

Coral Reef Threats and Management: Some Context



The Importance of Coral Reefs



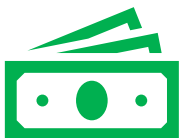
Cover about **0.1% of the ocean floor** but support over 25% of all fish life, ~ **4000 species of fish**, and ~ **800 species of corals**



Over **one billion people are directly dependent on reefs** for their livelihoods. In Small Island Developing States (SIDS), about 94% of the population lives with 100 km of reefs.



Healthy coral reefs provide sources of **sustainable food, livelihoods and income generation**, and **protection from storm surge**. In many places, local communities also have a **strong spiritual connection** to coral reefs



Value as high as **\$9.9 trillion/year globally** for the various goods and services they provide.

A threatened ecosystem

One of the **most valuable ecosystems** on the planet, and **ALSO** the ecosystem that is listed as **most at risk of extinction** by the end of the century

Local Threats

- Overfishing and destructive fishing practices
- Coastal development
- Pollution
- Tourism and recreational impacts
- Coral predator outbreaks
- Invasive species
- Coral disease outbreaks

SYNERGIES



**COMPOUNDING
EFFECTS**

Climate Threats

- Warming SSTs and associated mass coral bleaching
- Ocean acidification
- Increase in the frequency and intensity of tropical storms
- Sea level rise

Current Context for Managers

- About **50% global loss of coral cover** in the last 30 years
- **FOUR** mass coral bleaching events since 1998
- Now on the eve of a “**Super El Niño**”
- Catastrophic ecological and socio-economic consequences



**Unprecedented challenges
for coral reef managers**



Climate Change Projections

IPCC: International Panel on Climate Change

RCP (2019):
Representative Concentration Pathways (2.6 to 8.5)

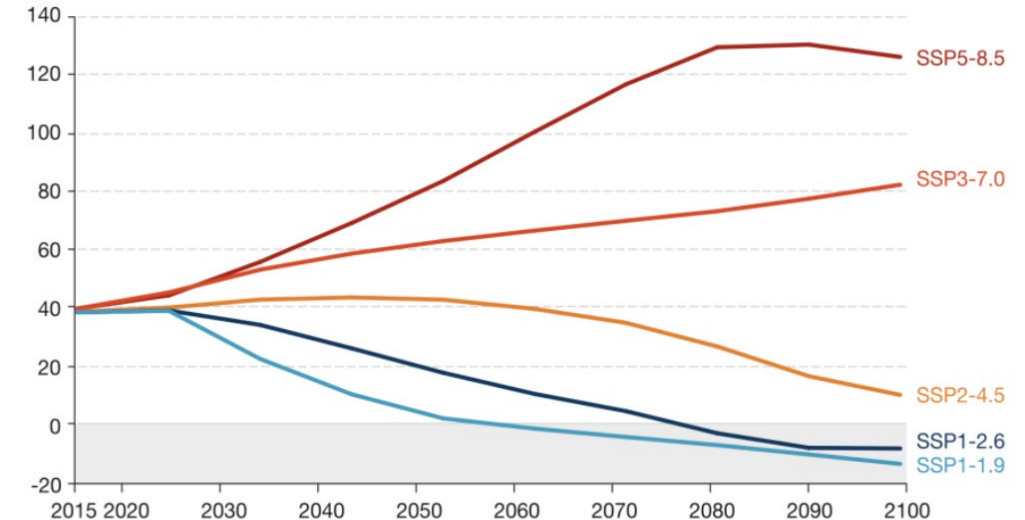
SSPs (2021): ** new language
Shared Socio-Economic Pathways (1.9 to 8.5)



