

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"

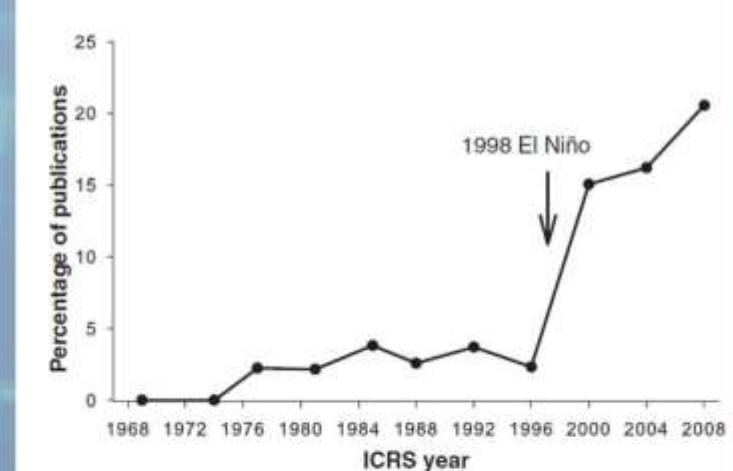
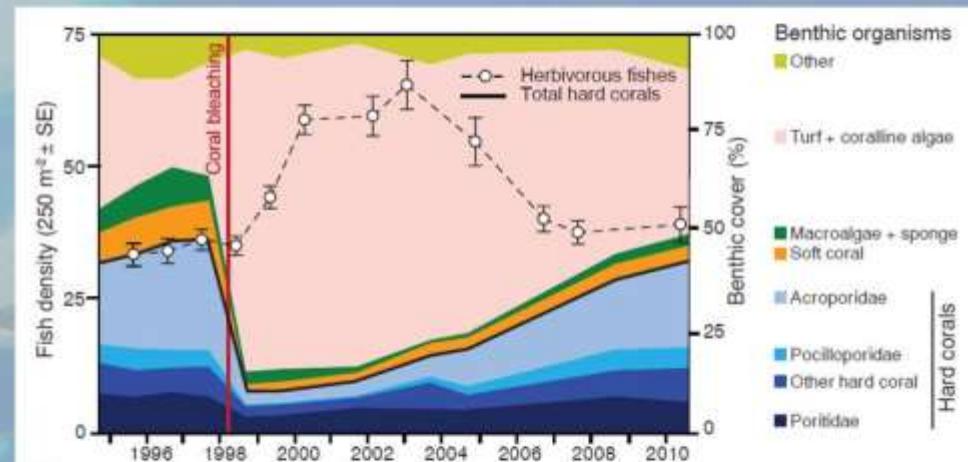


Figure 1. Statistics generated from keyword searches in the International Coral Reef Symposia (ICRS) table of contents.

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

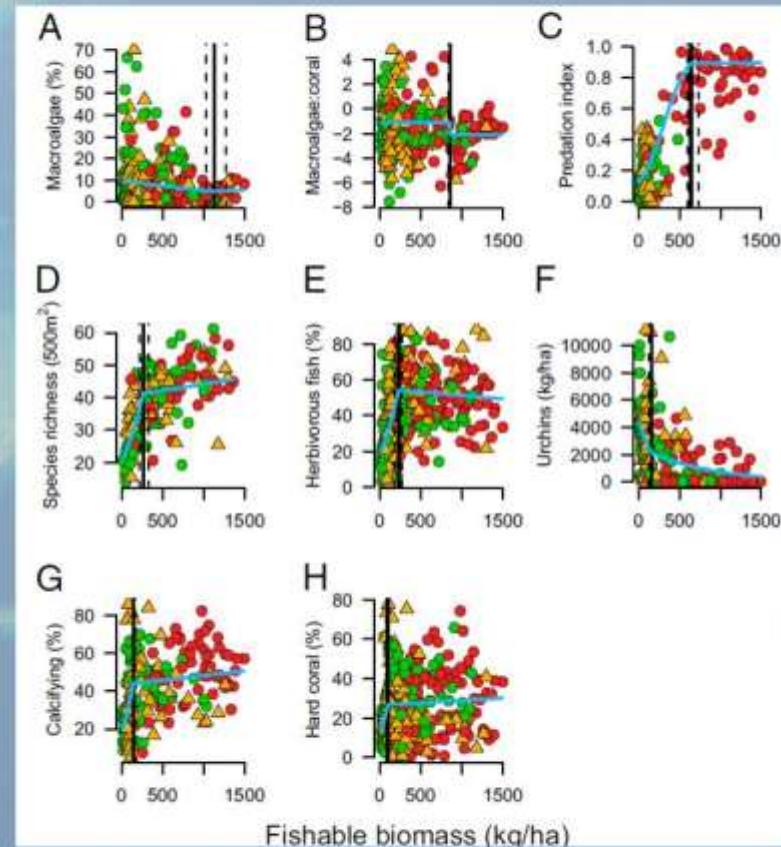
- Not common for most island nations
- But, when present their utility very insightful



