Collaborative coral-reef monitoring for local jurisdictions with limited resources across Micronesia

Maximizing local benefits and regional knowledge

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Outline

- Perspective on question-driven coral-reef monitoring
- Micronesian Challenge
  - Example of establishing a regional monitoring framework from the ground up
- Benefits of standardized monitoring
  - Shared learning, science, management
- Evaluating the challenge

Coral-reef monitoring perspective

- Apparent rise in monitoring since thermal stress associated with 1998 El Niño

- Yet, database searches reveals greater emphasis on 'methods' compared to 'biological trends'

- Example:
- 226 citations – "Coral reef monitoring methods"
- 126 citations – "Coral reef monitoring trends"

Keywords="coral-reef monitoring"

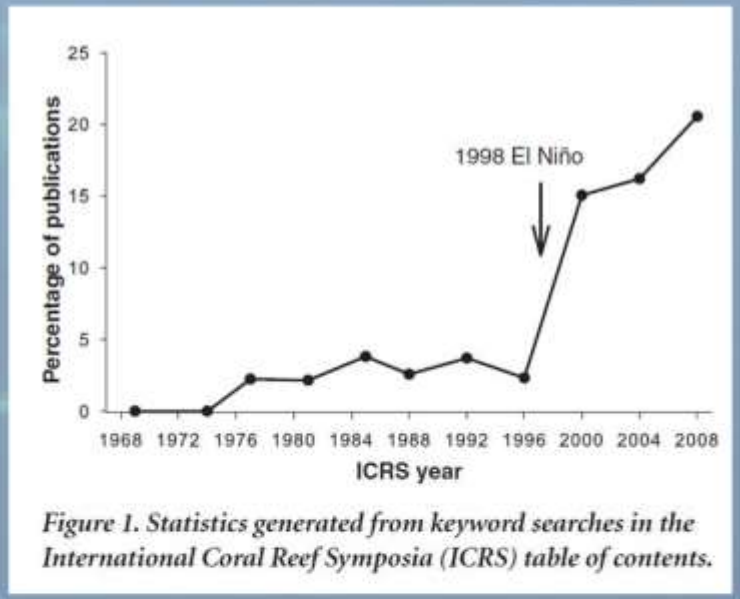
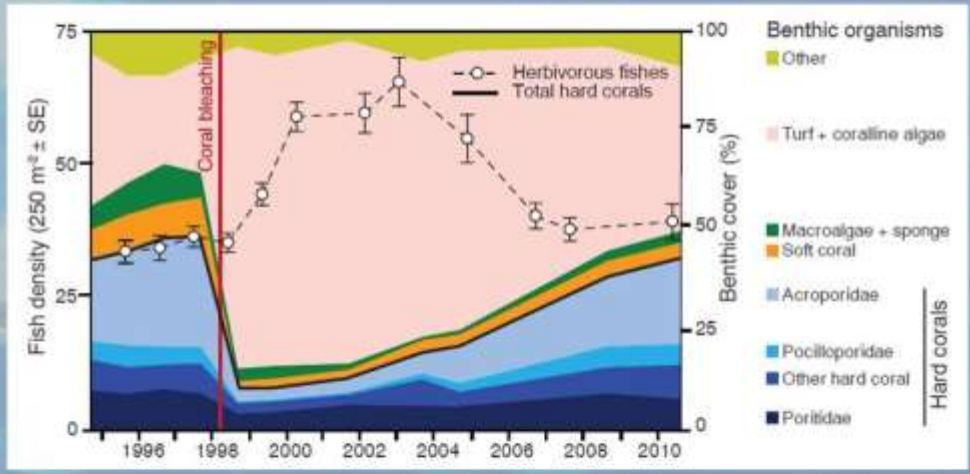


Figure 1. Statistics generated from keyword searches in the International Coral Reef Symposia (ICRS) table of contents.

Source: *Houk and van Woesik 2013 - Bioscience*

Yet, long-term trends are critical for our understanding of reef processes

- Not common for most island nations
- But, when present their utility very insightful

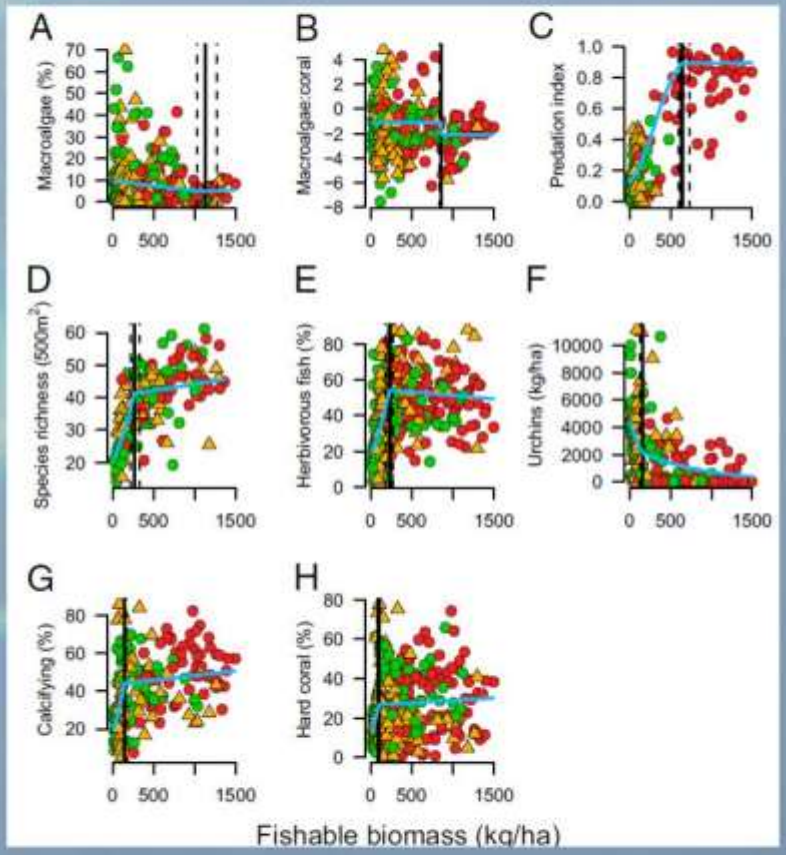


Quantifying processes influential to reef recovery following disturbance, in this case trophic interactions

