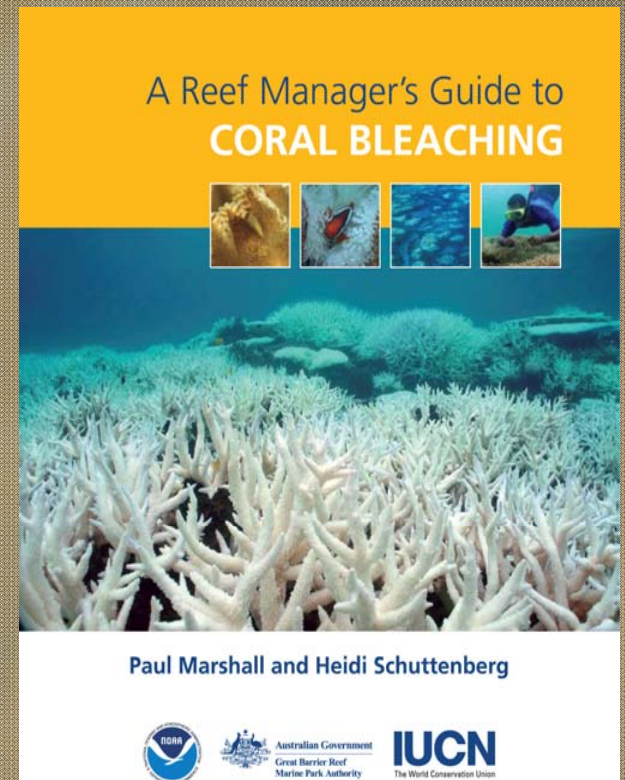
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The vision.....

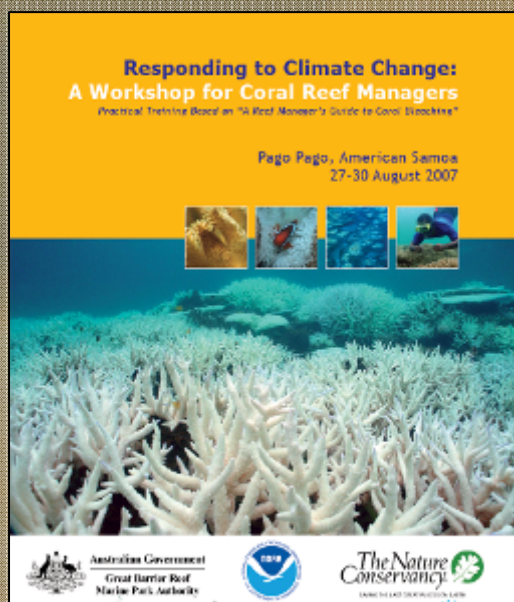
- A global network
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Beyond the *Guide*:

Responding to Climate Change Workshops

- Taking the *Guide* from theory to implementation
 - Brings together managers to understand climate change risks, build response plans to bleaching events, and build resilience into management



Workshops

- **Lady Elliot Island, Australia (July 2007)**
- **American Samoa (August 2007)**
- **Pigeon Key, Florida (April 2008)**
- **Kane'ohe, Hawai'i (September 2008)**
- **Tentative:
Bonaire & Guam (2009)**