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

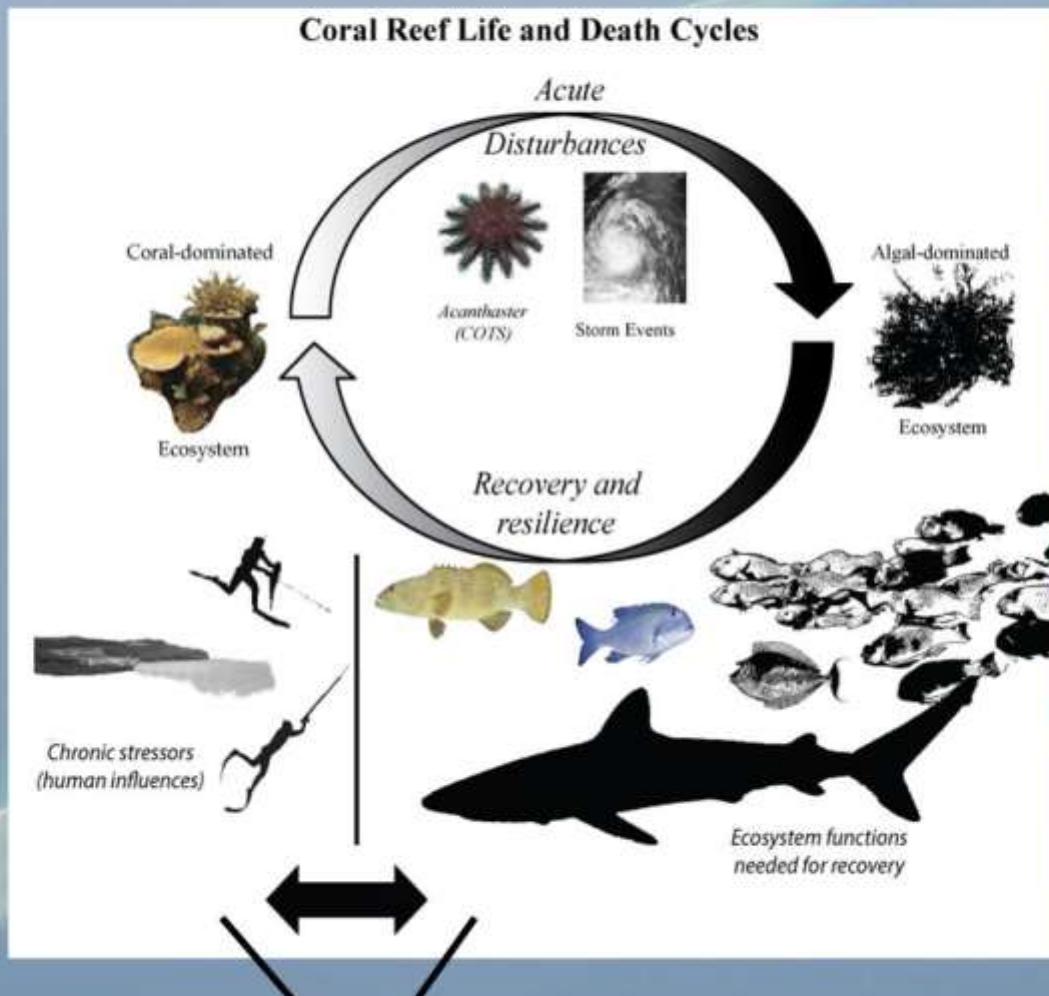
Trends across large spatial scales equally influential

- 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

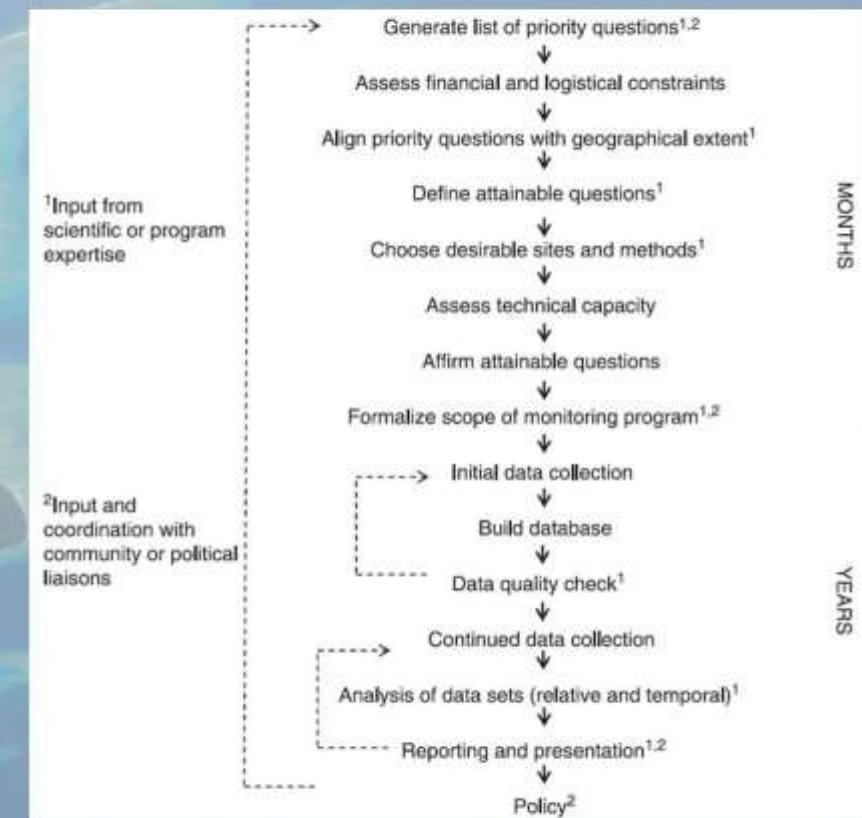
Using temporal and spatial frameworks, we can also learn from disturbance cycles



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

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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



An aerial photograph showing a series of coral reefs or atolls extending from the bottom left towards the top right. The reefs are bright white against the deep blue ocean water. The image has a slightly hazy, overexposed quality.

“Effective” conservation?

Disturbance and recovery cycles are basis



Disturbance event
(predator starfish)



