

# Building Resilience Into Coral Reef Management

## Section 1: Socio-Ecological Resilience

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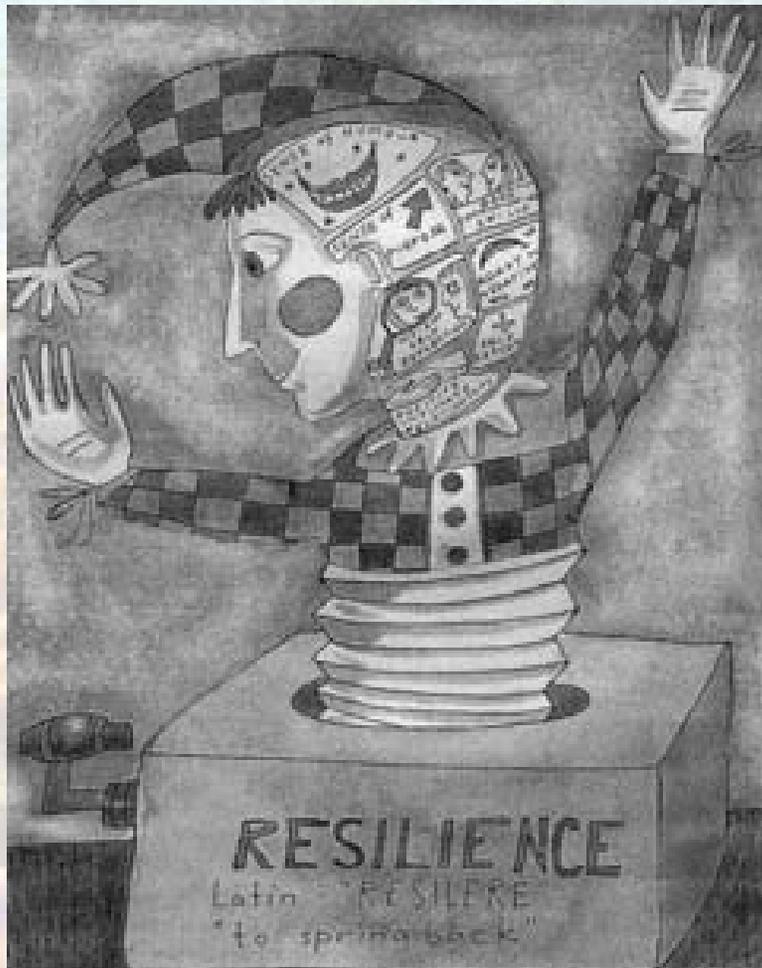
# Outline

1. What and why social-ecological resilience?
2. Building social-ecological resilience into management
3. Building social resilience into management
4. Building ecological resilience into management