Source: *Gilmour et al. 2013- Science*

Trends across large spatial scales equally influential

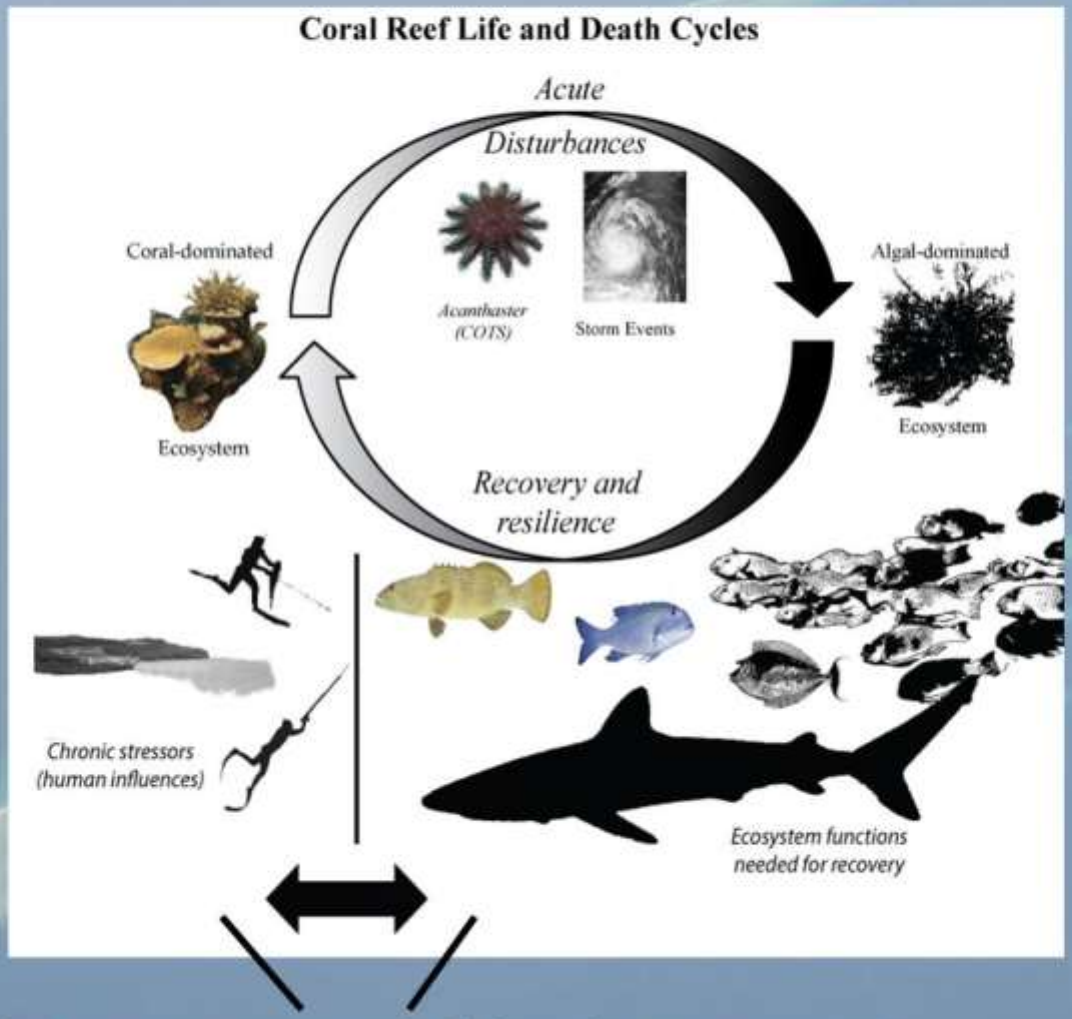
- Ecological role of coral-reef fish as a means for setting fisheries targets



Quantifying management targets for fisheries across nine countries in the Indian Ocean

Source: *McClanahan et al. 2011- PNAS*

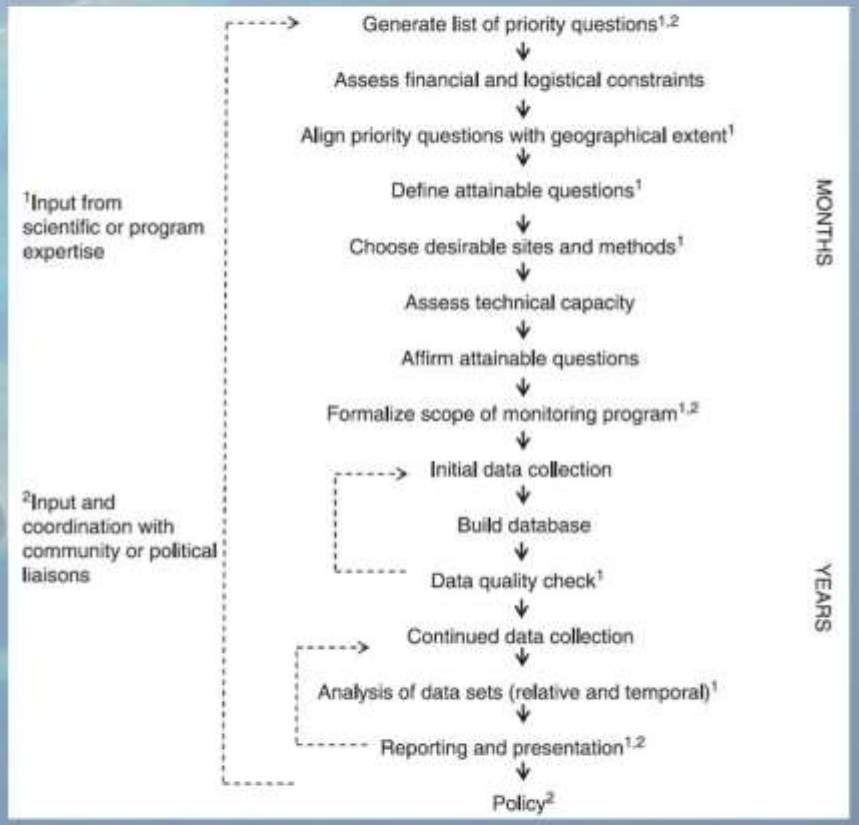
Using temporal and spatial frameworks, we can also learn from disturbance cycles



What targets are needed for what scenarios?

Clear monitoring utility, but difficult to build a program to attain benefits

- Cumbersome process
  - How can we ensure high-quality data capable of producing useful insight needed to understand critical processes and set/evaluate management?



Desirable monitoring framework, but difficult for local programs to accomplish alone

Source: *Houk and van Woesik 2013 - Bioscience*

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Micronesian Challenge

- In 2006, regional leaders signed the MC declaration
- Effectively conserve 30% of marine resources and 20% of terrestrial resources across Micronesia by 2020
- Created sub-committees
  - MC measures group focus here


“Effective” conservation?