Effectively managed



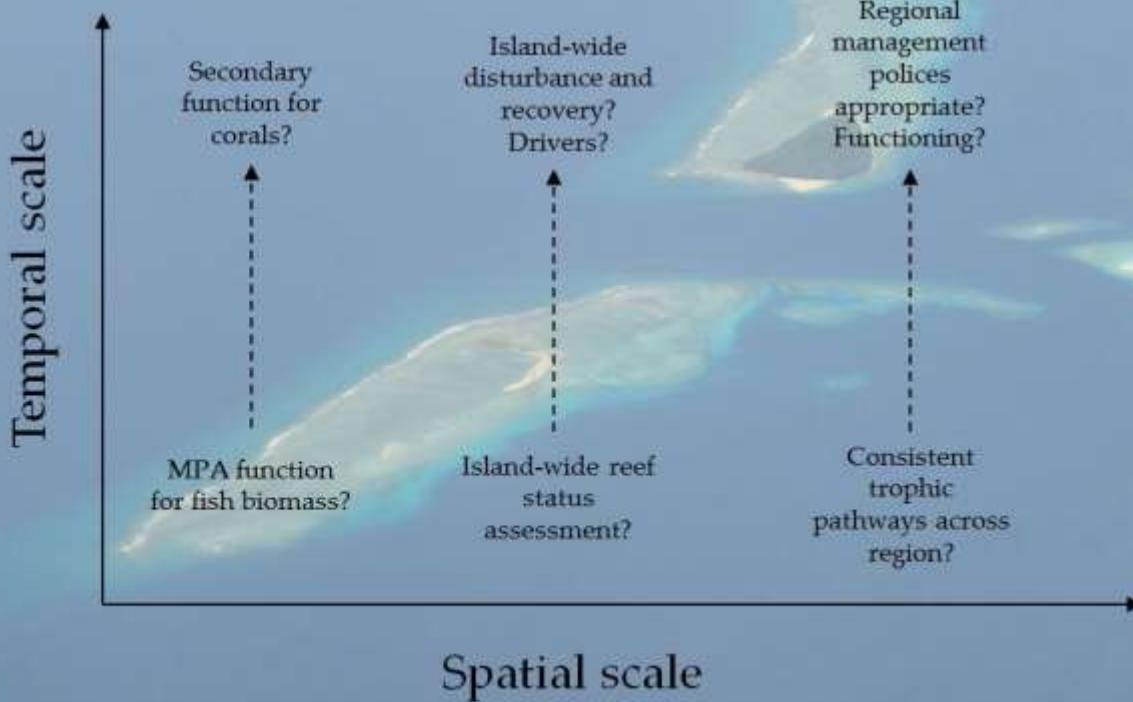
Not effectively managed

The background image shows an aerial view of a vast coral reef system, likely the Great Barrier Reef. It features numerous small, low-lying islands (cays) and larger, more prominent island groups (atolls) surrounded by shallow, light blue lagoons. The surrounding ocean is a deeper shade of blue.

Design monitoring

Question-driven monitoring designs

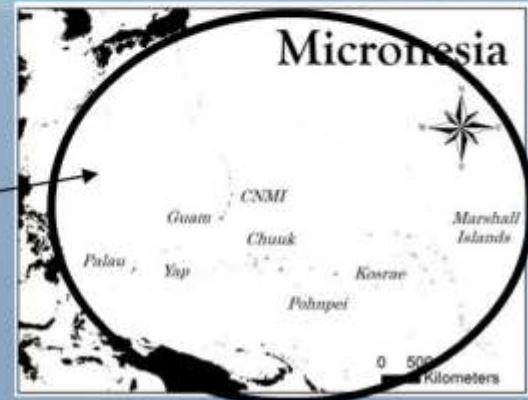
- Regional working group together prioritized questions/needs



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?



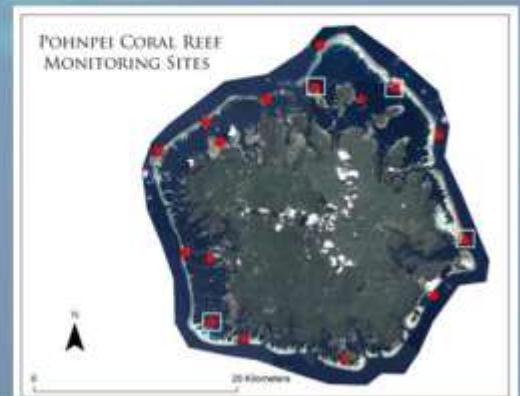
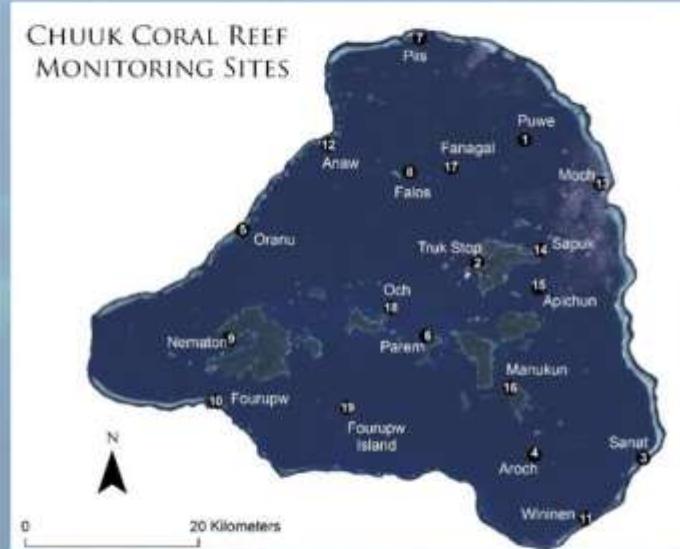
What habitats most sensitive to climate change (OA, bleaching, etc.)?



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

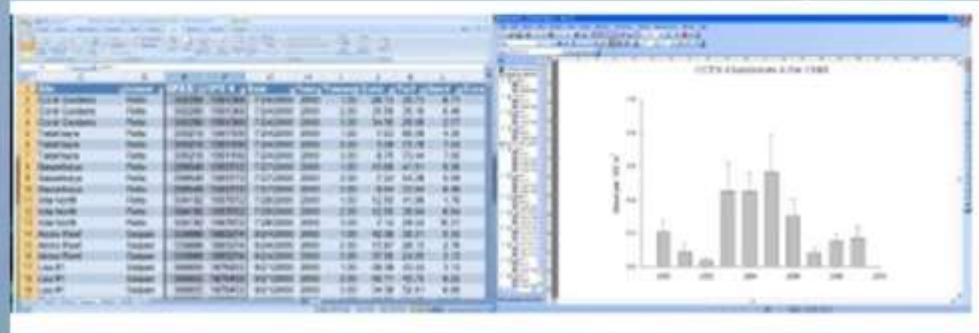


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Shared learning, science, and outreach



Welcome to the Micronesia Challenge benthic database. As a user, you have access to the latest, quality assurance and controlled, benthic substrate datasets collected by regional monitoring programs. The master database is updated regularly as new data are generated. Data reports are provided to you as Excel files. Within each output file there are three Excel sheets: The first sheet is set up with all the raw data, alongside some of the most relevant metadata, in a format conducive for efficient querying using "Pivot Tables". The second sheet has the data prepared for import to the PRIMER software package. The third sheet has all the relevant metadata.