# 1. What is Social-Ecological Resilience?

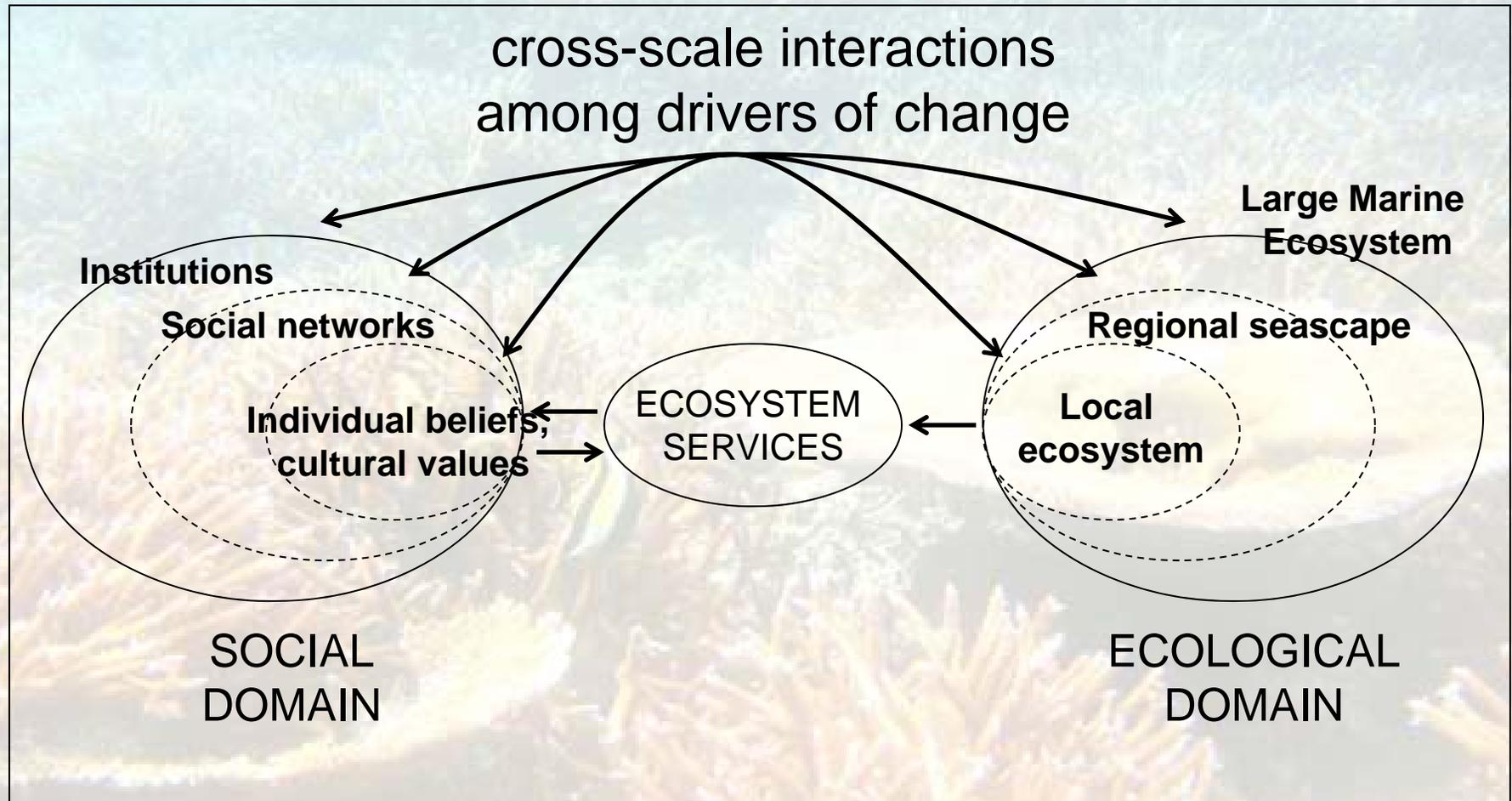


# Social-Ecological Resilience in Climate Change:



*The capacity of  
social and  
ecological systems  
to cope with  
climate changes,  
recover and adjust.*

# Social-Ecological Systems (SES)



McLeod & Leslie 2008 (in press)  
Shackeroff, Hazen, & Crowder 2008 *in* (ibid)

# Social-Ecological Systems (SES)

Throughout history, people have been strongly dependent on nature for support, and nature has in turn strongly shaped human development. Humanity and nature have been observed to coevolve in a dynamic fashion, and consequently the term “social-ecological” system (SES) was used to emphasize this integrated concept

(Berkes and Folke as cited in Folke et al. 2005)

# Rediscovering Humans & Nature as Inseparable

- New to “western science” -  
- rediscovering involves  
overcoming longstanding  
disciplinary divides
- Increasing  
acknowledgement of  
traditional/local ecological  
knowledge but concern of  
its application in today’s  
situation



# Why do we need to integrate human component to improve coastal management

The ecosystem goods and services provided by coral reefs are critical to the social and economic welfare of hundreds of millions of people, overwhelmingly in developing countries (Moberg and Folke 1999).

