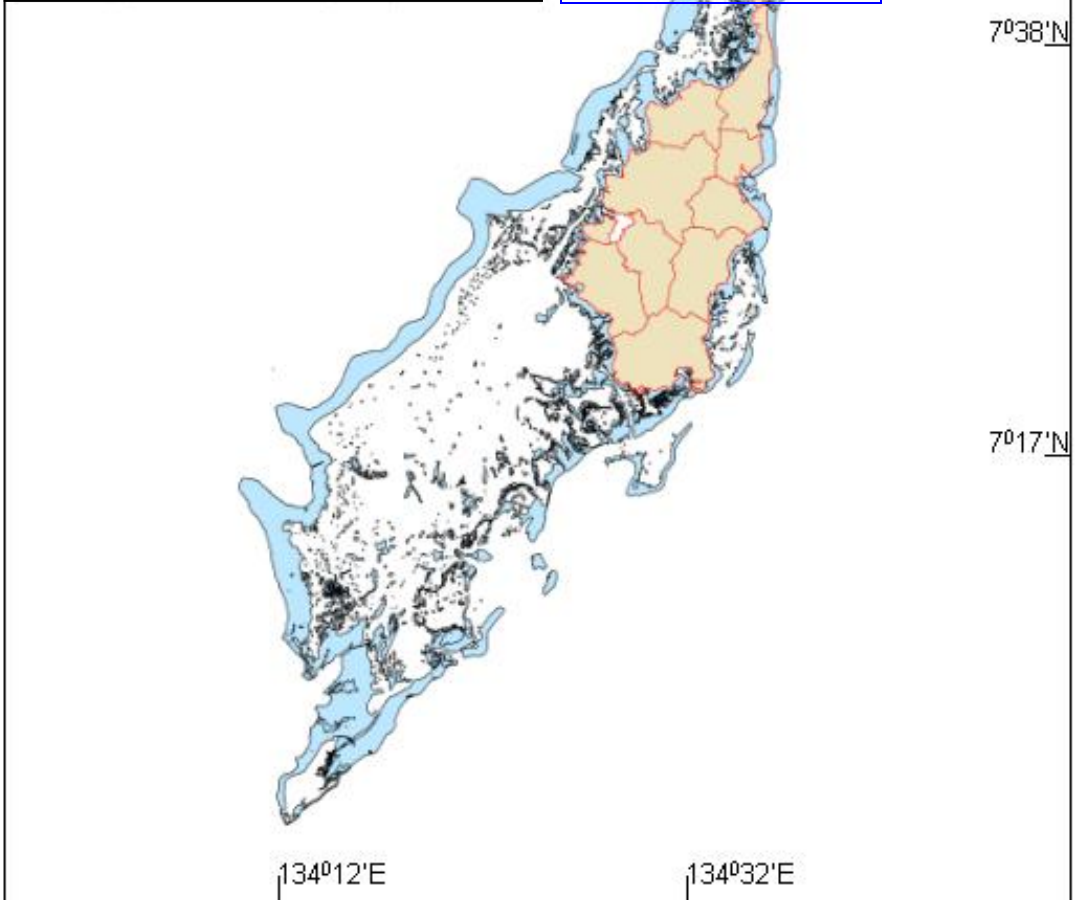
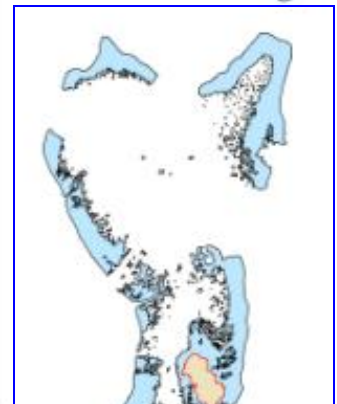
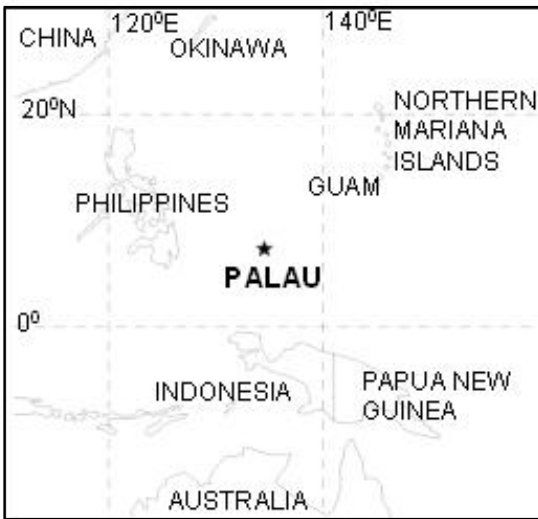




Palau's Northern Reefs: Management in the face of climate change

Y. Golbuu, R. van Woesik, Northern Reefs Management
Planning Team, Northern Reefs Climate Adaptation Team





1998 bleaching event



Bleaching was widespread and variable

Acropora species had the highest mortality

Offshore reefs were hit the hardest

Affected corals down to 90 ft.