Report Page

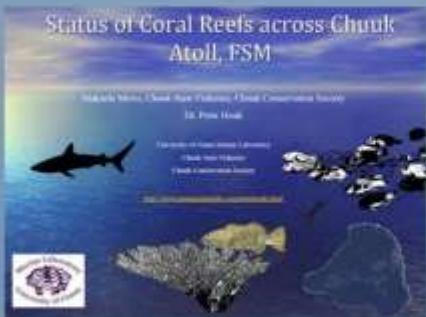
admin
uploads
reports
about
legend

Subregions:

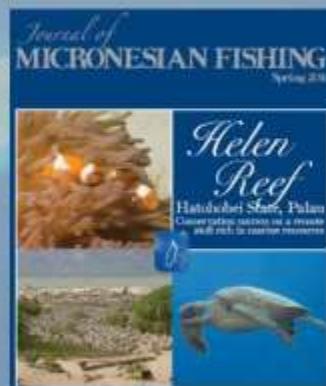
- P: Pohnip
- D: Ulithi
- R: Kosrae
- N: Ngap
- M: Majuro
- B: Rongelap
- S: Saipan
- F: Federated States of Micronesia

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

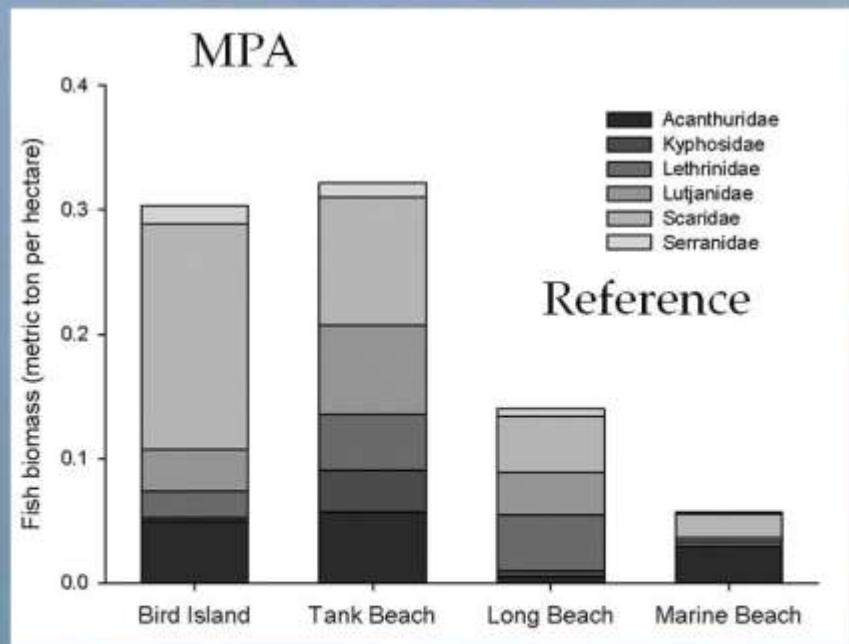
Peter Honk · David Benavente · Vanessa Fread

Generate credible science, and translate

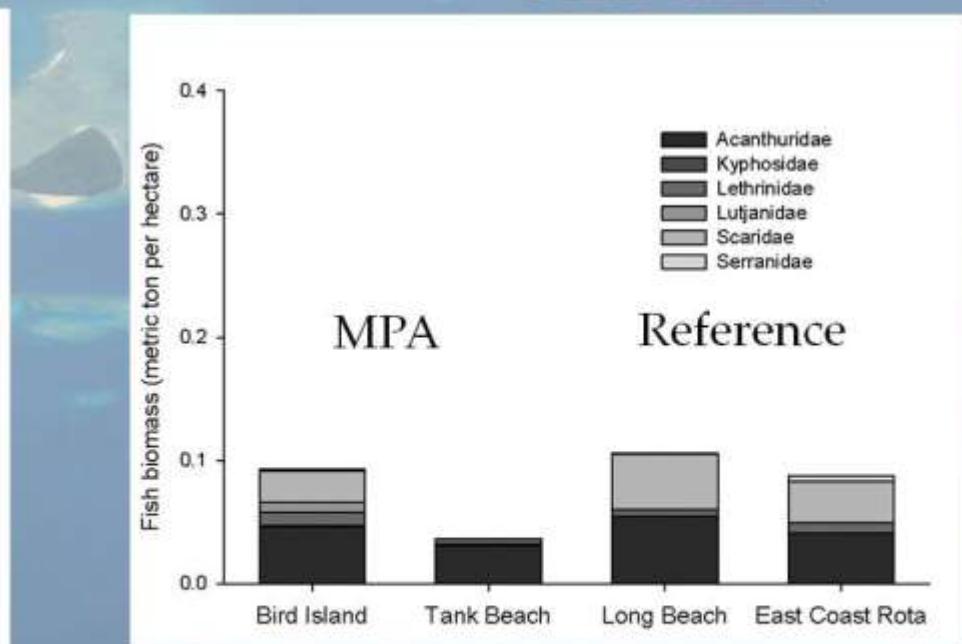
The background image shows a large, irregularly shaped coral reef atoll in the middle of a vast, clear blue ocean. The reef structure is composed of light-colored, sandy landmasses and darker, more vegetated areas. Several small, isolated islets or sandbars are scattered across the surrounding water. The overall scene is one of natural beauty and geological complexity.

