Easygrants ID: 43142

National Fish and Wildlife Foundation NFWF Project ID: 0302.14.043142

Coral Reef Conservation Fund 2014 - Submit Final Programmatic Report (New Metrics)

Grantee Organization: Central Caribbean Marine Institute

Project Title: Enhancing Capacity for Coral Reef Resilience Management in the Cayman Islands

Project Period 7/01/2014 - 6/30/2015

Project Location Description (from Proposal) We have a unique opportunity to study factors leading to coral reef resiliency due to a rapid 40% increase in corals from 2009 to 2012 surrounding Little Cayman, where our research centre is located.

Project Summary (from Proposal) Improve ecosystem-based management of coral reef habitats around Little Cayman which have higher resilience to change, including to ocean acidification. Project will enhance capacity of local reef managers.

Summary of Accomplishments

A vulnerability assessment framework was used to compare reef sites in the Cayman Islands. The framework combined both exposure and resilience to assess relative vulnerability. Remote sensing data and climate models were used to map historic and projected future exposure to disturbances in the Cayman Islands. These analyses suggest that of the three Cayman Islands, Little Cayman has been the least exposed to temperature stress (last 30 years) and is projected to have the latest exposure to annual bleaching conditions in the future.

We conducted in-water surveys of sessile, benthic reef organisms (e.g. corals, algae, sponges) and of fish at 16 sites around Little Cayman. These extensive surveys detailed the distribution of five Ecologically Distinct and Globally Endangered (EDGE)coral species, two IUCN Red Listed coral species, and their surrounding community structures.

The remote sensing and in-water data were incorporated into our ecological assessment which identified those habitats that may be more capable of buffering the potential impacts of climate change. Sites with greater resilience are higher priorities for conservation, are more suitable for bleaching monitoring and recovery surveys, and are expected to have higher survivorship during reef restoration/coral translocation.

Our results were discussed in a workshop setting with Cayman Island's Department of Environment staff and are being used to defend their proposed MPA boundary expansions.

Lessons Learned

Vulnerability-based decision-support frameworks that combine remote sensing, climate modeling, and ecological resilience assessments are increasingly needed. However, guidance is lacking on how to combine these disparate information layers to identify high-priority conservation areas most likely to benefit from management as disturbance frequencies increase under climate change. Other conservation organizations could adapt our process to their own data and use similar prioritization schemes to develop unique solutions to local and regional conservation challenges.

Resilience assessments are necessarily relative; i.e., sites are compared only to sites included within the analysis. The consequence is that the data have to be re-analyzed if more sites are included at a later date. We learned this early and have set up our data tables to ensure more sites can be added to our analytical framework with minimal data processing time and costs.

We have written the first spreadsheet-based algorithms to automate the calculation of herbivore biomass in g/100m2 for data collected and stored using AGRRA protocols. Other conservation organizations could benefit from use of our algorithm.

Our Coral Reef Early Warning System (CREWS) buoy records long-term environmental data which are not easily accessible to the general public. We have created "dashboards" to provide 60-day snapshots of the data which may be used by students, local stakeholders, and other interested parties.

Activities and Outcomes

Funding Strategy: Capacity, Outreach, Incentives
Activity / Outcome: Coral - Building institutional capacity - # FTE with sufficient training
Description: Enter the number of staff or full-time equivalents with sufficient training and skills engaged in conservation activities
Required: Recommended
FTE with sufficient training - Current: 0.00
FTE with sufficient training - Grant Completion: 13
Notes: CCMI chaired a workshop at the Department of Environment (DoE) of the Cayman Islands Government in May 2015. We shared the results of the historic and projected future exposure mapping exercises as well as our ecological resilience assessment and resultant decision-support framework. We described how to set criteria to query our data to identify target sites near Little Cayman for various management actions such as (i) CONSERVATION based on reef resilience potential, which can be used to defend and support DoE recommendations for expanding Marine Protected Area boundaries which have recently been published for public comment before adaptation, (ii) CORAL BLEACHING MONITORING and reef DISTURBANCE RECOVERY site selection prioritization based on bleaching resistance and herbivore biomass, and (iii) REEF RESTORATION and CORAL TRANSPLANTATION based on coral diversity, macroalgae cover, favorable substrate, and herbivore biomass. We are discussing plans with our manager partners for potential expansion of the project to include ecological resilience assessments for the reefs near Grand Cayman Island and Cayman Brac.