Disturbance and recovery cycles are basis

Effectively managed

5-7 years

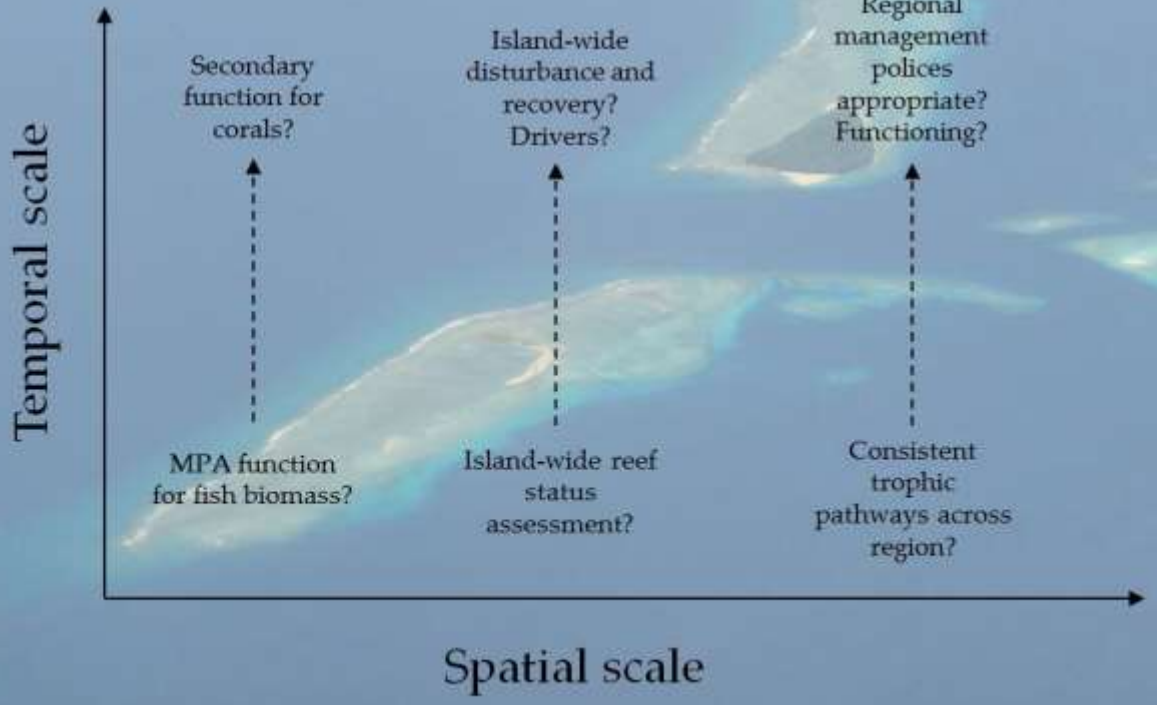
Not effectively managed

Disturbance event
(predator starfish)

Design monitoring

Question-driven monitoring designs

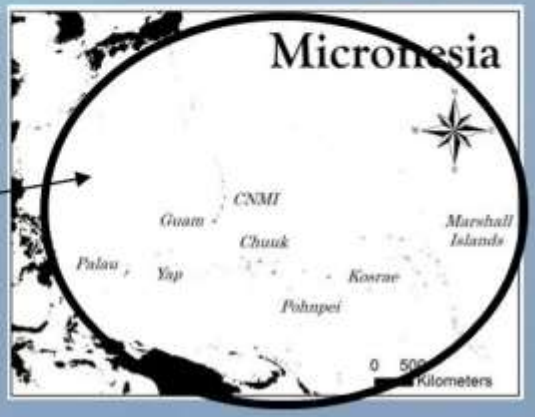
- Regional working group together prioritized questions/needs



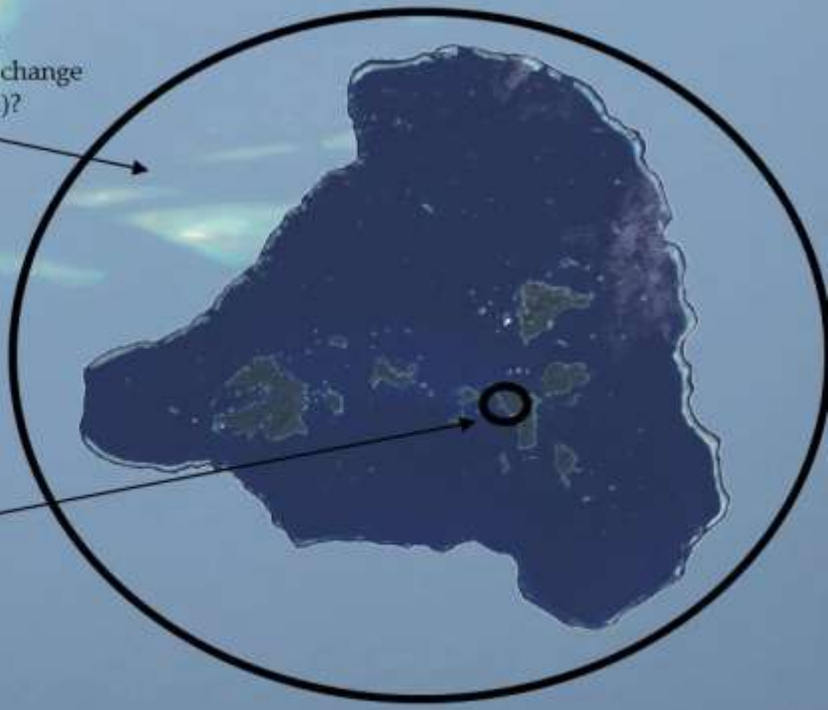
Agreed upon needs

- Simple enough to have temporal consistency with changing personnel and key leadership
- Site-based designs
- Ability to scale up data analysis to islands/regions
- 1-2 nodes for QA/QC

Changing trophic pathways across region with climate change?



What habitats most sensitive to climate change (OA, bleaching, etc.)?

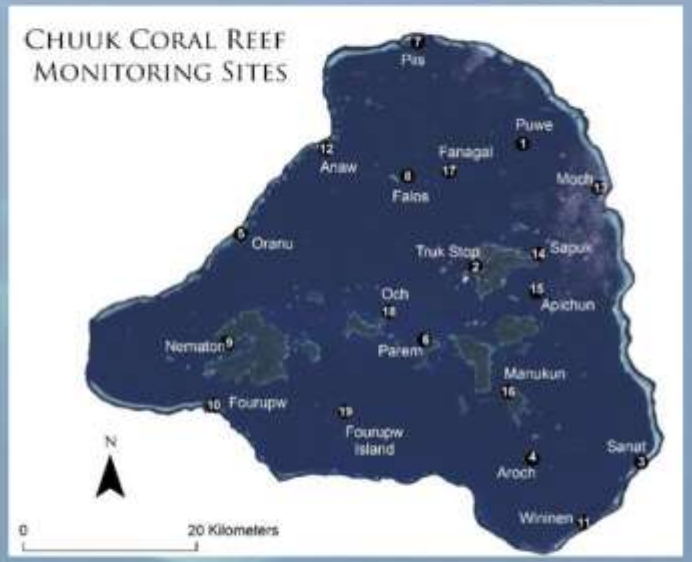


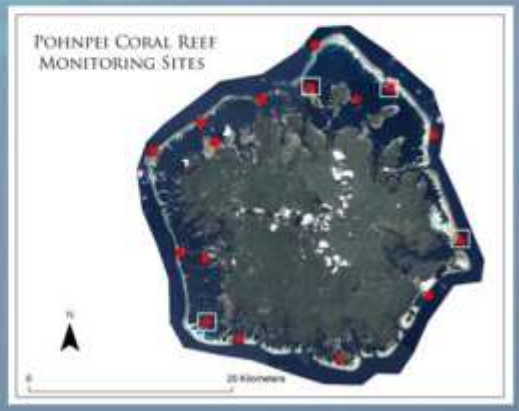
MPA functioning in Chuuk, FSM?