Corals near estuaries survived better than those farther from land

After 1998 bleaching



Northwest slopes: 77% immediate decrease in coral cover, but now (2009), good recovery with 50-70% cover, mainly *Acropora*

Northeast slopes: little change

Patch reefs: no data before 1998, but western patch reefs have high coral cover in 2009, although northeast patch reefs show little recovery

Thermal stress is dependent on...

- Species
- Size of colony
- Depth
- Locality....
- ...







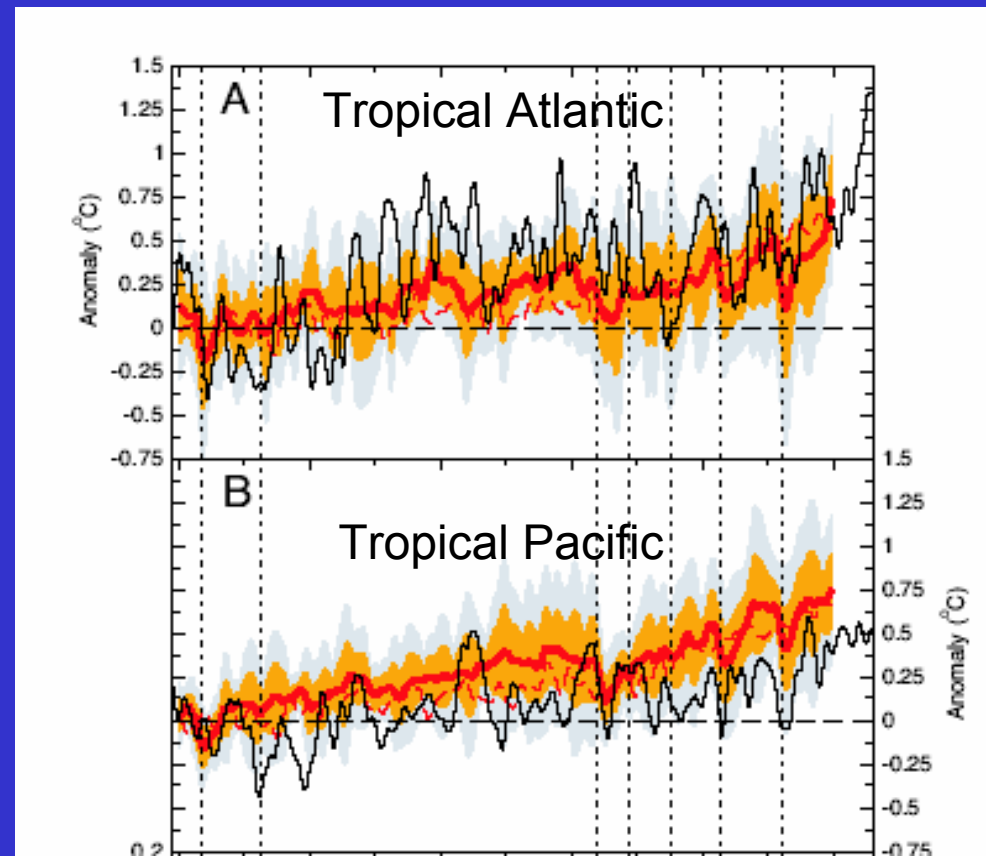
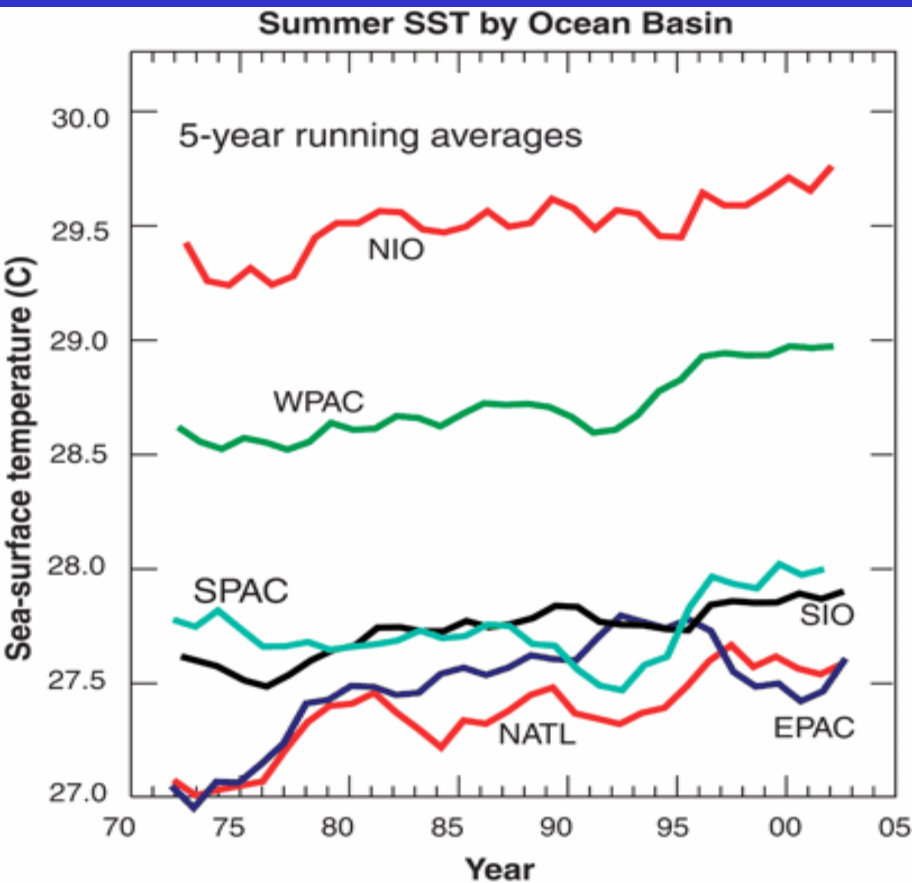
Old & New