The DoE managers with whom we discussed our work were very excited by both the project results and the approach used. We held break out sessions with hands-on demonstrations of the decision-support tool using DoE's long term coral reef data. We continued with post-workshop support via emails and Skype. Our capacity building activities with Cayman Islands DoE managers provided sufficient training for the attendees to independently undertake ecological resilience assessments of coral reefs, compile and analyse the data, and use the data to identify targets for various management actions. We provided DoE with the workshop presentation (included with this report as an uploaded document) so they may conduct internal training.

Our target was to have 10 FTE with sufficient training to conduct resilience assessments similar to this one. We have exceeded this target by now having eight DoE and five CCMI employees with sufficient training.

Funding Strategy: Capacity, Outreach, Incentives
Activity / Outcome: Coral - Outreach/ Education/ Technical Assistance - # people reached
Description: Enter the number of people reached by outreach, training, or technical assistance activities
Required: Recommended
people reached - Current: 0.00
people reached - Grant Completion: 10000.00
Notes: Our goal was to reach 2000 people through outreach, education, and technical assistance; however, we believe we have reached over 10,000 people. Project information was posted on CCMI's website and on our Facebook page which has 2700+ followers. The broadest outreach came from press releases and news interviews.

A newspaper article "Scientists explore secret of Little Cayman's coral reef success" was published in the Cayman Compass, which has a circulation of 10,000.
http://www.compasscayman.com/caycompass/2014/12/30/Scientists-explore-secret-of-Little-Cayman-s-coral-reef-success/

A similar newspaper article "National Fish and Wildlife Foundation supports CCMI's research" was published in the Cayman Reporter a free newspaper which also posts daily updates on its website and mobile apps.
http://www.caymanreporter.com/2014/12/29/national-fish-wildlife-foundation-supports-ccmis-research/

Cayman 27, the national television channel, aired a piece which detailed this project.
http://www.cayman27.com.ky/2015/04/29/into-the-blue-ccmi-surveys-caymans-reef

Funding Strategy: Habitat Management
Activity / Outcome: Coral - improved management practices - Miles under improved management
Description: Enter the number of miles under improved management
Required: Recommended
Miles under improved management - Current: 0
Miles under improved management - Grant Completion: 10
Notes: Approximately 50% of Little Cayman Island's coastline was already under some degree of conservation management/protection at the beginning of this project. The results from CCMI's exposure and vulnerability assessments were shared with the Cayman Islands Department of Environment and may be used to support and defend DoE's proposed Marine Protected Area boundary expansions. The hope is that, following public comment, as much as 75% of Little Cayman's coastlines will be protected within the Marine Park system. The additional area under improved management would be equivalent to ~10 miles.

Funding Strategy: Habitat Management
Activity / Outcome: Coral - improved management practices - Acres under improved management
Description: Enter the number of acres under improved management
Required: Recommended
Acres under improved management - Current: 0
Acres under improved management - Grant Completion: 1200
Notes: Approximately 2400 acres (50%)of Little Cayman Island's marine environment was already under some degree of conservation management/protection at the beginning of this project. The Cayman Islands Department of Environment has proposed extended MPA boundaries which would increase protection from 50% to 75%. The increased acreage under improved management is expected to be ~1200 acres.

Funding Strategy: Planning, Research, Monitoring
Activity / Outcome: Coral - Tool development for decision-making - # tools developed
Description: Enter the number of tools developed
Required: Recommended
tools developed - Current: 0
tools developed - Grant Completion: 1
Notes: The primary tool developed for this project was the vulnerability assessment framework.

Other resources which may also be considered as "tools" include the (i) excel spreadsheet which easily calculates total fish biomass and herbivore biomass using the standardized AGRRA fish survey data and format and (ii) the CREWS data dashboards which provide 60-day snapshot views of oceanic and atmospheric data recorded by the Little Cayman CREWS buoy.