Designs representative of "islands"

- Stratified site selection
  - Inside and outside MPAs
  - High and low wave exposure
  - Inner, channel, and outer reefs
  - Across island geography (N-S, E-W)

- Protocols
  - Won't delve into this, but given questions and needs, your quantitative approaches become more apparent





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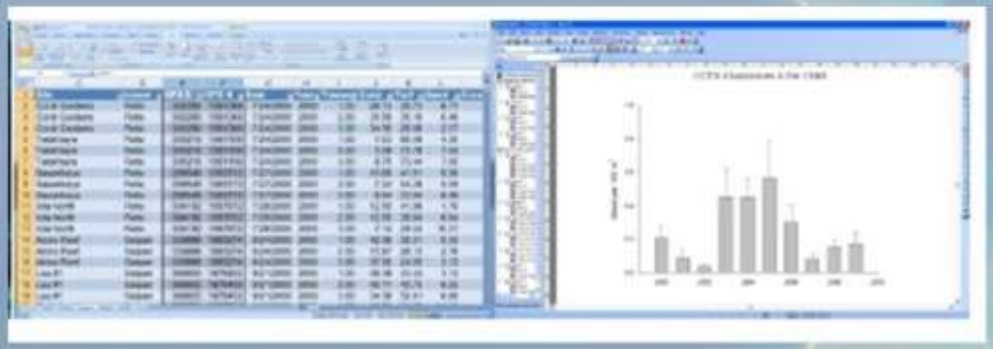
Shared learning, science, and outreach

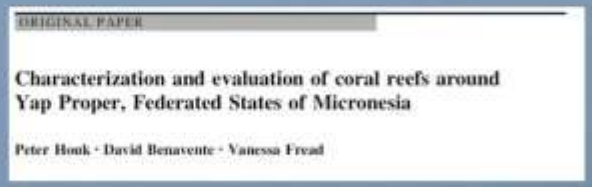


Shared database, data analysis, trainings
http://www.pacmares.com/home/our-work/regional/2010datatraining/

Online QA/QC data access

Shared reef status outreach material formats

Shared forms of community outreach


ORIGINAL PAPER

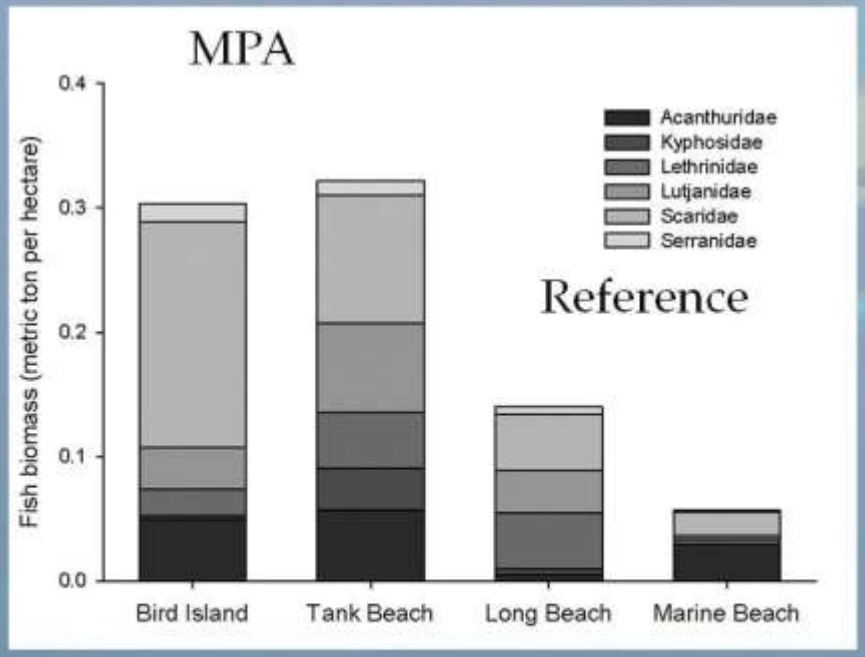
Characterization and evaluation of coral reefs around Yap Proper, Federated States of Micronesia

Peter Houk · David Benavente · Vanessa Fread

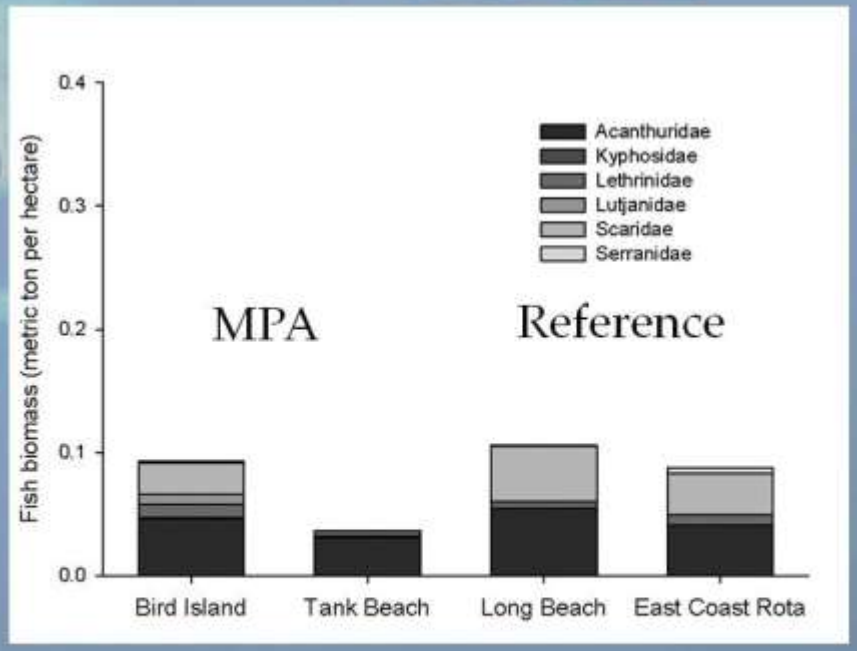
Generate credible science, and translate