Widespread reef degradation is severely eroding these goods and services, but the socioeconomic factors shaping the ways that societies use coral reefs are poorly understood (Hughes et al 2005).

# Why do we need to integrate human component to address climate change impacts

**Sensitivity** = exposure and degree to which natural and **human** systems are affected

**Vulnerability** = a function of a sensitivity (both ecological and **social**) to the condition and the capacity of that system to adapt to change

**Adaptive capacity** = potential, capability, or ability of a system (again ecological and **social**) to adapt to impacts

**Resilience** = ecological and **social** capacity to cope with changes, recover and adjust (without becoming undermined or unable to adapt).

# Resilience to climate change: What are we trying to do?



## Ecologically:

- **Coral dominance**
- **Functional redundancy**
- **Stability and growth**

## Socially:

- **Sustainable resource use**
- **Diversifying livelihood**
- **Securing social well-being**
- **Good governance**



## 2. Building Social-Ecological Resilience into Management in the context of Climate Change

What are the key differences  
compared to  
conventional way of management?

**1. Managing not just to maintain a 'STABLE' state,  
but to promote RECOVERY and ADAPTATION**

- We are already committed to change for at least 100 years even if we stopped greenhouse gas emissions now.

**Ecological and social systems WILL change.**

# Building Resilience into Management

focuses on recovery and adaptation

## Support social resilience

What management strategies can we develop to help communities maintain well-being in the face of changing coral reef resources?

## Support ecological resilience

What management strategies can we use to help reefs survive & recover from disturbances?

# Suggested ways of adapting (based on Tompkins et al 2005)

## **1. *Building adaptive capacity:***

Improving the ability to cope with or respond to the impacts of climate change.

Examples: doing research and gathering knowledge and information about climate change, monitoring impacts, capacity building/training/educating, livelihood diversification, social network, build on traditional and local knowledge

## **2. *Implementing adaptation:***

Decisions or choices that generate change.

Implementation through laws or policies; integrated CZM, organizational change; individual action

## ***2. Recognize that 'surprises' are more likely***

- Uncertainty about future, uncertainty in science
- Ability to manage adaptively is more important
- Need to build constituencies (multi-stakeholder involvement including governments and communities) and develop appropriate policies and processes to make adaptive management easier

# 3. Building Social Resilience into Coral Management



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# Definition of Social Resilience

Social Resilience is the ability of institutions and/or communities to cope with external stresses and disturbances as a result of social, political and environmental change (Adger 2000)

*Differs fundamentally from ecological resilience by having the added capacity of humans to anticipate and plan for the future*

# Building Social Resilience



# Principles of Building Social Resilience

(Folke et al 2002)

Four critical social resilience factors:

- Learning to live with change and uncertainty
- Nurturing diversity for reorganization and renewal
- Combining different types of knowledge for learning
- Creating opportunity for self-organization



# Measuring Resilience

Statements from Marshall survey (rated level of agreement on Likert scale)

- I am confident that I could get work elsewhere if I needed to
- I would be nervous trying something else
- I have many career options available to me if I decide to no longer be a fisher
- I am too young to retire and too old to find work elsewhere
- I have planned for my financial security
- I am interested in learning new skills outside of the industry
- I would find it very difficult working for someone else
- Change is normal part of our everyday life
- I am always thinking of new and better ways to improve my fishing business

# Measuring perception and readiness of household to respond and adapt

Statements from American Samoa survey (rated level of agreement on Likert scale)

- Our household economics is particularly sensitive to climate conditions.
- In the past my household was able to successfully cope with impacts of extreme climate events.
- Our household is prepared to respond to a natural disaster.
- Our household has the capacity to adapt to climate change impacts.
- Our community has the capacity to help one another during disaster.