Rapid recovery

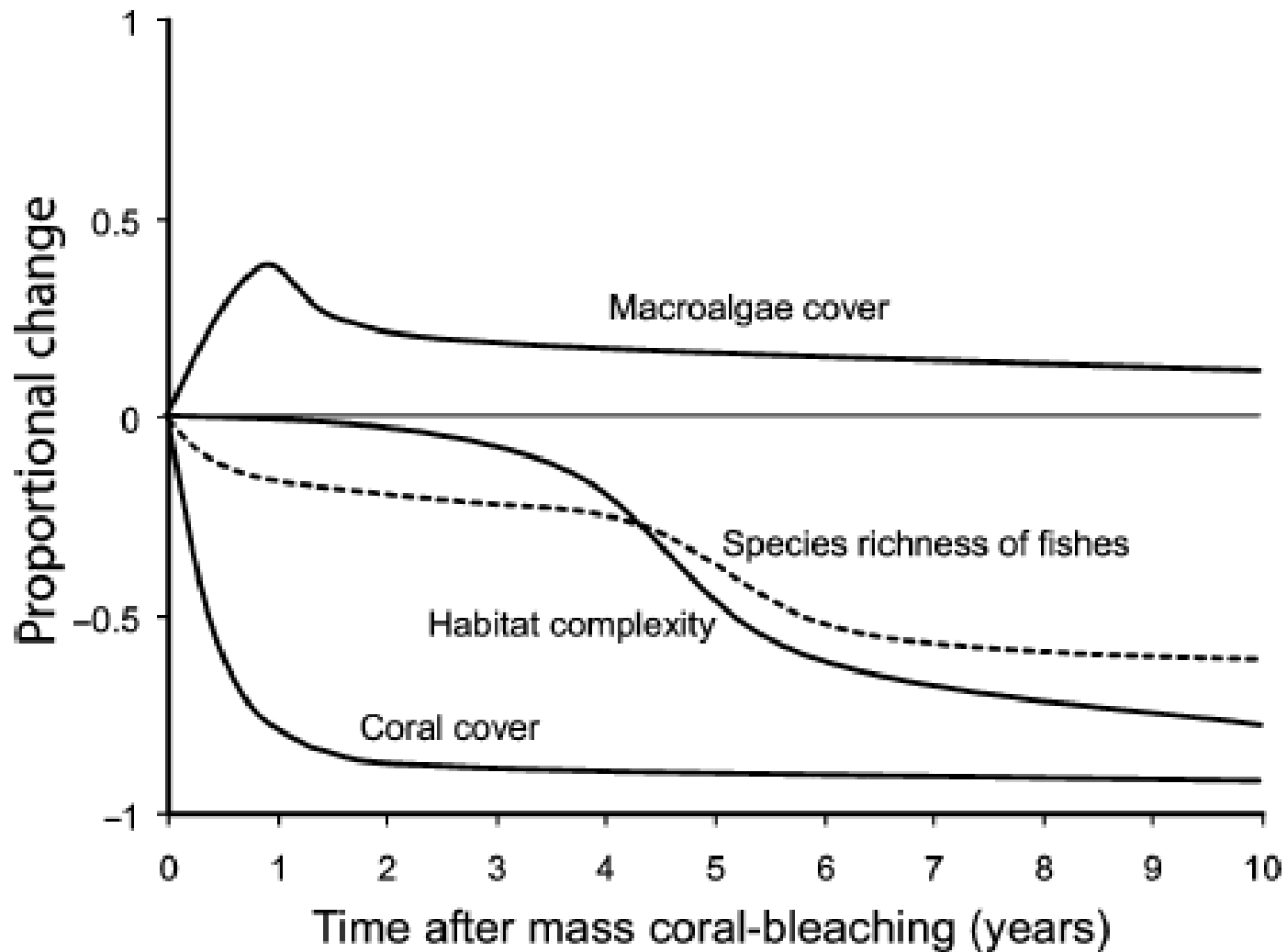
Water temperature rise !