Some interesting examples

MPA enforcement needs



2010

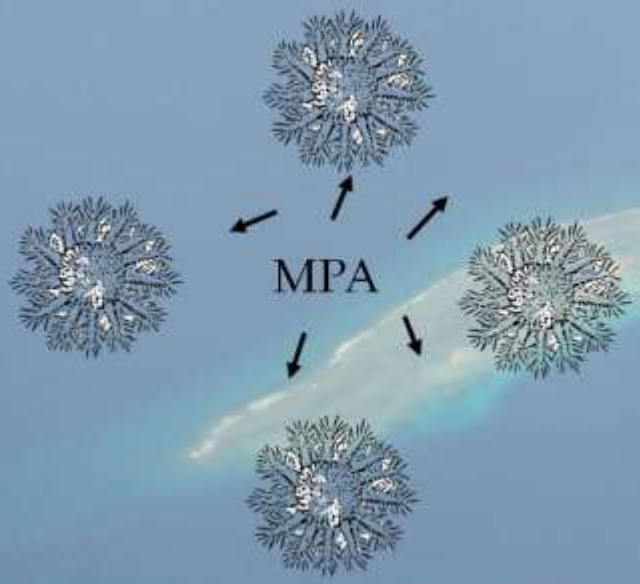


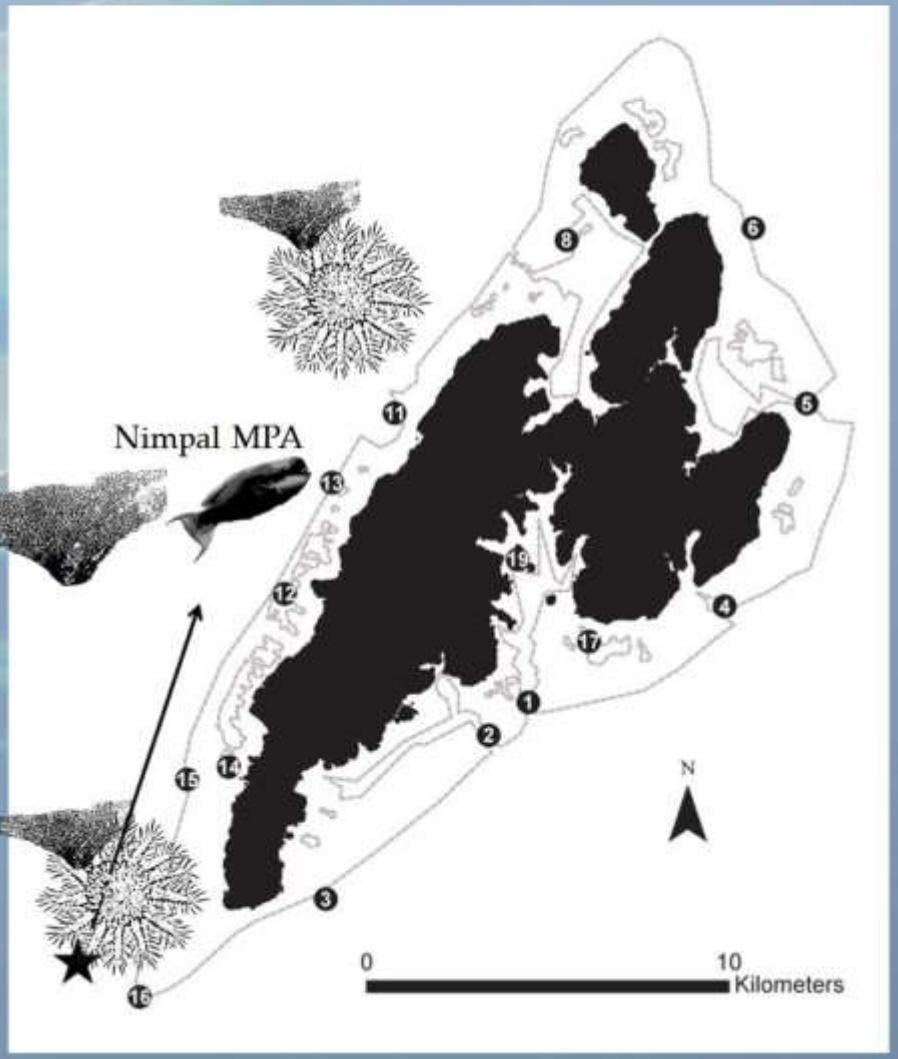
2012

Data: CNMI Marine Monitoring Team

Benefits of successful MPA

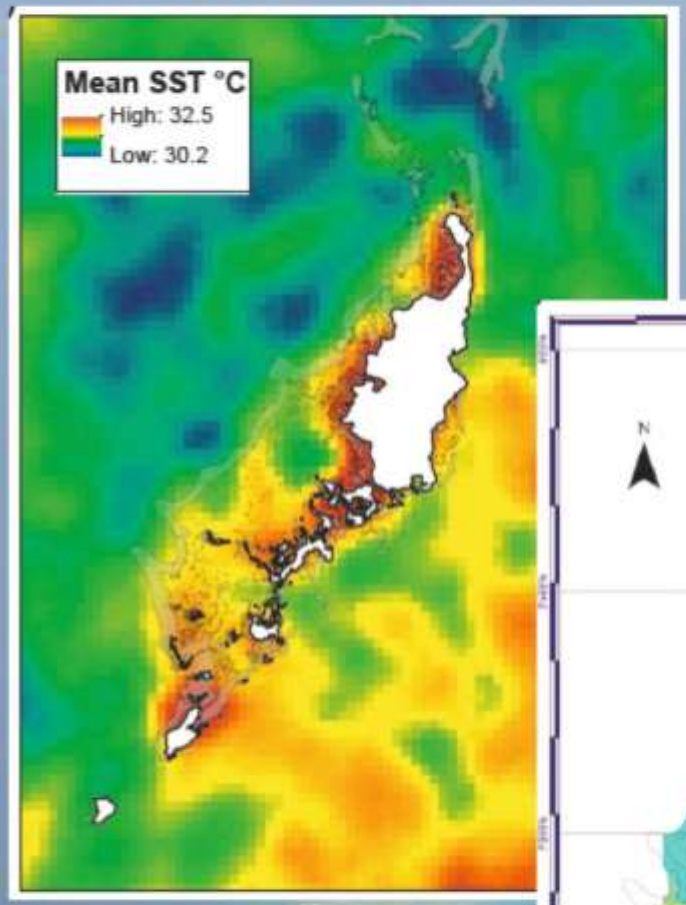
- Beyond fish biomass

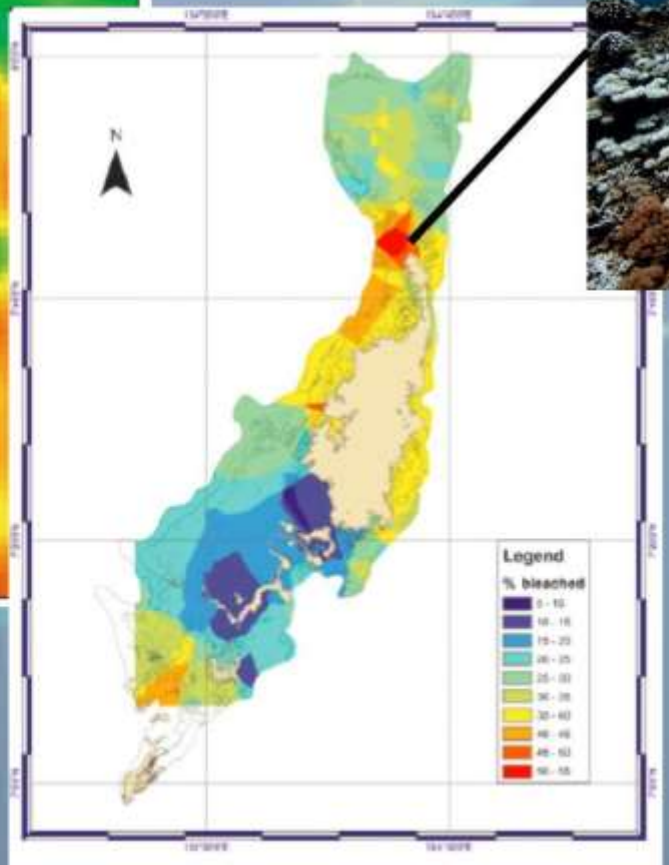




Source: *Houk, Benavente, and Fread, 2012-Biol Conserv*