Projections of CO² emissions and associated changes in ocean heat content

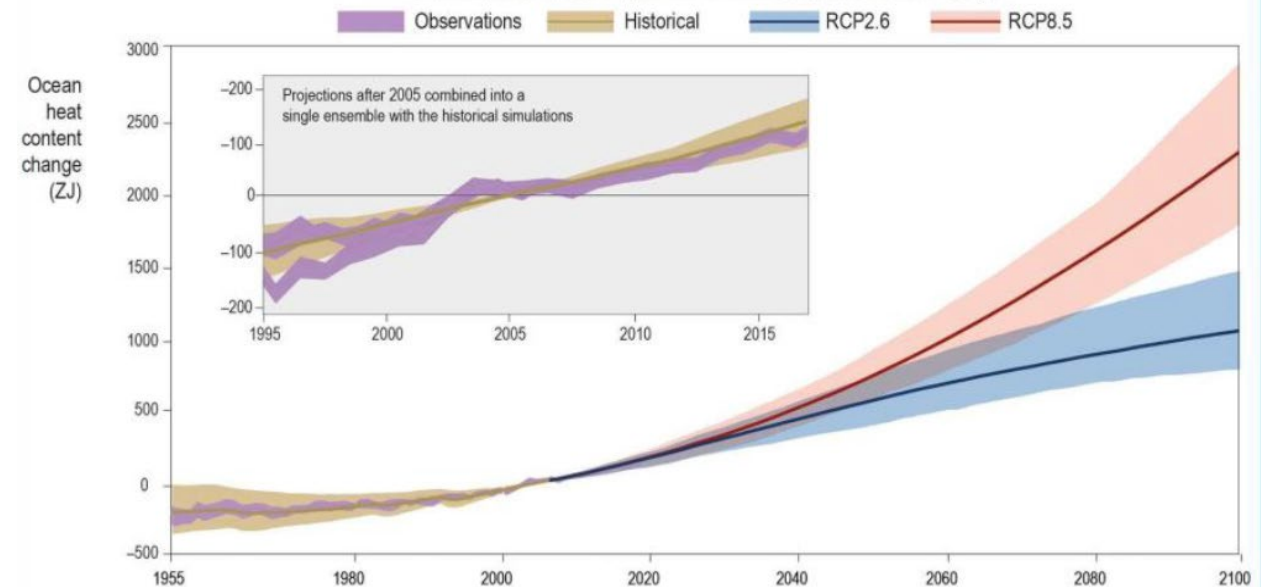
IPCC 2021

Carbon dioxide, in Gt per year



IPCC 2019

Simulated and observed global 0–200 m ocean heat content change

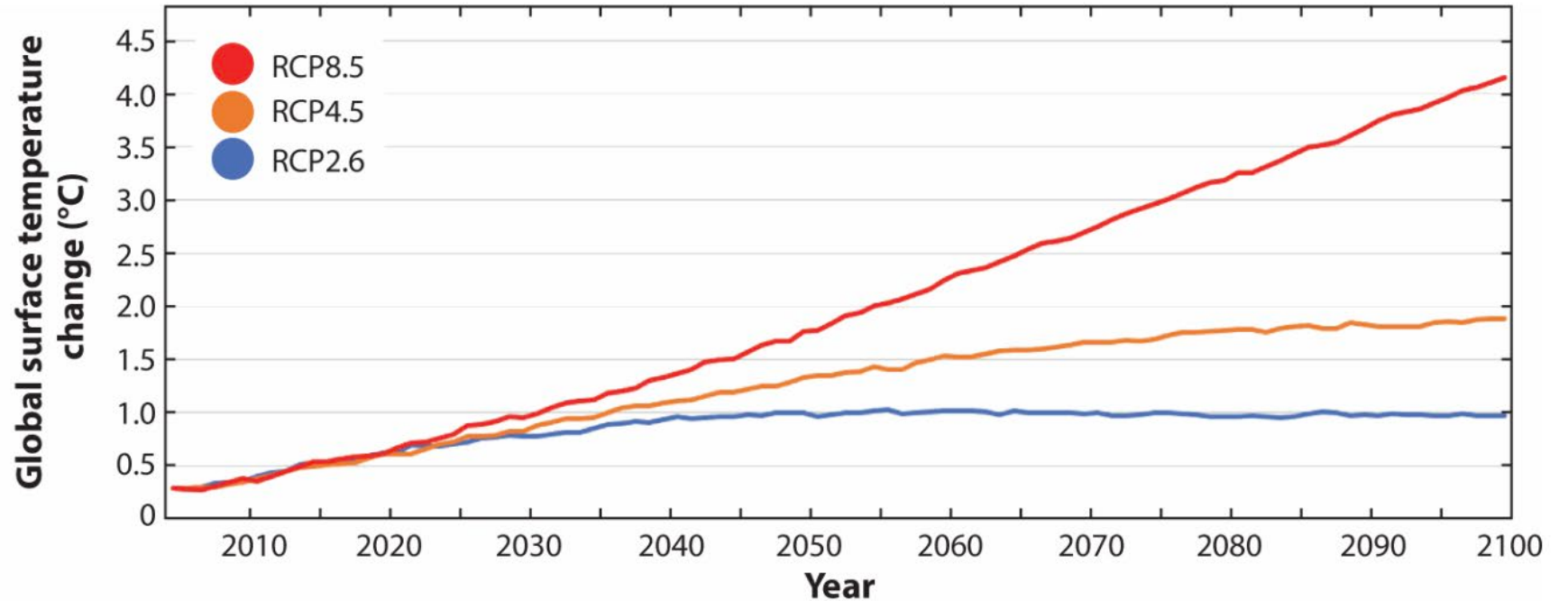
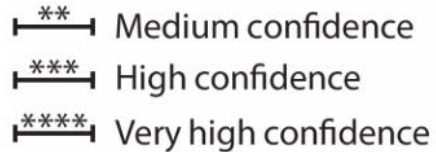