Last 30 years –
average increase of 0.5°C



Webster et al 2005. Science

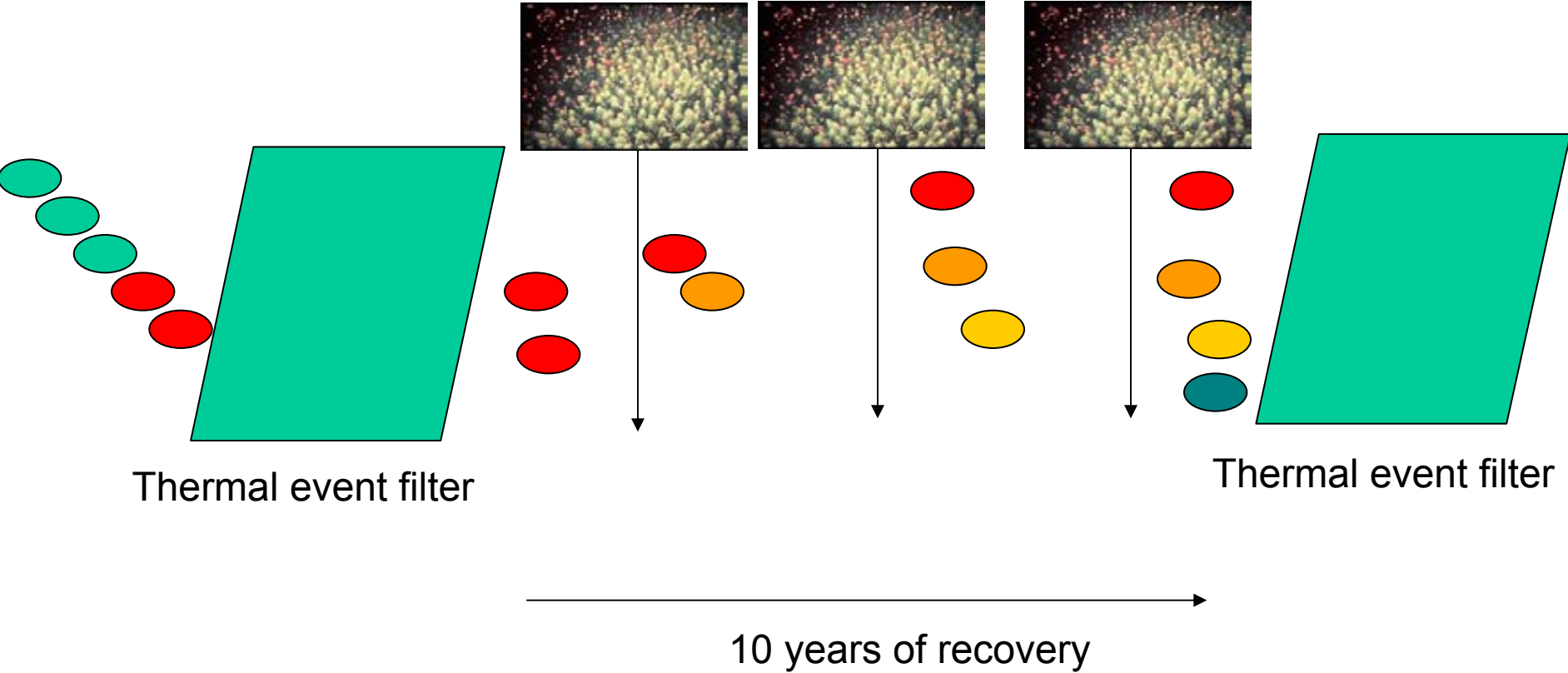
Santer et al 2006. PNAS 103: 13905-13910



Munday et al 2008. Fish & Fisheries 9: 261-285

Adaptation involves ***differential-reproductive rates*** on different individuals within populations.

Annual -reproduction
(recombination) – biannual in tropics



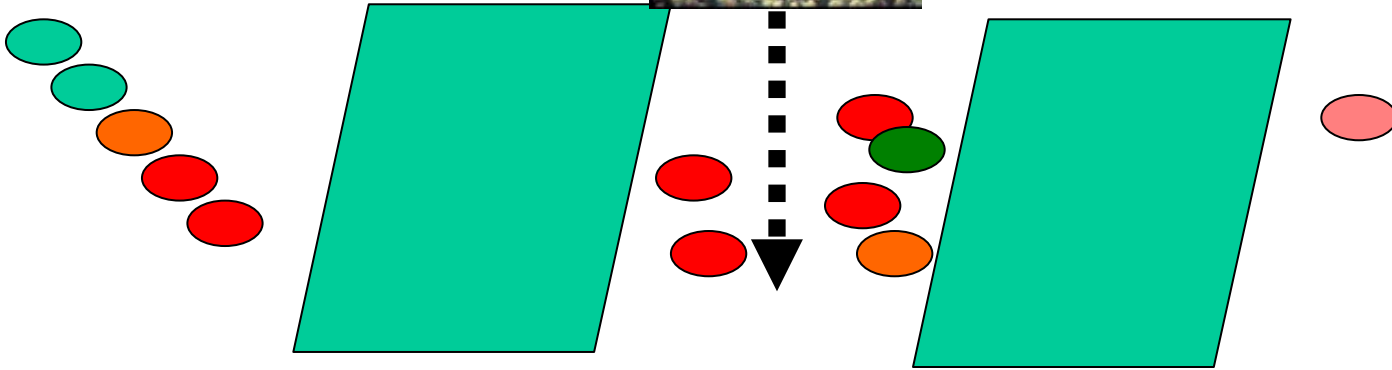
Thermal event filter

Thermal event filter

10 years of recovery

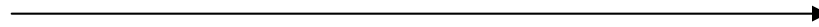
Annual -reproduction
reduced

?