## Measuring perception and readiness of individuals to respond and adapt

Statements from American Samoa survey (rated level of agreement on Likert scale)

- I have sufficient information about the impacts of global warming and climate change.
- I know what to do to reduce human impacts on climate change.
- I want to take action to help reduce climate change impacts.
- I would switch to alternative energy sources (such as solar, wind, biomass, or other renewable sources) even when I have to pay more for it.

# Case Study

**Gear-based fisheries management as a potential adaptive response to climate change and coral mortality in Kenya and Papua New Guinea** (Cinner et al 2009)

This study presents a way to help reduce the negative impacts of climate change and potentially increase resilience of marine ecosystems by managing fishing gear.

## Main Findings

1. The most common management recommendation has been to prohibit fishing using fisheries closures, but this response often has limited support from resource users.
2. Only 6% of the fishes targeted by fishers were susceptible to the immediate effects of coral mortality; however, loss of habitat structure following coral mortality is expected to affect 56% of targeted species.
3. Importantly, 25% of target species had feeding characteristics (i.e. reef scrapers/excavators and grazers) that contribute to the recovery of coral reef ecosystems, and gears differed considerably in catches of these species.
4. Spear guns and traps target a high proportion of species likely to be affected by bleaching and key for the recovery of corals.

## Management recommendation

Spear guns and traps are strong candidates for management restrictions in reefs with high coral mortality. In contrast, line fishing catches the lowest proportion of susceptible and recovery-enabling species and is preferential for increasing recovery rates on coral reefs

Given that full fisheries closures are not always practical, selectively banning or restricting fishing gears is a potentially powerful tool for reducing the detrimental ecosystem effects of climate change disturbances

# Role of Management

- Top-down approaches to fisheries management tend to erode social resilience
- Enhancing resilience includes:
  - adaptive co-management
  - multi-level governance
  - stakeholder participation, education and capacity building (make people part of the solution)
  - integrating local systems of ecosystem management
- MPA managers may feel supporting social resilience is beyond the scope of their work

# Building Ecological Resilience into Management



# Building Ecological Resilience into Management

Build Resilience Concepts into:

- Ecosystem-based Management (EBM)
- Coral Fisheries Management
- Marine Protected Area Design