Coral Reefs & Climate Change

IPCC transitions in the level of risk for coastal ecosystems



Transitions in the level of risk and confidence levels

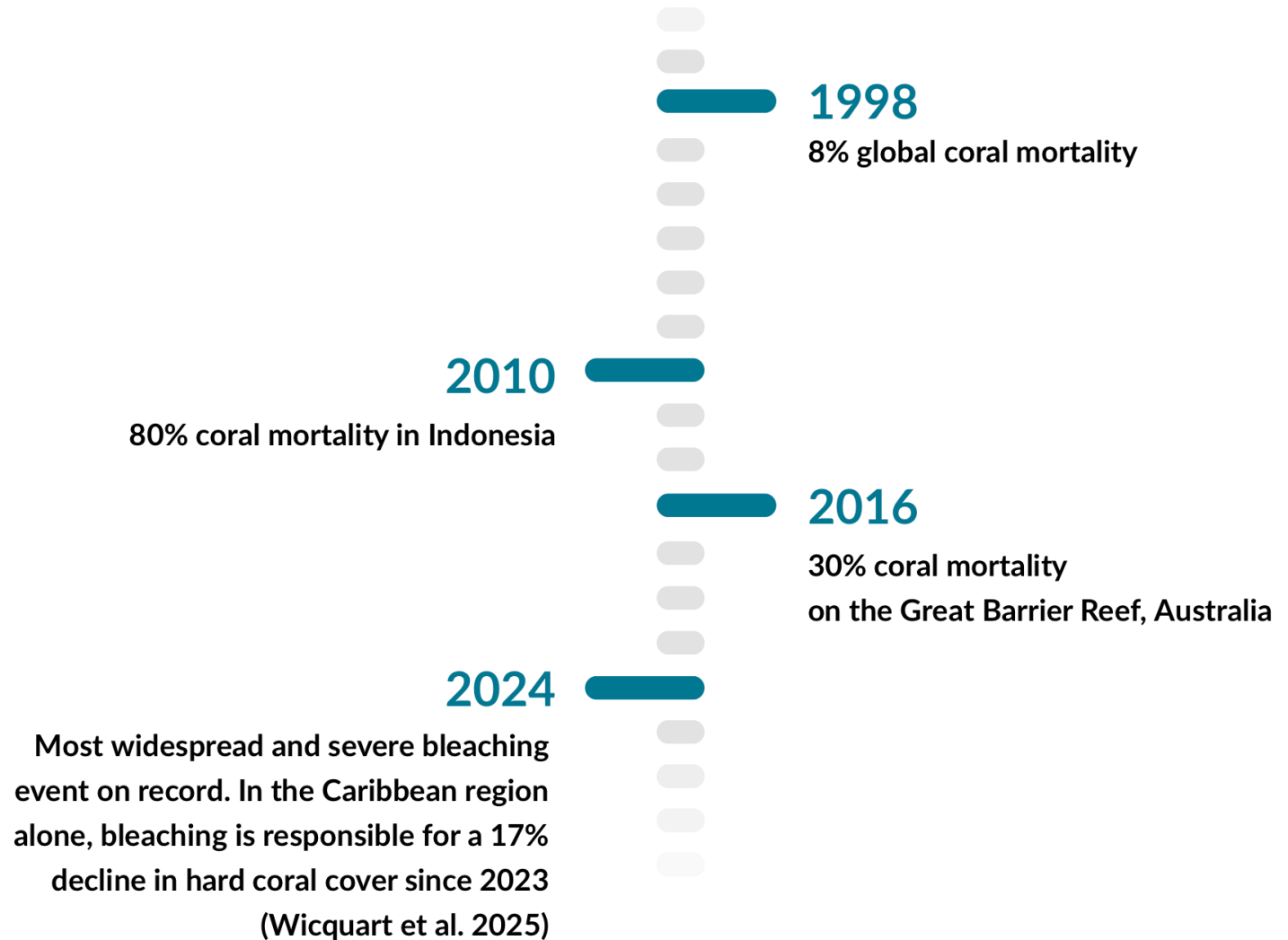


Coral Reefs & Climate Change

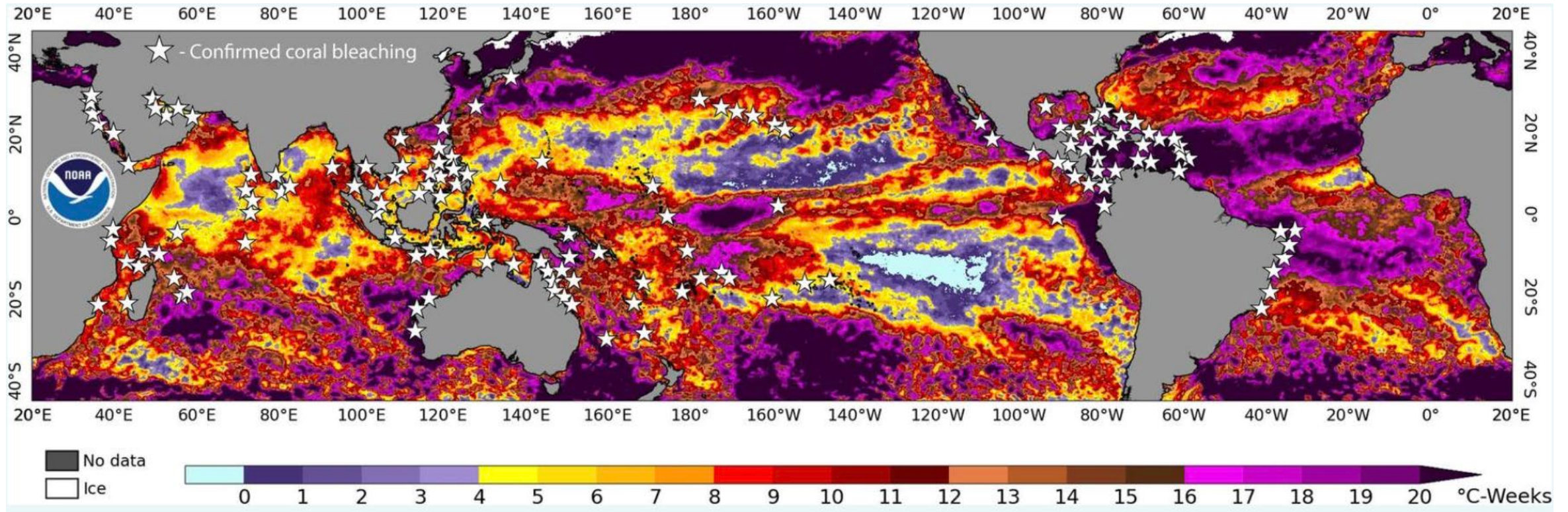
Global bleaching events in numbers:



Photo: The Ocean Agency



Coral Reefs & Climate Change



Coral Reef Resilience and RBM



**Reef
Resilience
Network**

Resilience

Resilience is defined as:

“the ability of a system to **maintain key functions and processes** in the face of disturbances by **resisting, recovering from, or adapting to change**”

(Holling 1973, Nyström and Folke 2001, Folke et al. 2010)

3 components of resilience

1 Resistance

The extent that a system can withstand a disturbance

2 Recovery

The ability of a system to return to its original state following a disturbance.