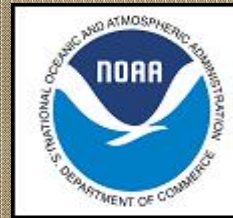
Module 1 Workshop Goals

**From Theory to Implementation...
a framework for shared learning**

Understand climate change risks

Respond to mass bleaching events

Build resilience into reef management



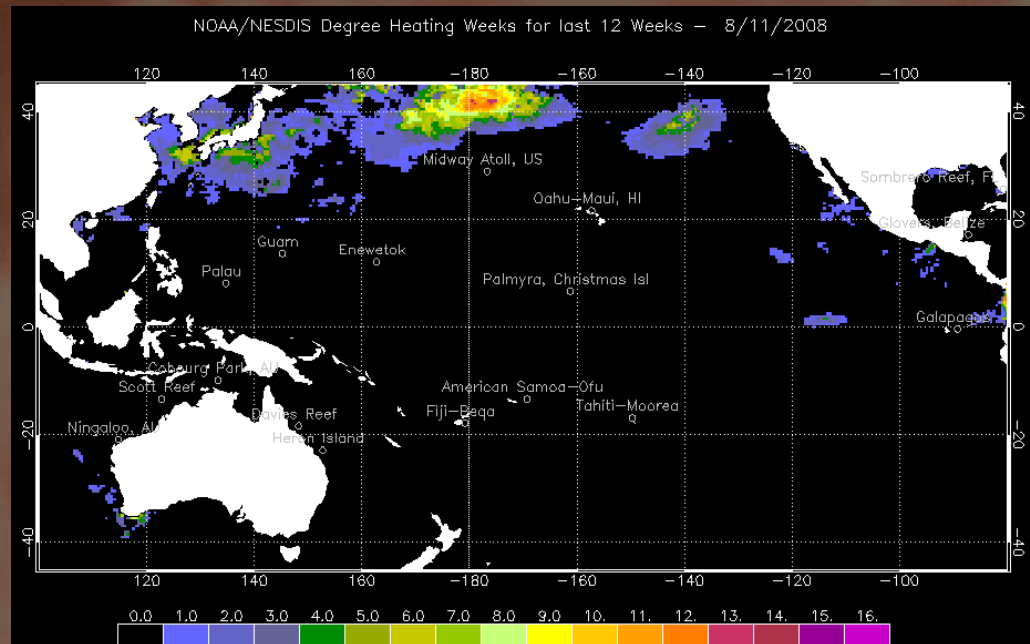
OFFICE OF HAWAIIAN AFFAIRS



KE'ENA KULEANA HAWAII



Module 2: Predicting Mass Coral Bleaching



Degree Heating Weeks

**Will the reef
bleach?**

Satellite SSTs

Anomalies

Bleaching Weather

HotSpots and DHWs

Satellite Bleaching Alerts

Virtual Stations

Bleaching Outlooks

Module 3: Assessing Ecological Impacts

**Are the corals
bleaching?**

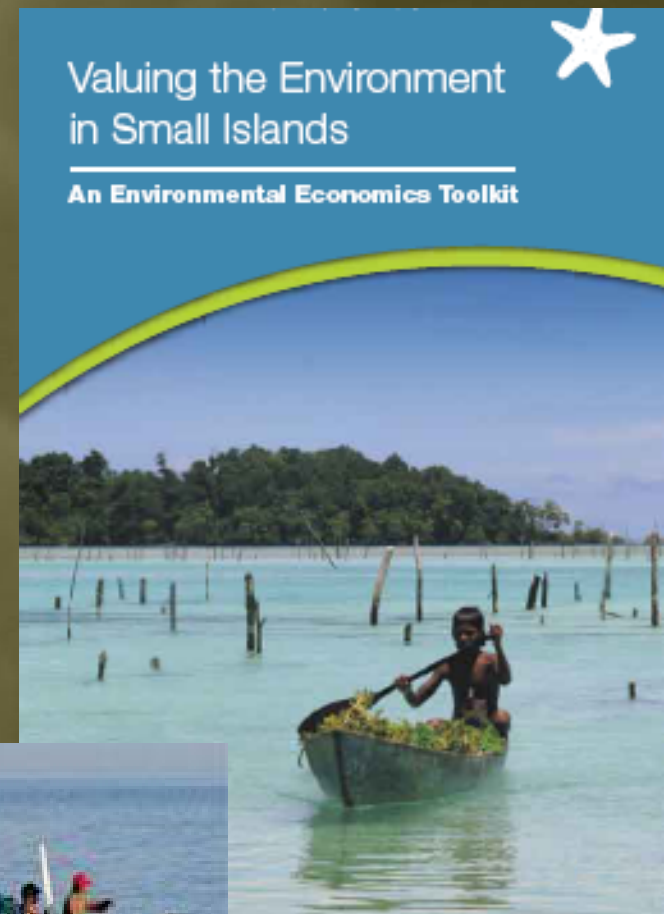
How severe is it?

**Are some areas more
resistant?**



Module 4: The Human Dimension

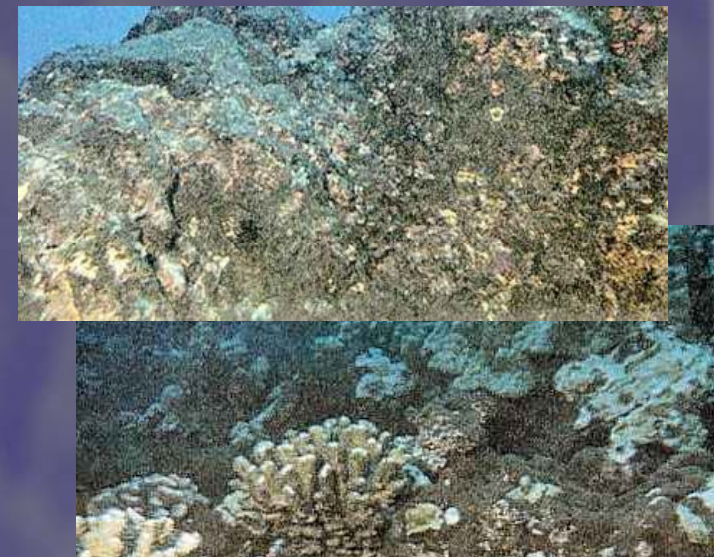
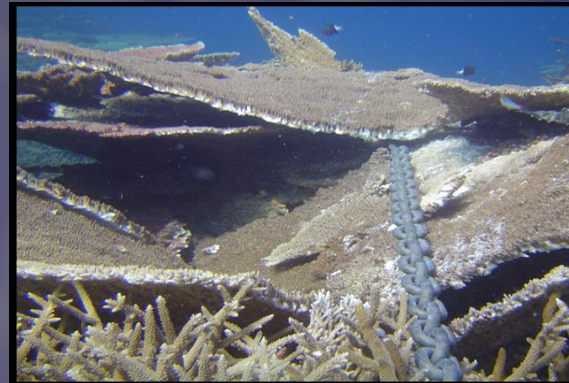
**What are the
Socioeconomic Impacts
of Climate Change and
Coral
Bleaching?**





Module 5: Management Interventions

Management Interventions & Restoration





Module 6: Communication Strategies

Communicating about Coral Bleaching and Climate Change





Module 7: Building *Social-ecological Resilience*

What is Social-ecological Resilience?