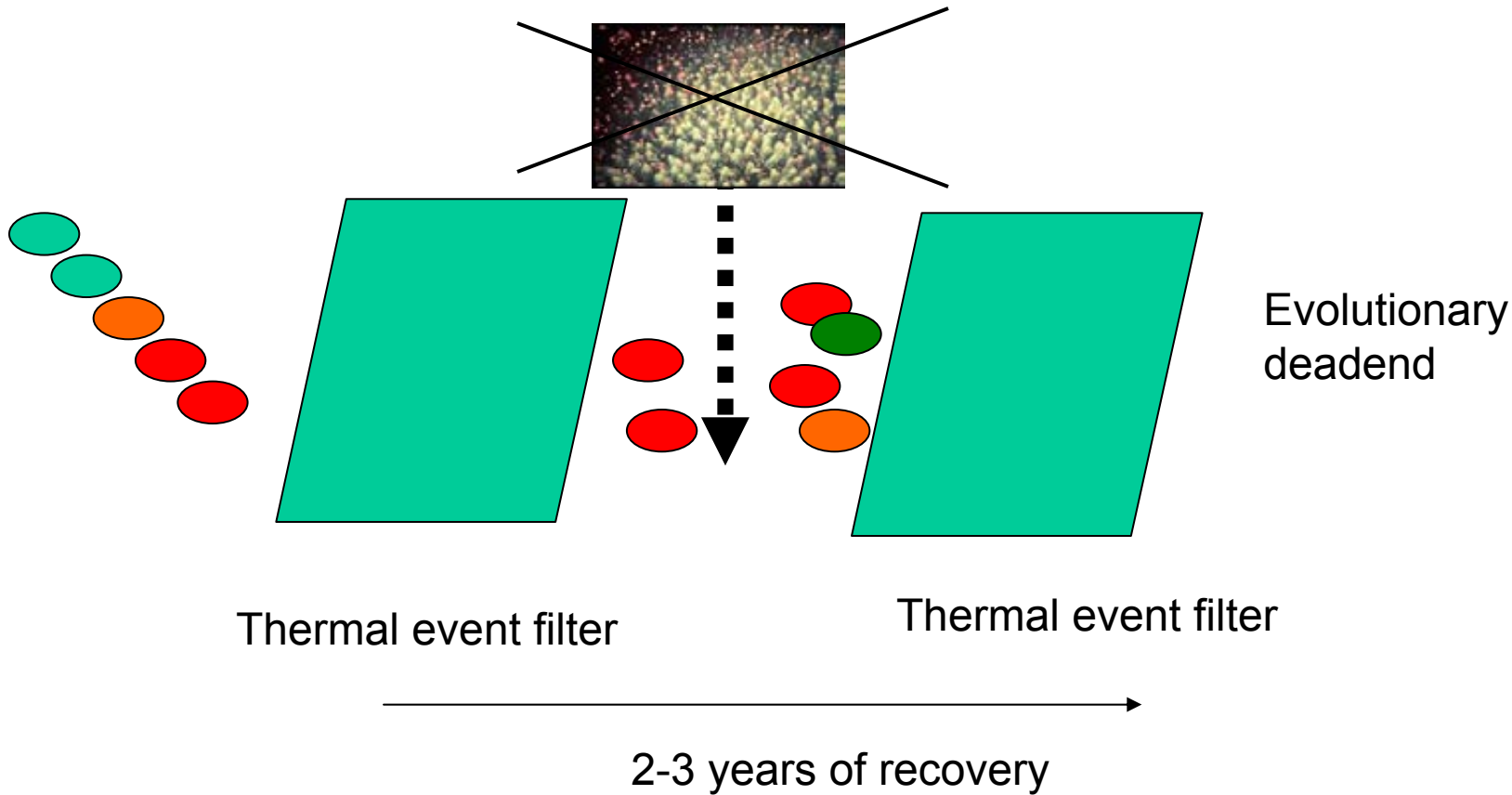


Thermal event filter

Thermal event filter



2-3 years of recovery





MENGELLAKL DECLARATION



Ngarchelong's Road Map

Towards Effective Management of the Northern Reefs

Political and traditional leaders and community members

Develop and implement a management regime for the
Northern Reefs

Establishment of the State Planning Team to lead
the conservation planning process