Sweatman, 2008-Curr Biol; McCook et al. 2010, PNAS similar findings

Identifying resilient habitats in Palau after a second major bleaching event

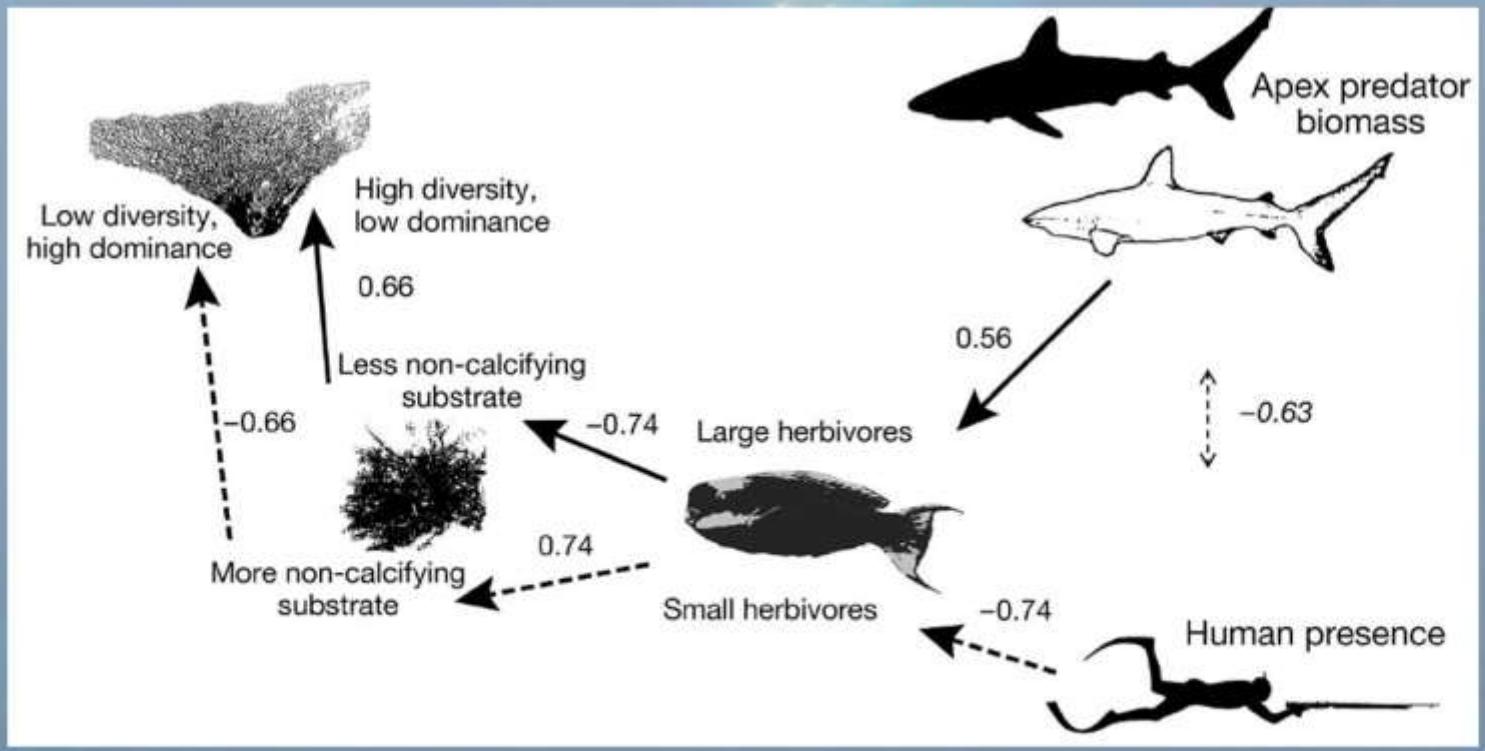




Long-term mean SST (top), 2010 bleaching prevalence (right)

Photo: Ian Shive
Source: *van Woesik, et al. 2012, Ecol Evol*

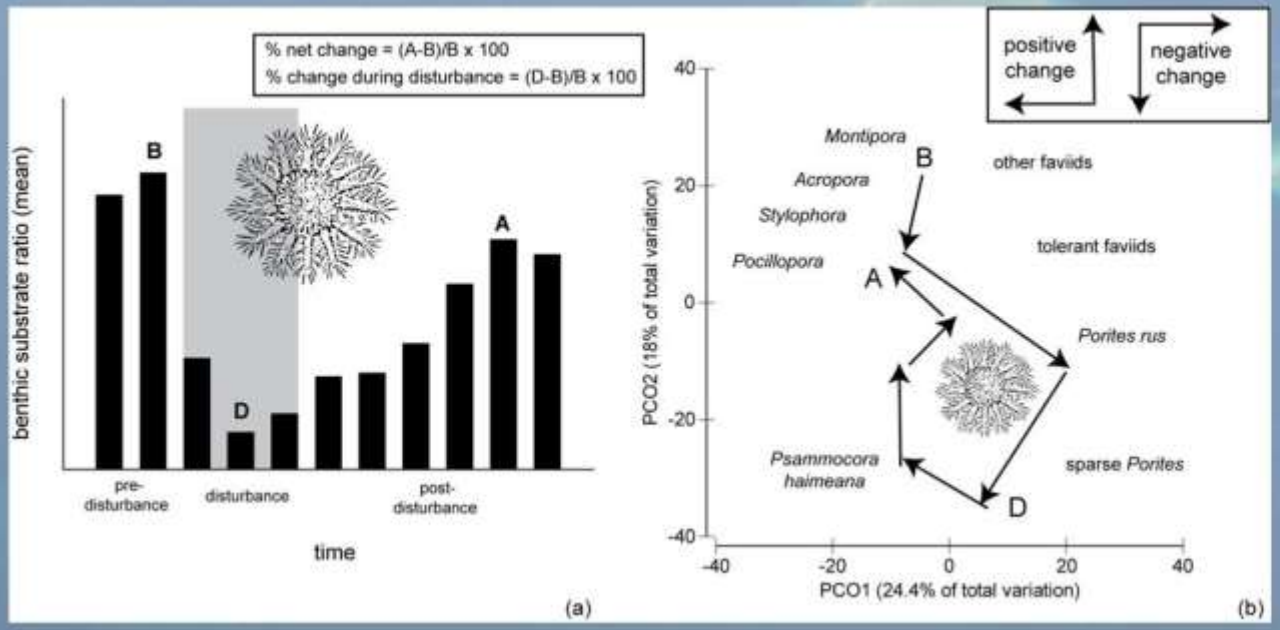
Strength and magnitude of trophic pathways across the Marshall Islands