Building Social and

Ecological Resilience into

Coral Reef Management

Planning for Climate Change

New: Traditional Ecological

Knowledge

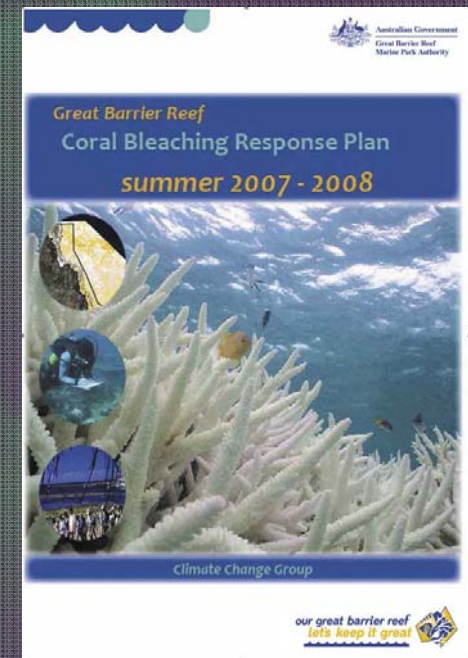




Module 8.

Developing a bleaching response plan

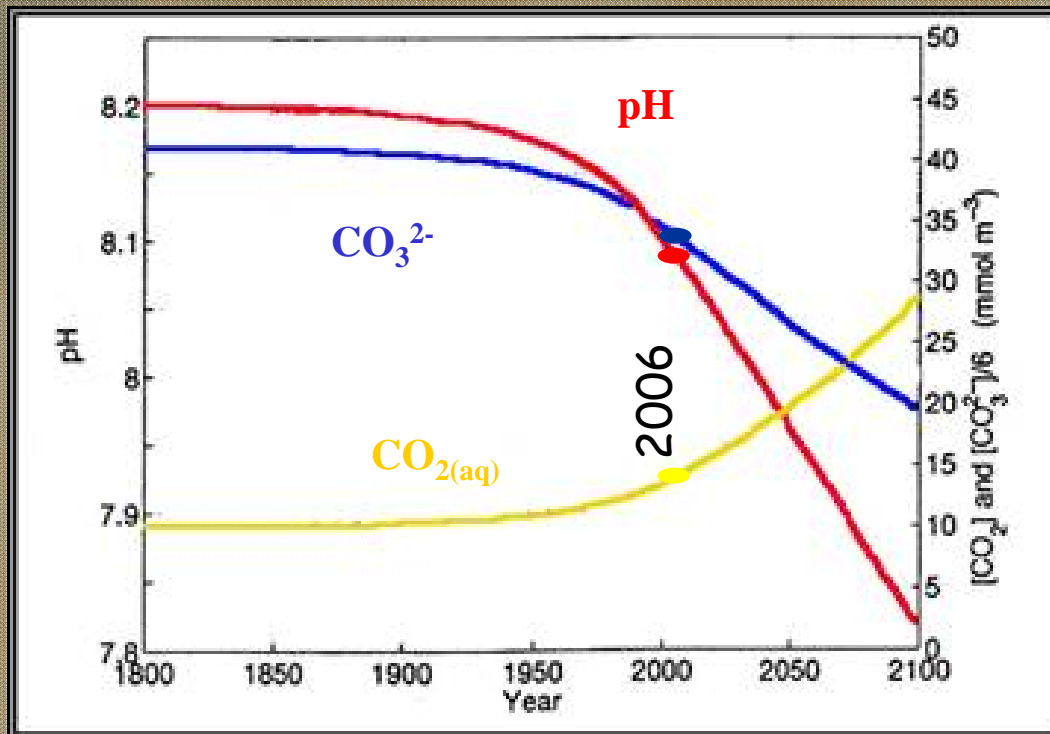
- Predicting - be prepared
- Setting thresholds - when to act
- Assess ecological impacts - how/who
- Assess socio-economic impacts - how/who
- Communicate - why/who
- Management interventions - options
- Funding - where to get it
- Capacity - resources
- Support - decision-makers/stakeholders



Curriculum Evolution:



Ocean Acidification



After Wolf-Gladrow et al., 1999



Coral Reefs Under Rapid Climate Change and Ocean Acidification

14 December 2007

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