Conservation Area Planning

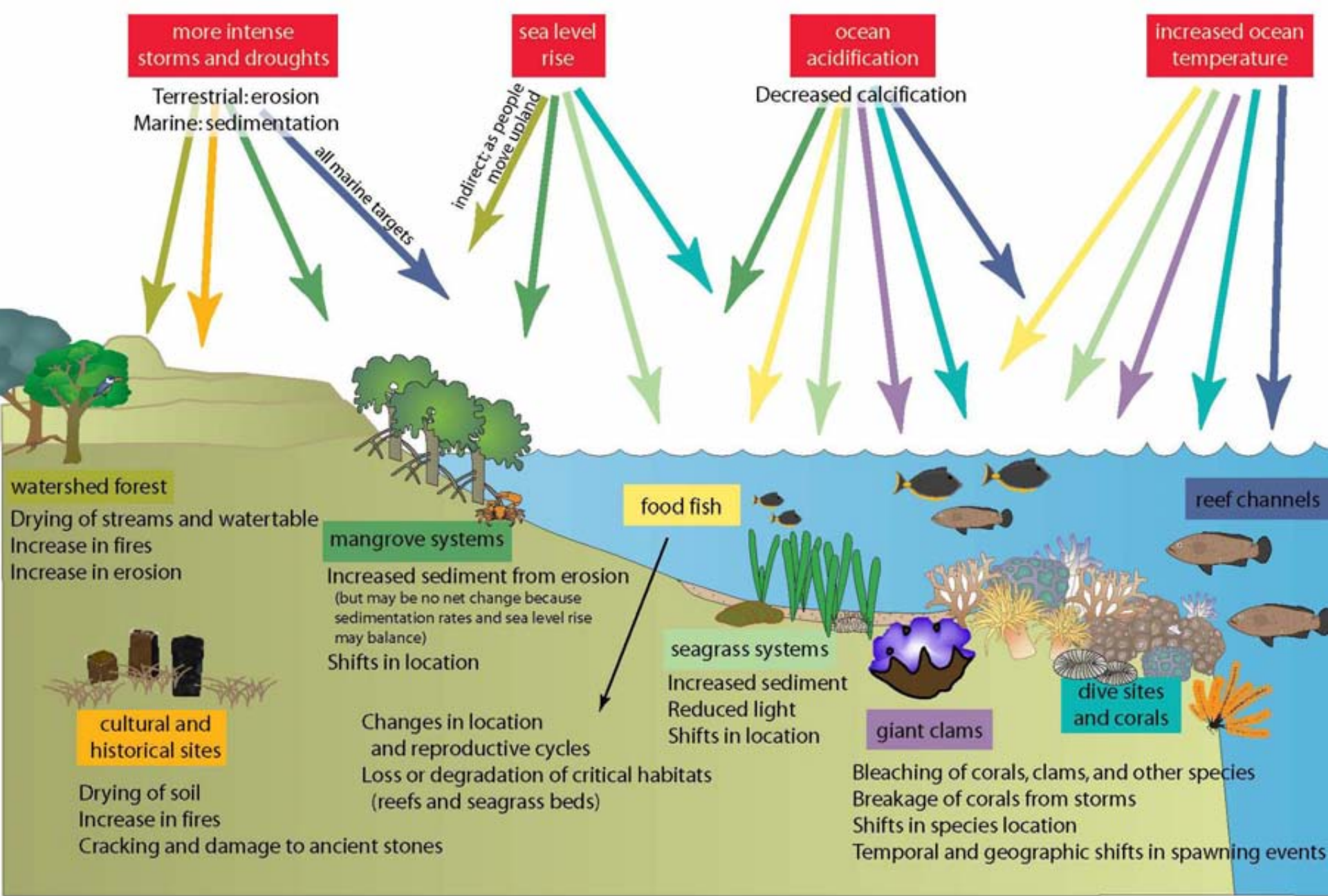
Identify conservation targets

Identify and assess threats

Conduct situation analysis

Develop conservation strategies

Establish measures



Impacts of Climate Change on Northern Reefs, Palau

Hypotheses of Change

Conservation Target	Climate Factor	Key Ecological Attribute	Hypothesis of Change	Likelihood
Dive sites and corals	Seawater temperature	Species composition/ dominance	Increase in seawater temperature will lead to bleaching events that will reduce the number of corals on reefs	likely

Adaptation

Variety of habitats

Replication

Reproduction (size and habitats)