Some interesting examples

MPA enforcement needs



2010

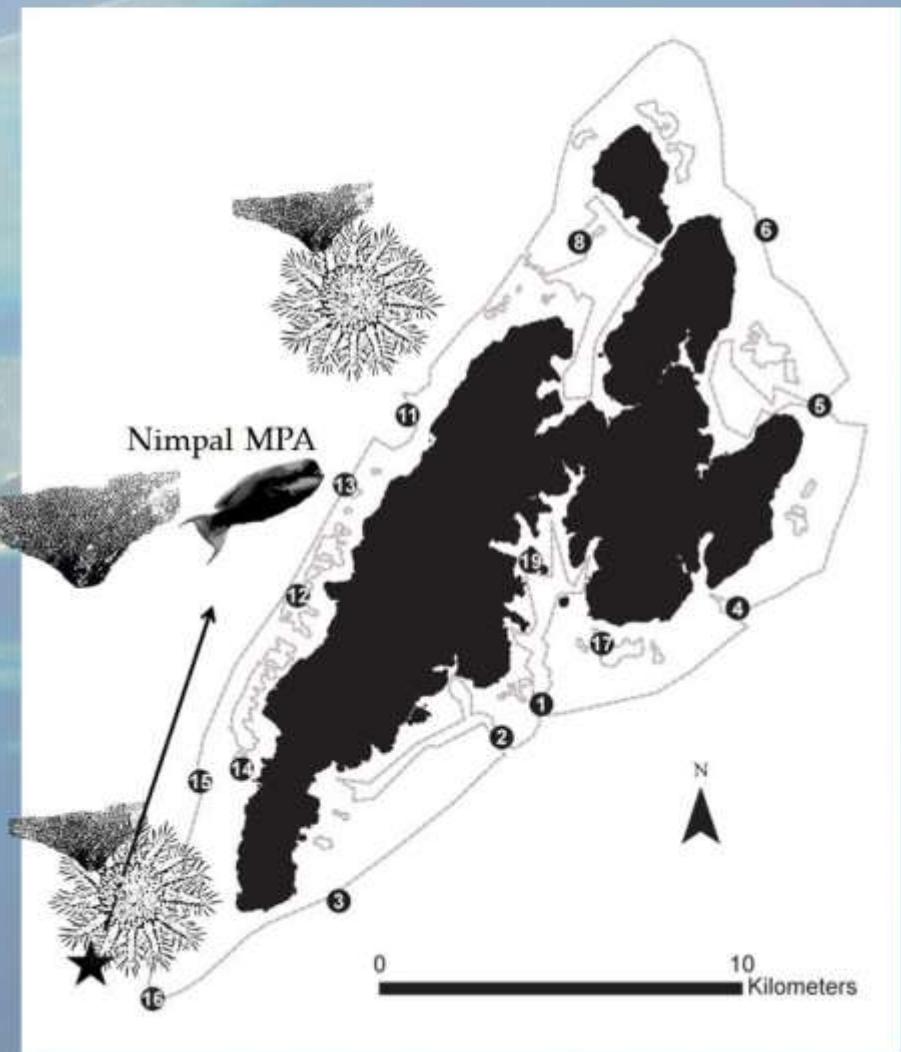
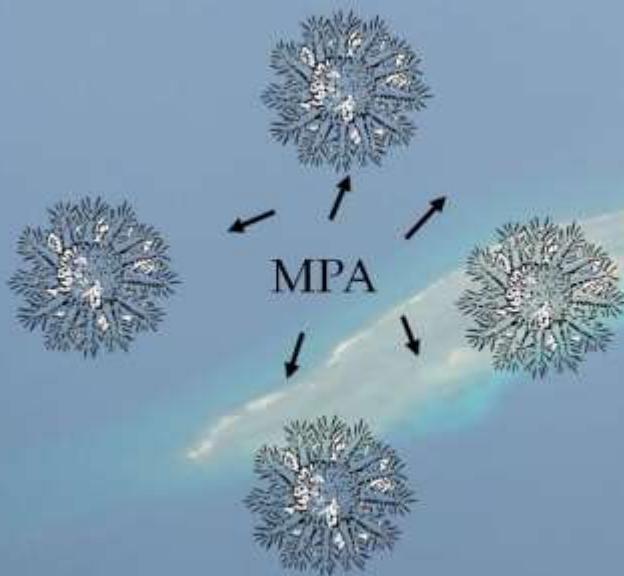


2012

Data: CNMI Marine Monitoring Team

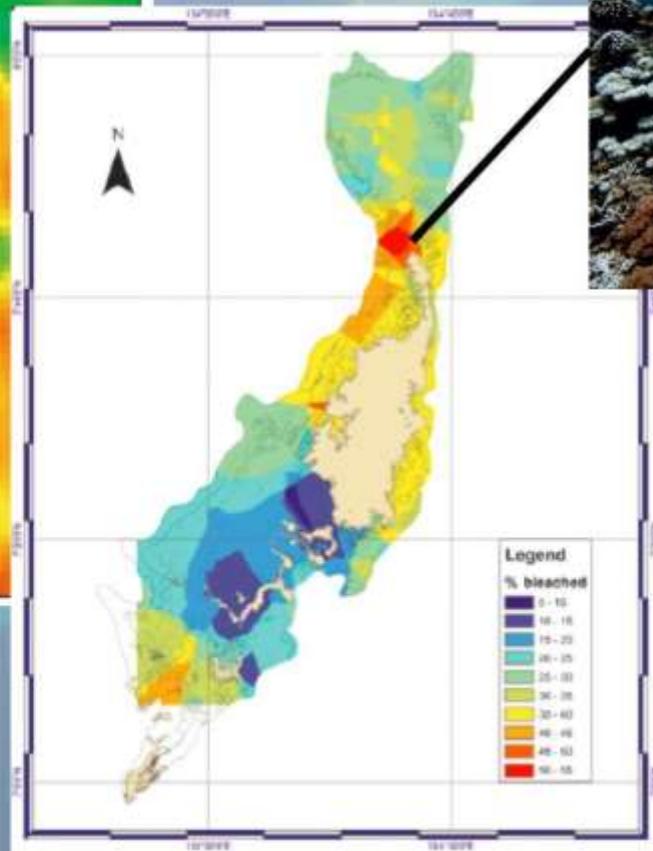
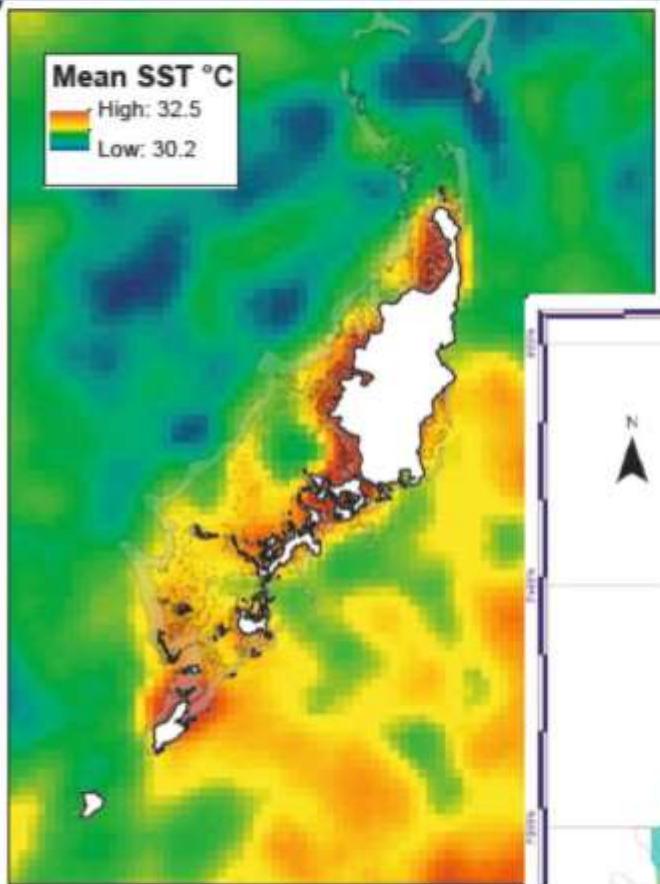
Benefits of successful MPA