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# Resilience & EBM

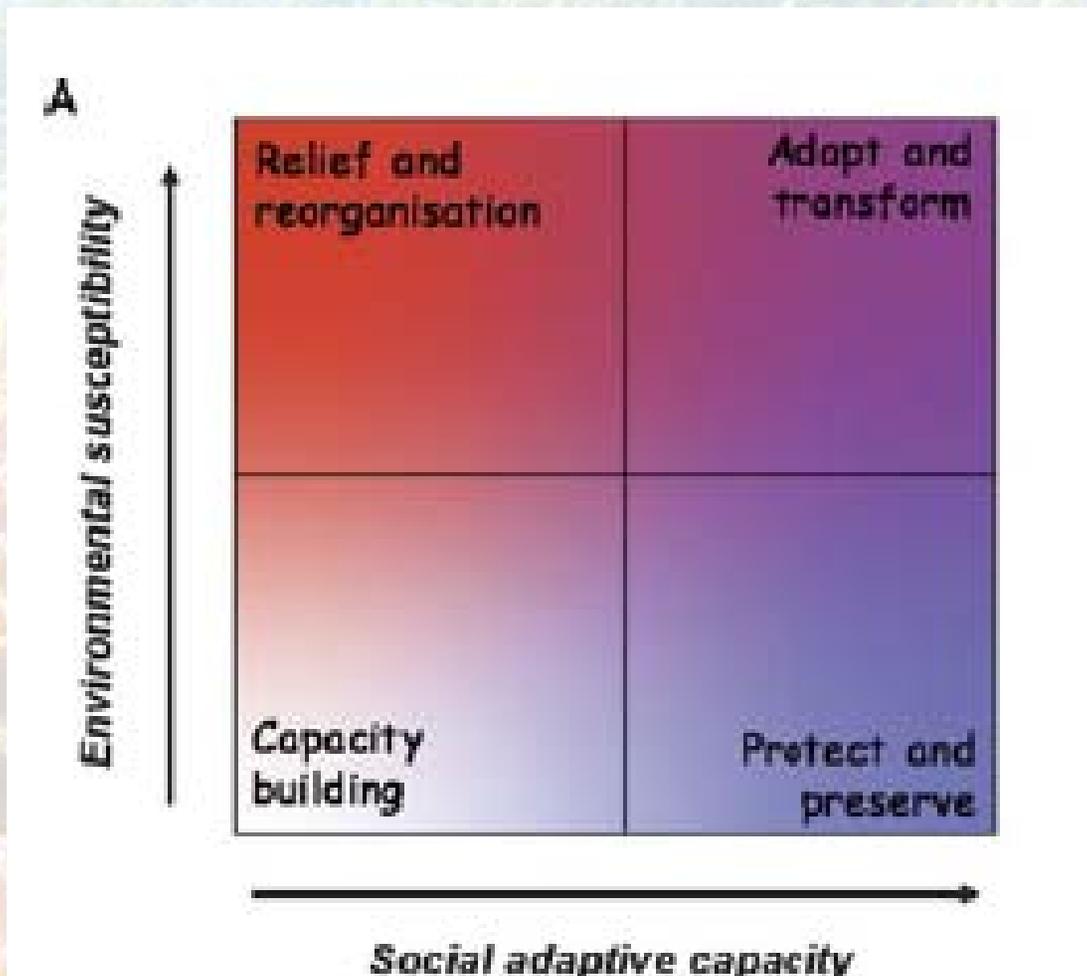
## *Ecosystem Based Management:*

*A holistic approach that recognizes connections and interactions between habitats, systems, and people*

Strategies for building resilience to climate change into EBM:

- Regulating fisheries, tourism, extraction
- Regulating adjacent land uses, improving water quality
- Reducing pollution
- Promoting social and ecological resilience  
(adaptive capacity; resource dependency;  
alternative livelihoods)

# New Framework for Conservation Planning based on Environmental Susceptibility and Social Adaptive Capacity (McClanahan et al 2008)



Study examines conservation actions in five western Indian Ocean countries, where climate-related coral reefs and social adaptive capacities differ.

Finding: Current conservation strategies do not reflect adaptive capacity and are, therefore, ill prepared for climate change.

Reason: Social adaptive capacity that copes with complexities of climate change is not taken into consideration in conservation planning.

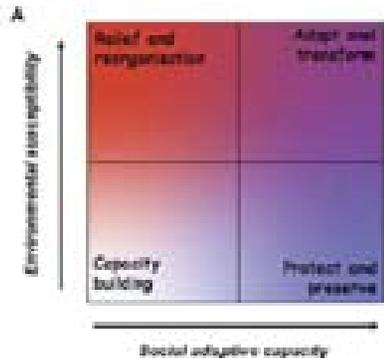
**Conservation planning should consider both**

environmental susceptibility

(extent of impact and spatial differences of extreme events)

**AND**

socioeconomic conditions that influence vulnerability and adaptive capacity



<b>Environmental Susceptibility</b>	<b>Social Adaptive Capacity</b>	<b>Suggested Options</b>
<b>High</b>	<b>High</b>	<b>Ecosystem manipulation</b>
<b>High</b>	<b>Low</b>	<b>Disaster management, diversifying livelihoods</b>
<b>Low</b>	<b>High</b>	<b>Protected area</b>
<b>Low</b>	<b>Low</b>	<b>Capacity building</b>

# Take Home Messages

- Social & ecological systems linked
- Resilience provides framework for managing complex systems under uncertainty
- Concepts are new & evolving – especially related to coral reefs & climate change
- Shared learning is key