Connectivity

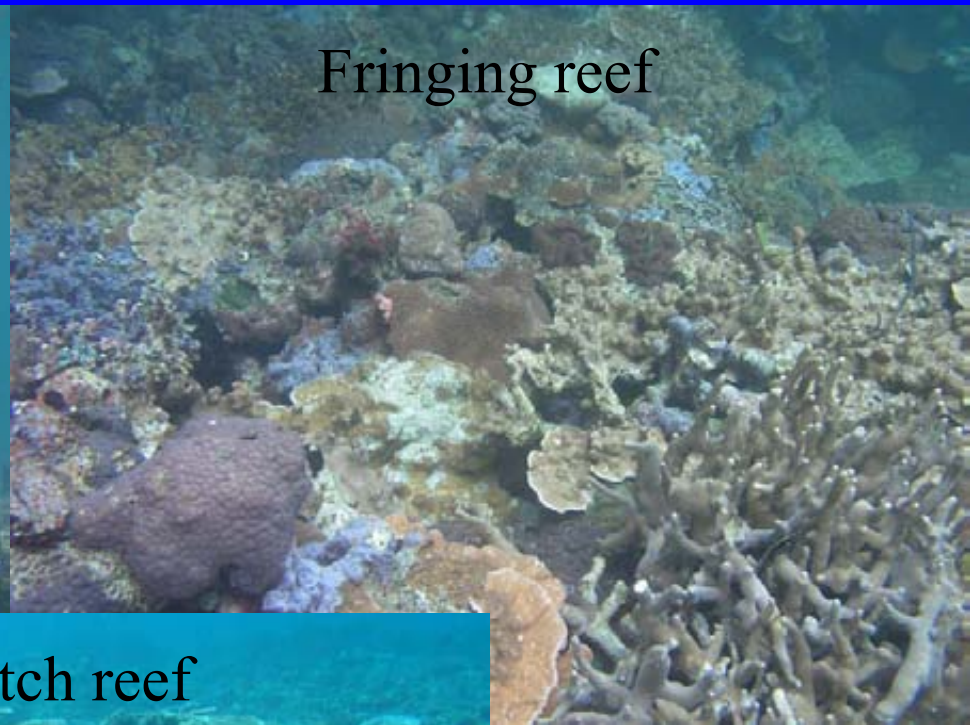
Almany et al, 2009; Heller and Zavaleta, 2009 ; McLeod et al, 2009