- 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



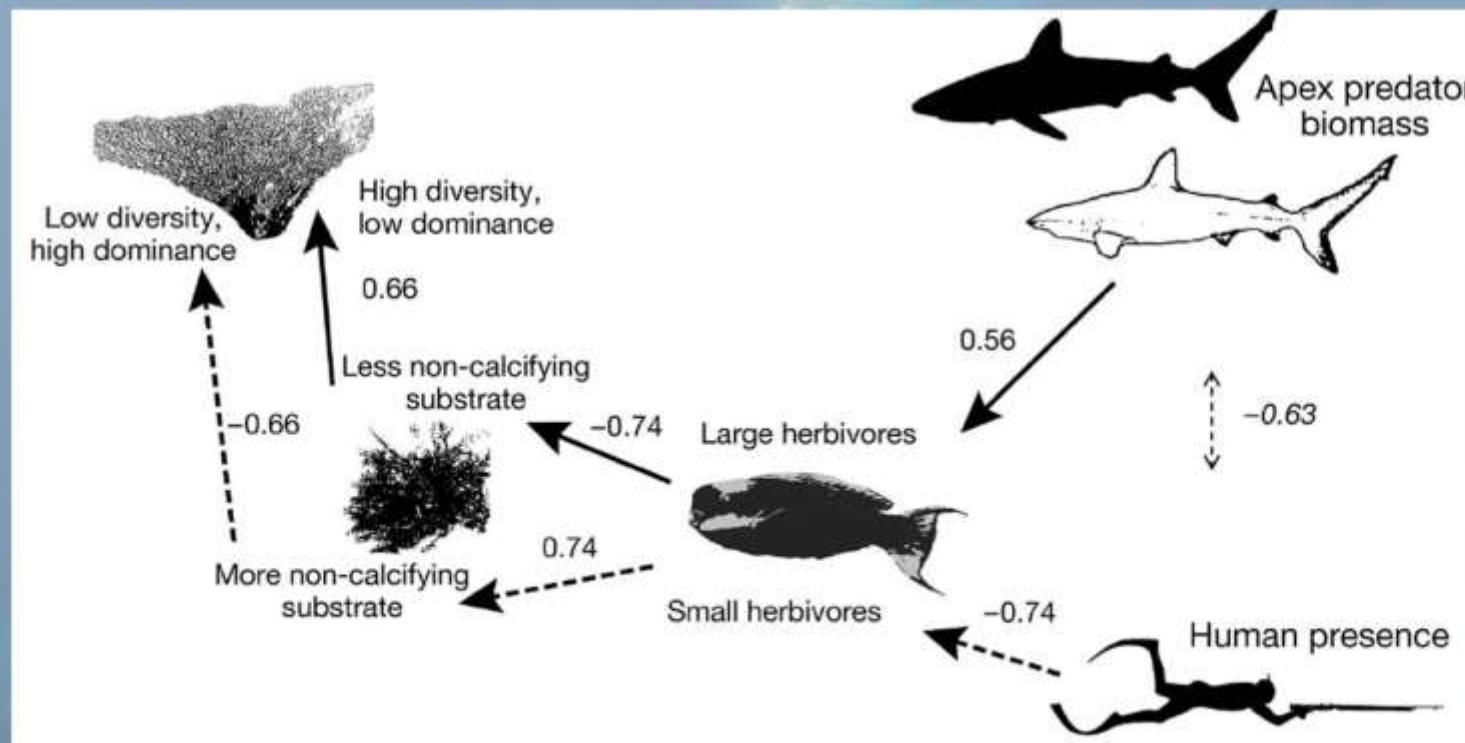
Long-term mean SST (top), 2010 bleaching prevalence (right)



Photo: Ian Shive

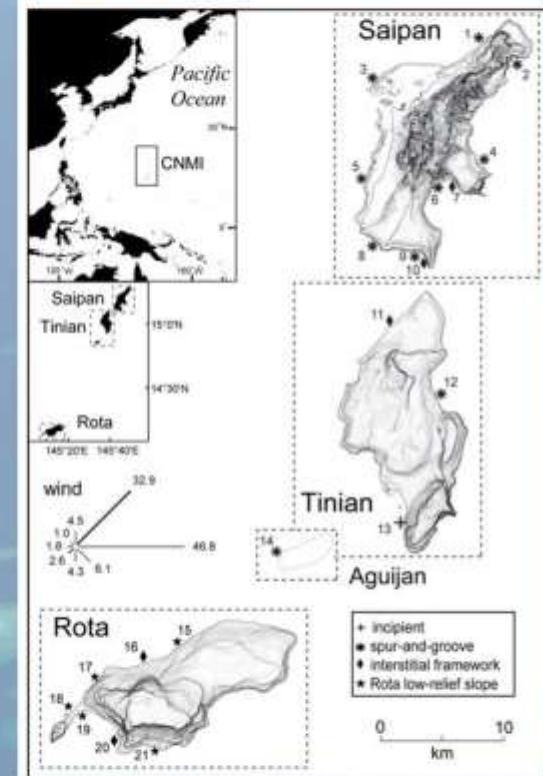
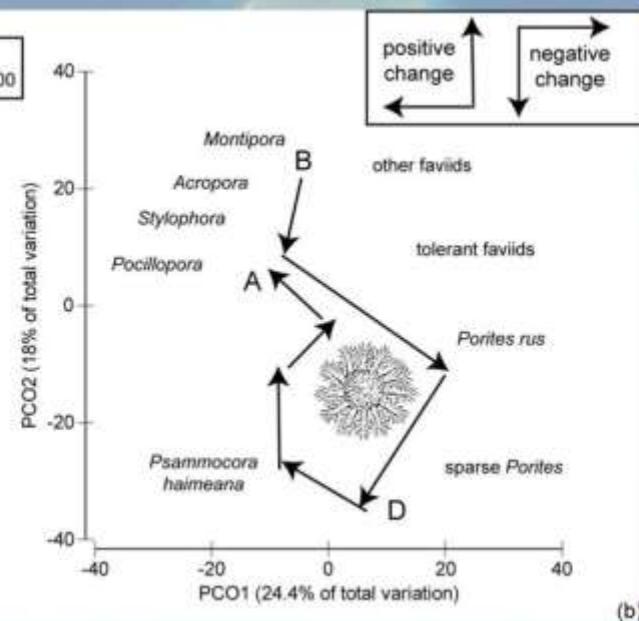
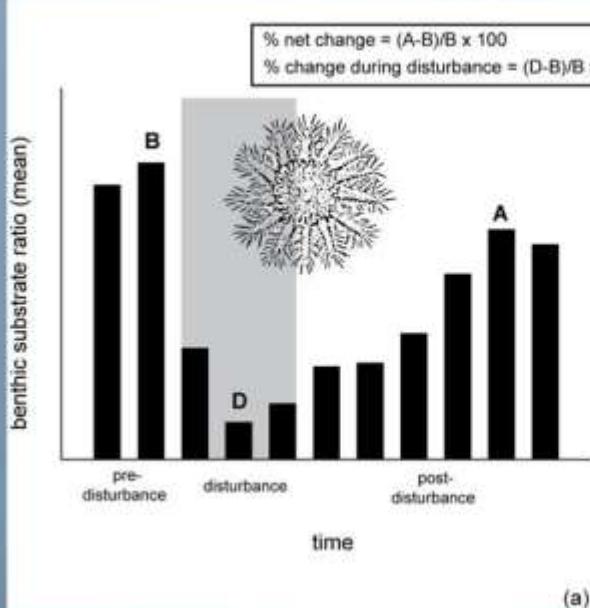
Source: van Woesik, et al. 2012, *Ecol Evol*