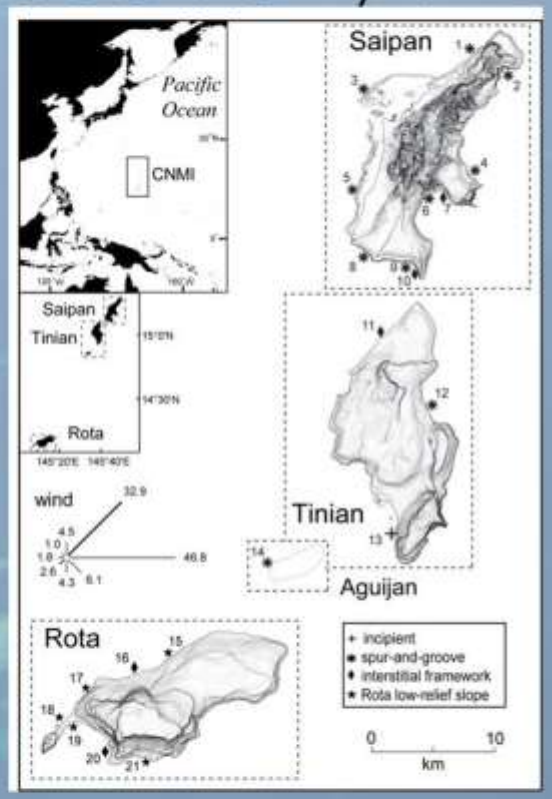


Source: *Houk and Musburger 2013-MEPS*

What drives the magnitude of reef decline and rate of recovery?

- 12 year monitoring dataset in CNMI

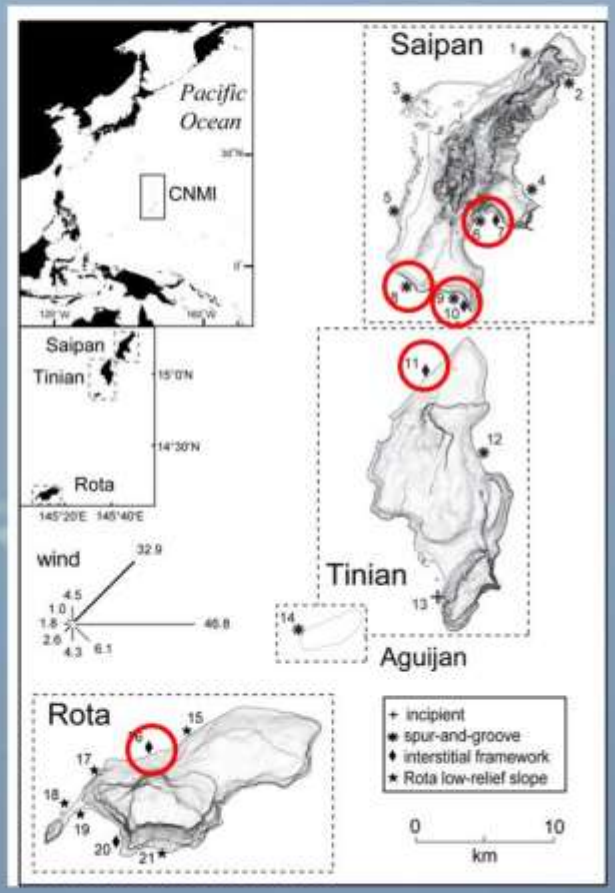




What drives the magnitude of reef decline and rate of recovery?

- Decline
  - COTS abundance (~50%)
  - Wave exposure, fish abundance (upto 68%)
- Recovery
  - Wave exposure (~40%)
  - Herbivore populations (upto 74%)
  - Watersheds (upto 83%)

Science driving focused management recommendations and actions



Biggest problems with leeward sites with small herbivore populations

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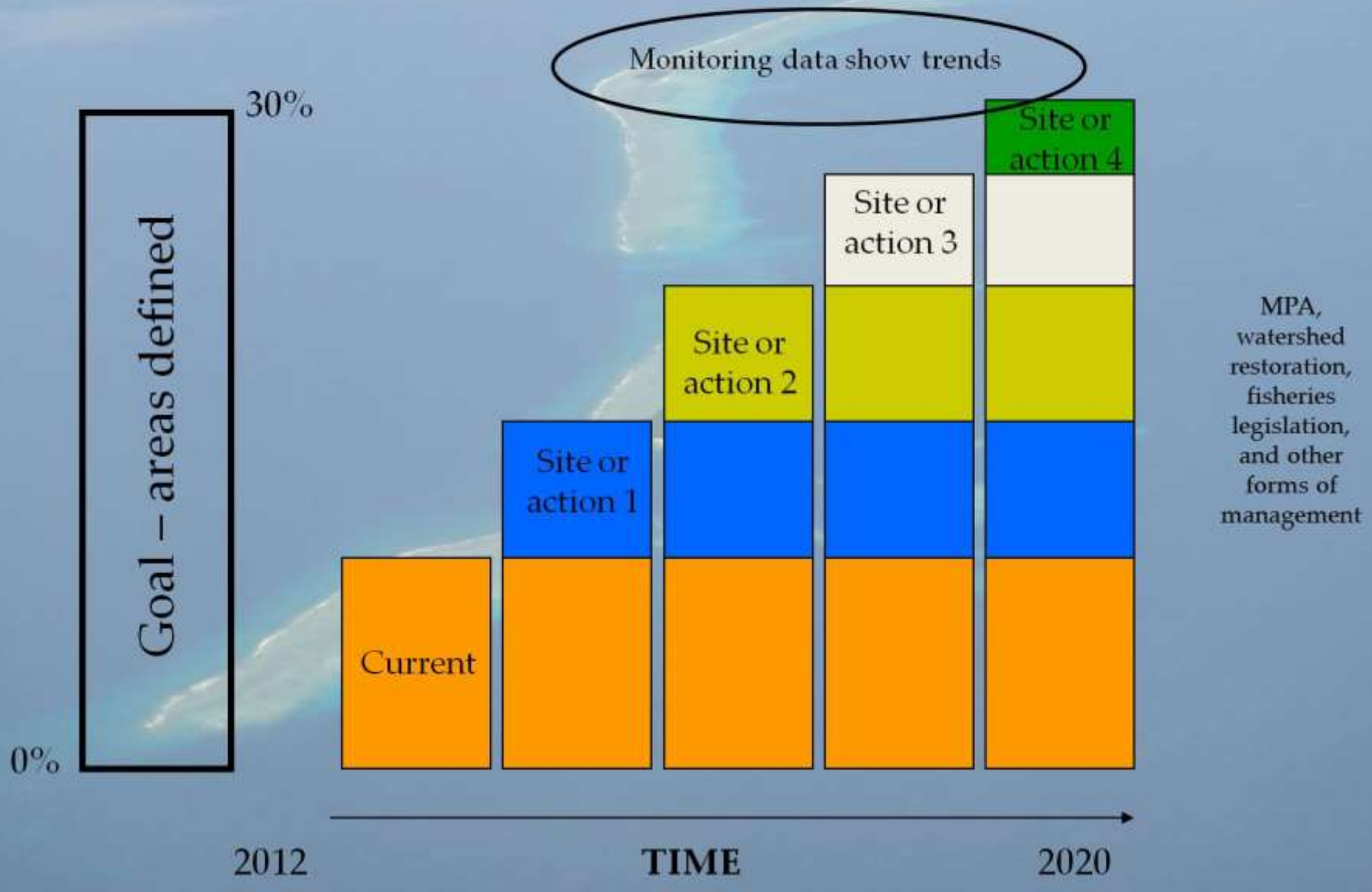
Percent of monitoring sites with supporting biological trends