Habitats do not all respond the same way

Fringing reef



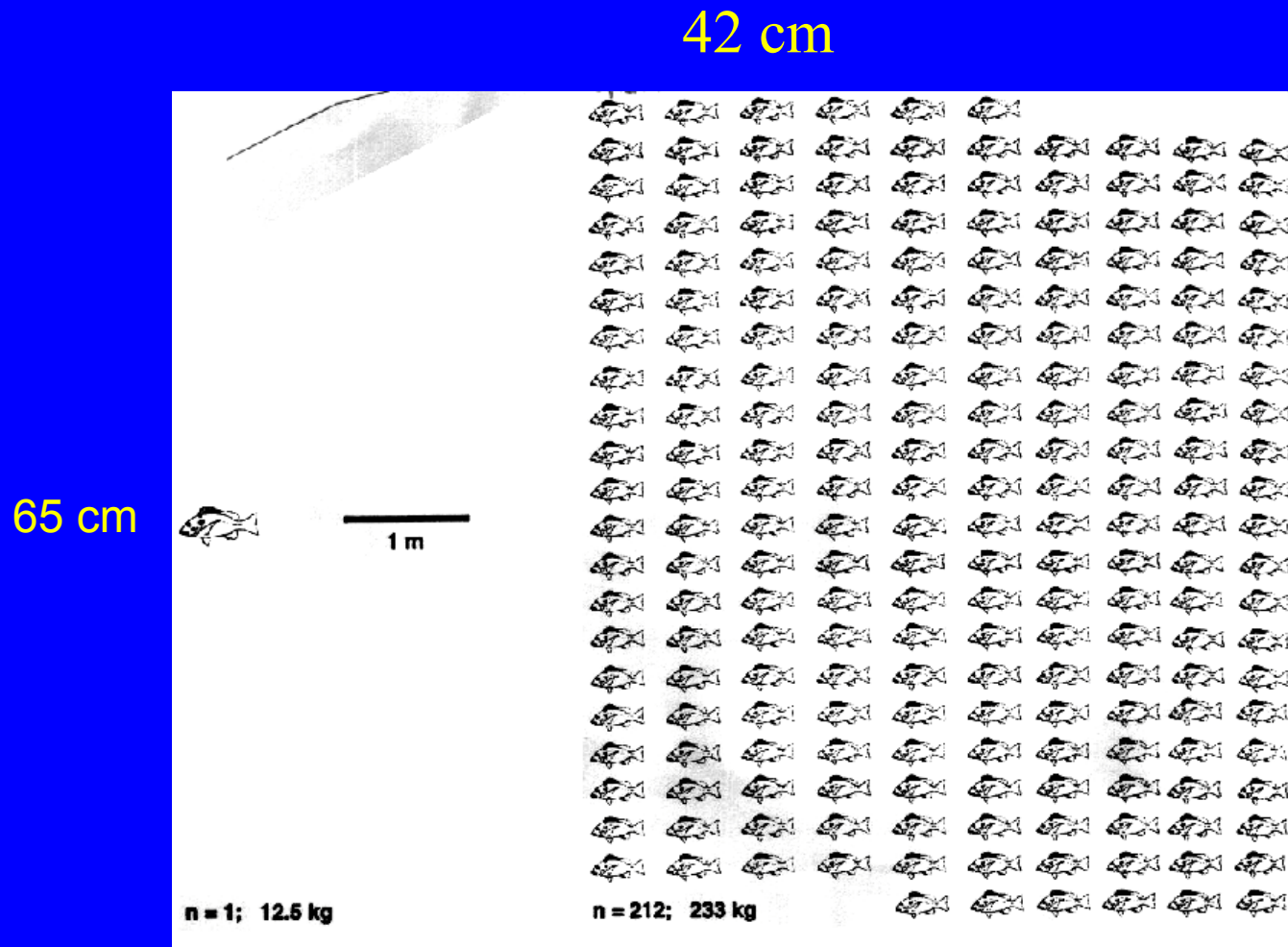
Fringing reef



Patch reef



Size and Habitats

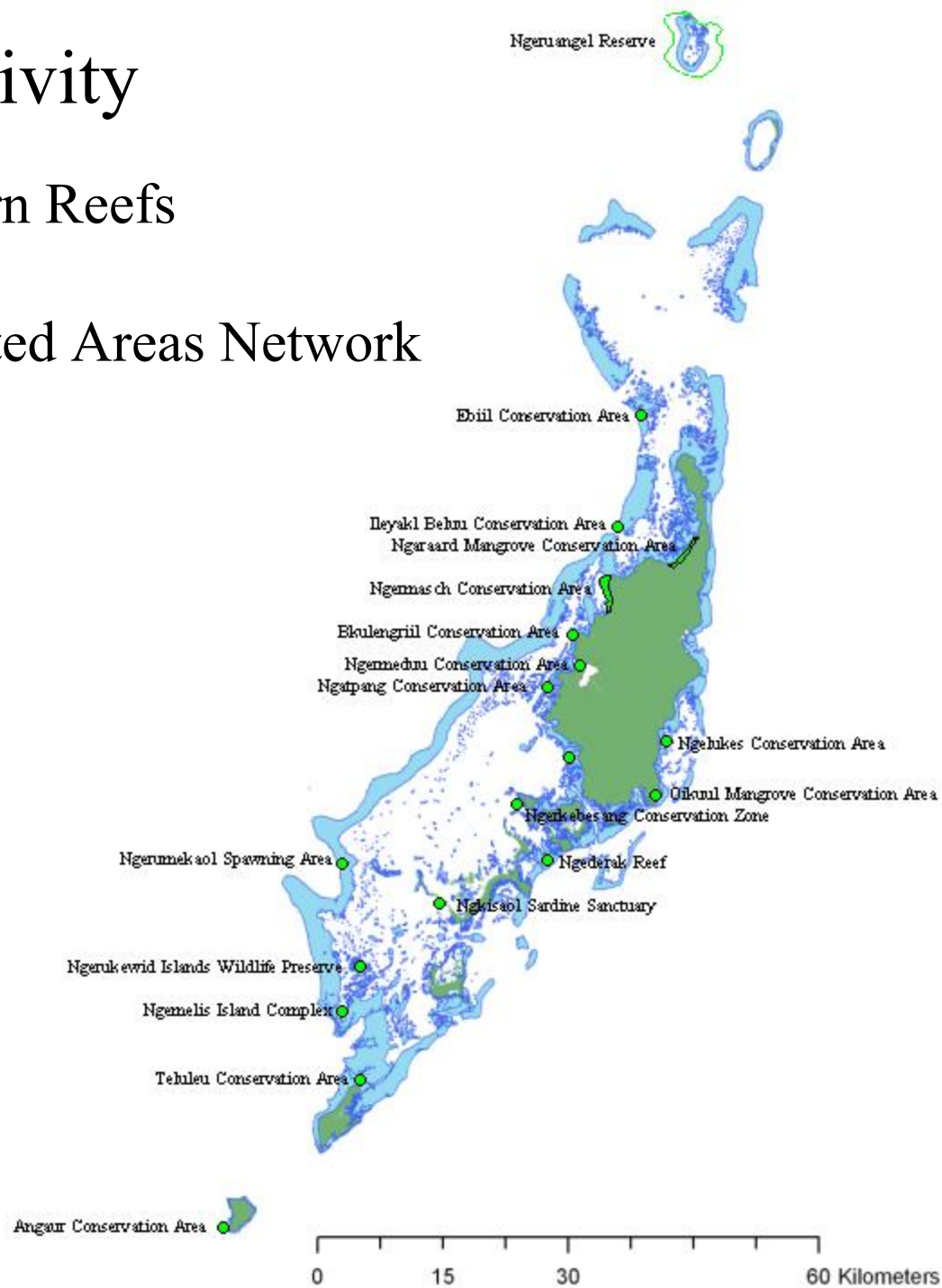


Birkeland C (1997) Life and death of coral reefs.

Connectivity

Whole Northern Reefs

Palau's Protected Areas Network



Acknowledgements

A vibrant underwater photograph of a coral reef. The scene is filled with various types of coral, including large, flat, table-like corals in the foreground and more branching, bushy corals in the background. The water is clear and blue, with sunlight filtering through from above, creating a bright and colorful environment. The coral colors range from light tan and yellow to deep blues and purples.

German LifeWeb

Palau Conservation Society

Palau International Coral Reef Center

The Nature Conservancy