Strength and magnitude of trophic pathways across the Marshall Islands



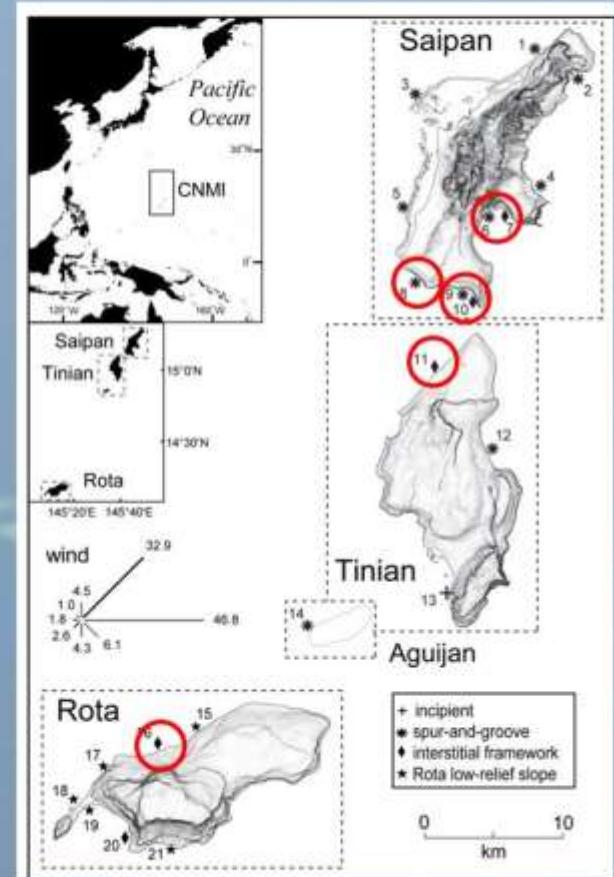
What drives the magnitude of reef decline and rate of recovery?

- 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

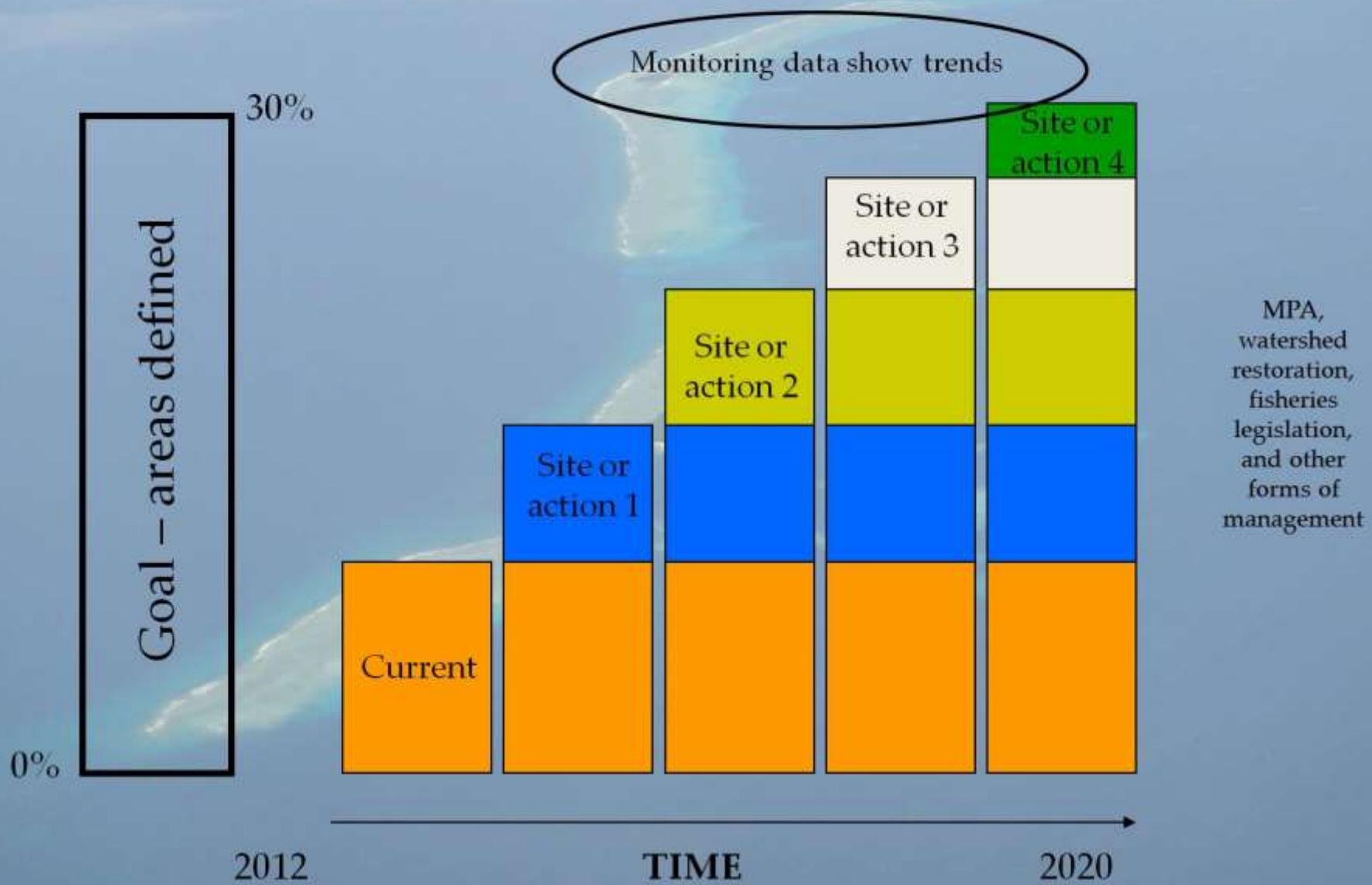
Biggest problems with leeward sites with small herbivore populations