Evaluation approach

Individual metrics
(MC measure group)

Mean herbivore size

Predator biomass

Calcifying substrates

Turf and macroalgae

Species diversity

Assemblage heterogeneity

Standardize metrics, PCA process for each latent variable

Latent variables

Reef fisheries

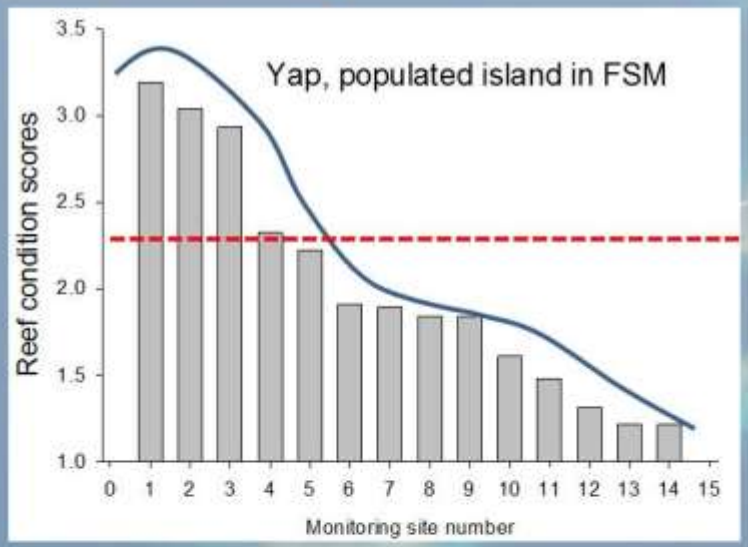
Benthic substrates

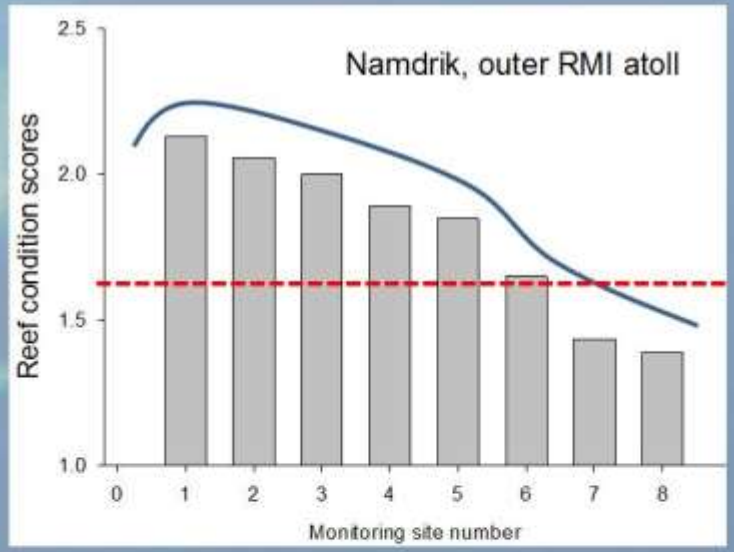
Coral assemblages

Take mean scores of each latent variable

Ecosystem condition

Distribution of reef condition is key

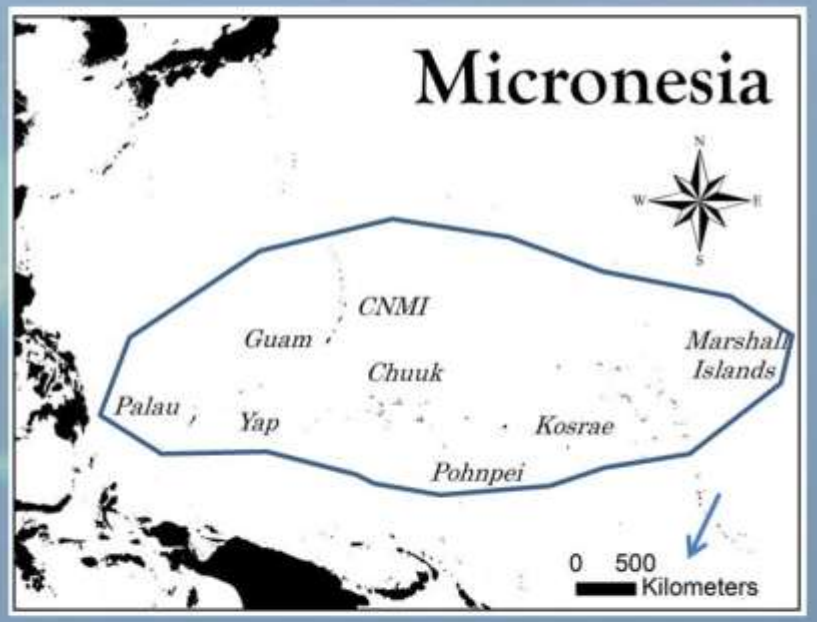




"Effective" conservation thresholds

Many challenges remain

- Spatial scale
- Capacity building for local teams
- Continued integration of all local teams across Micronesia
- Sustainable funding for monitoring and implementation



Many essential partnerships

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