3 Transformation

The ability of a system to adapt to change



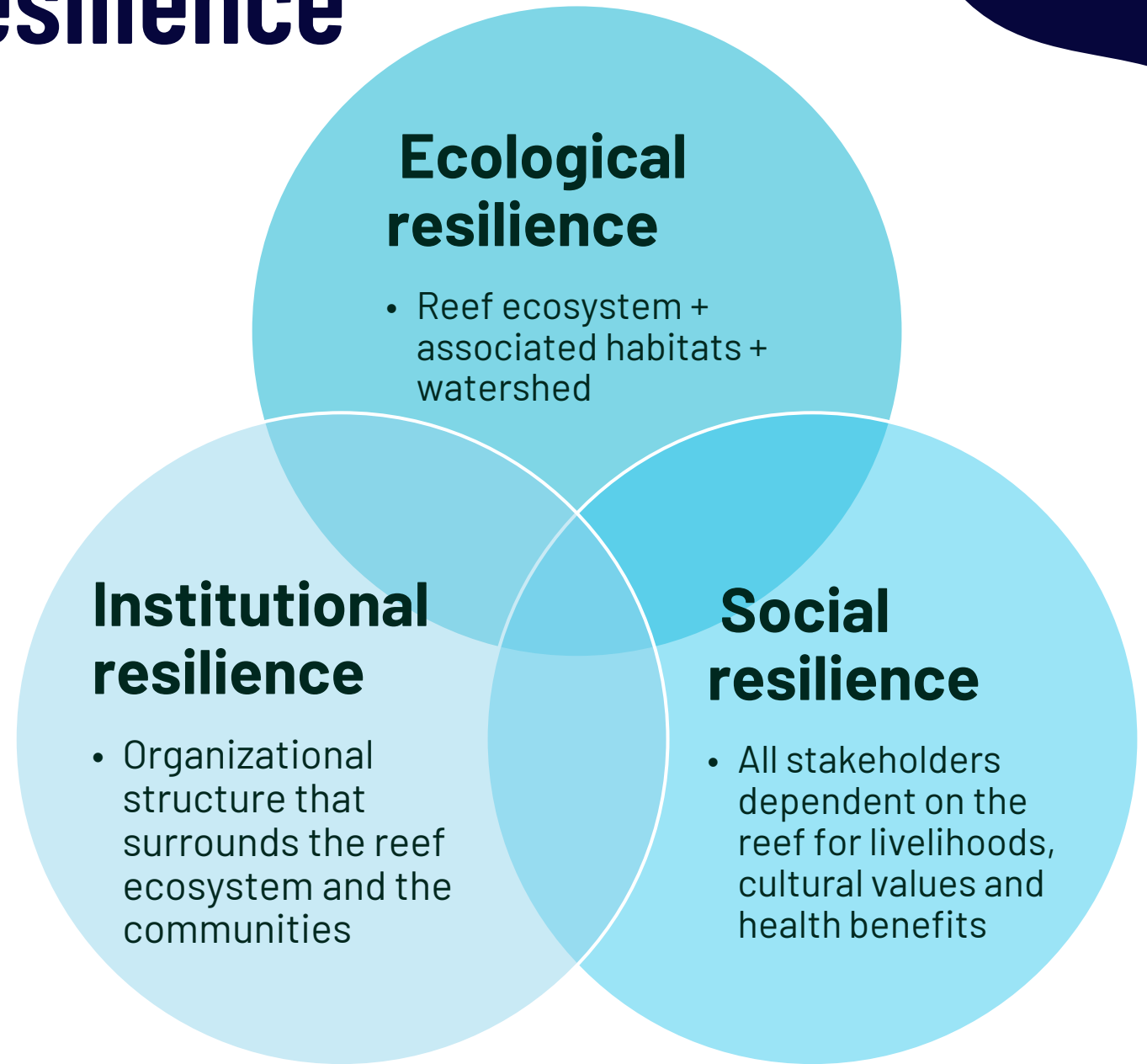
Social-Ecological Resilience

3 dimensions

Ecosystem

Community

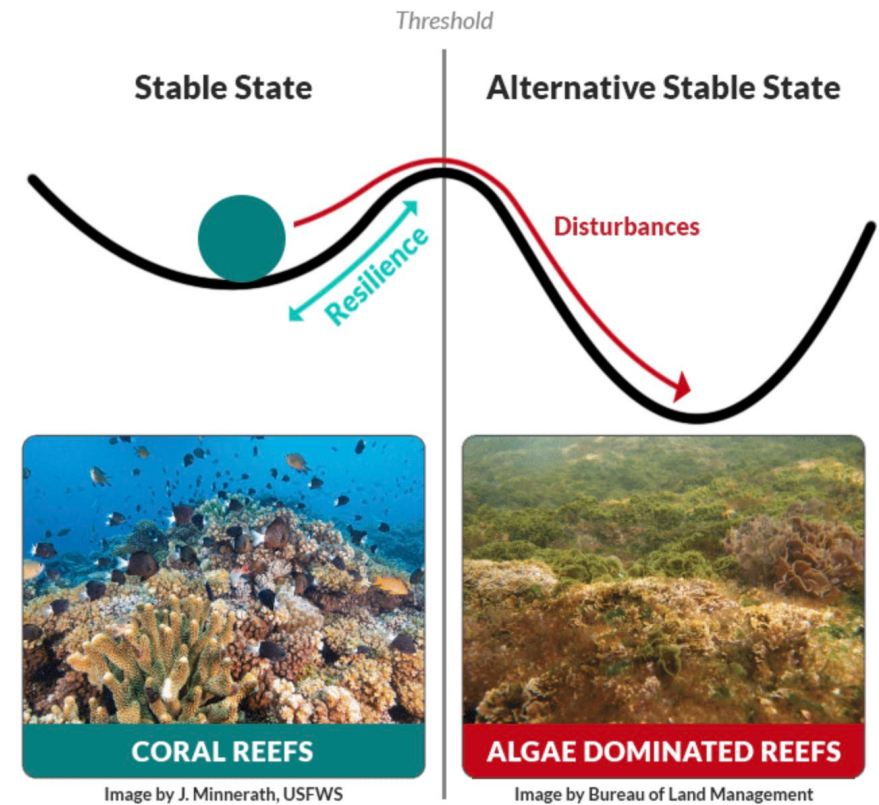
Governance



Ecological resilience of a coral reef

A resilient coral reef ecosystem is able to:

- Absorb or recover from disturbances **without permanently switching from a coral-dominated to an algal-dominated state**
- **Maintain key functions** (e.g., structural complexity, species diversity)
- **Sustain the delivery of important ecosystem services** to communities



Social Resilience

Social resilience is defined as the **ability of a human community to cope with and adapt to stresses** such as social, political, environmental, or economic change.

Communities have direct and indirect impacts on reef ecosystems that **can enhance or erode ecosystem resilience.**



Institutional Resilience

Institutional resilience includes **policies, practices, rules, and regulations** that establish responsibilities and accountability for communities and decision-makers in relation to the reef system.

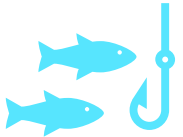
Socio-ecological systems are **more resilient** when the **governance systems** that oversee them are **transparent and accountable**, and when they are **trusted and knowledgeable**.



Resilience-Based Management (RBM)



Goal is to **enhance the resilience** of ecosystems, communities, and social-ecological systems



Focus on **prioritizing management actions for resilience** and informing resource allocation



Requires **adaptive management** for strategies that are flexible and can manage uncertainty under climate change

Highly context-specific



**No “one-size-fits-all”
approach**