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Percent of monitoring sites with supporting biological trends



Evaluation approach

Individual metrics
(MC measure group)

Standardize
metrics, PCA
process for
each latent
variable

Latent variables

Take mean
scores of each
latent variable

Mean
herbivore size

Predator
biomass

Reef fisheries

Calcifying
substrates

Turf and
macroalgae

Benthic
substrates

Species
diversity

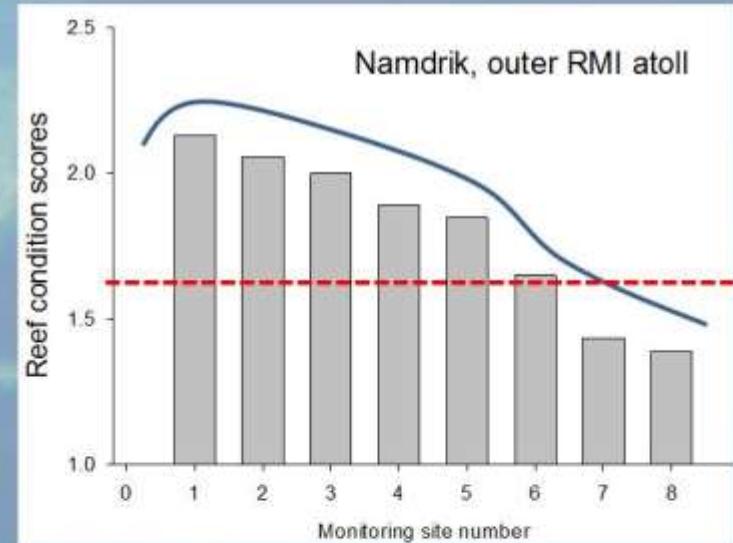
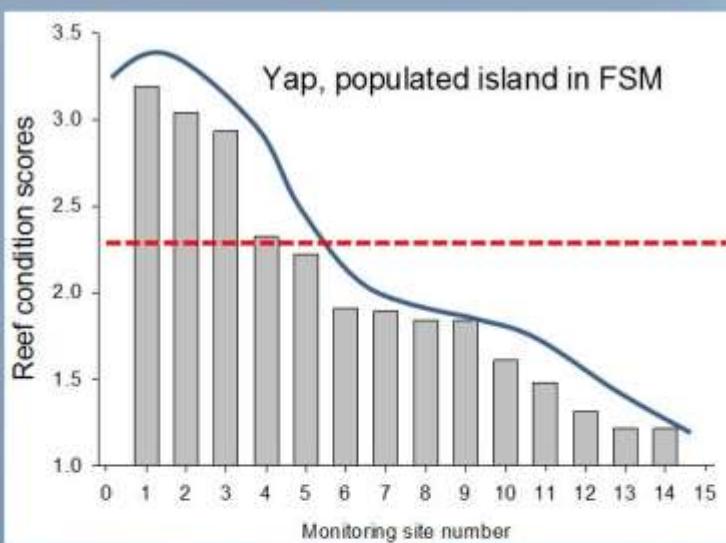
Assemblage
heterogeneity

Coral
assemblages

Ecosystem
condition



Distribution of reef condition is key

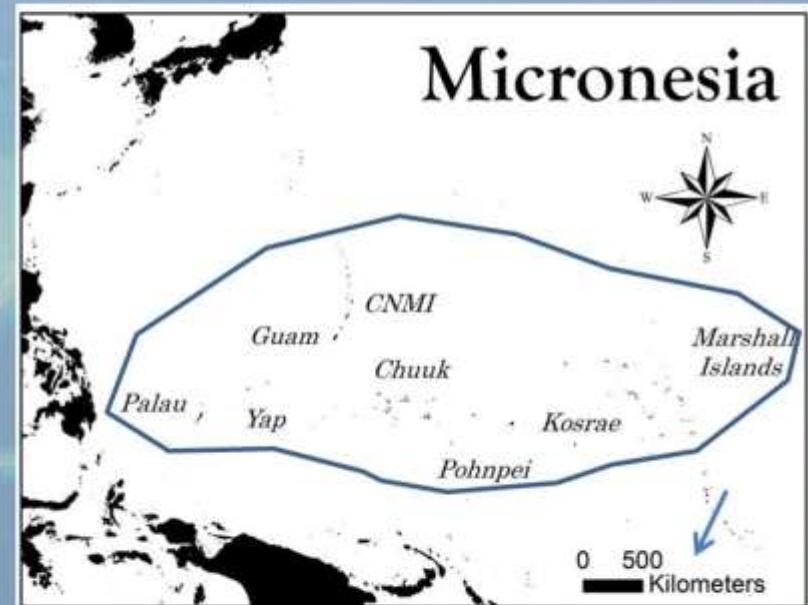


"Effective" conservation thresholds



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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