The following pages contain the uploaded documents, in the order shown below, as provided by the grantee:

Photos - Jpeg
Photos - Jpeg
Photos - Jpeg
Final Report Narrative - Marine
Other Documents

The following uploads do not have the same headers and footers as the previous sections of this document in order to preserve the integrity of the actual files uploaded.

Final Programmatic Report Narrative

Instructions: Save this document on your computer and complete the narrative in the format provided. The final narrative should not exceed ten (10) pages; do not delete the text provided below. Once complete, upload this document into the online final programmatic report task as instructed. **Please note** that this narrative will be made available on NFWF's Grants Library and therefore should provide brief context for the need of your project and should not contain unexplained terms or acronyms.

Project Title: Enhancing Capacity for Coral Reef Resilience Management

1. Summary of Accomplishments

In four to five sentences, provide a brief summary of the project's key accomplishments and outcomes that were observed or measured. This can be duplicative to the summary provided in the reporting 'field' or you can provide more detail here.

A vulnerability assessment framework was used to compare reef sites in the Cayman Islands. The framework combined both exposure and resilience to assess relative vulnerability. First, remote sensing data and climate models were used to map historic and projected future exposure to disturbances in the Cayman Islands. These analyses suggest that of the 3 Cayman Islands, Little Cayman has been the least exposed to temperature stress (last 30 years) and is projected to have the latest exposure to annual bleaching conditions in the future. Our ecological resilience assessment in Little Cayman identified sites with greater relative resilience that are high conservation priorities, as well as targets for bleaching monitoring and supporting recovery and reef restoration/coral translocation. The results were discussed in a workshop setting with Cayman Island's Government Department of Environment staff and are being used to inform and defend the planning of new MPAs in Little Cayman. The results have also been built into numerous education and outreach programs at the Central Caribbean Marine Institute (CCMI) on Little Cayman.

2. Project Activities & Outcomes

Activities

- Describe the primary activities conducted during this grant and explain any discrepancies between the activities conducted from those that were proposed.

Analyzed NOAA Pathfinder v5.2 sea surface temperature dataset to identify spatial patterns in the Cayman Islands in historic (1985-2012) exposure with respect to: warm season temperature variability, frequency of thermal stress events (>4 Degree Heating Weeks), rate of change in annual average temperatures, rate of change in warm season temperatures. Map graphics and spatial data layers were produced for display of the data and further analysis.

Used 33 climate models within an ensemble forced with the fossil-fuel aggressive RCP8.5 to produce projections of the timing of the onset of annual bleaching and severe bleaching conditions. These projection outputs were then statistically downscaled to examine spatial patterns in projected future exposure to bleaching-level thermal stress in the Cayman Islands at 4-km resolution. Map graphics and spatial data layers were produced for display of the data and further analysis.

Developed and standardized a procedure to download and disseminate of Coral Reef Early Warning System (CREWS) data from the CREWS instrument/buoy near CCMI (raw data from the CREWS buoy can be difficult for students, local stakeholders, and the general public to access, plot, and interpret). This data "dashboard" provides a simple 60-day snapshot of oceanic and atmospheric parameters – air and sea surface temperature, barometric pressure, ocean salinity, surface and underwater PAR, surface and underwater UV irradiance, relative humidity, rainfall, wind speed, and wind direction. Dashboard graphs shall be updated and posted on CCMI's website accessible from http://reefresearch.org/research/coral-reef-early-warning-system-crews/. Data accessibility requires the regular maintenance, cleaning, and calibration of the CREWS buoy and instruments which was conducted twice monthly as part of this project.

Conducted a field-based ecological resilience assessment of reefs near Little Cayman Island. 16 forereef sites were surveyed in total with near equal spatial coverage (a site roughly every 2 miles) around the island. The following resilience indicators were included: coral diversity, macroalgae cover, coral cover, bleaching resistance, coral recruitment, temperature variability, and herbivore biomass. Raw values for each of these have different units and different scales so were all normalized to a uni-directional scale of 0-1 where high scores are good scores. These scores were then averaged and re-normalised to produce the final scores for resilience potential, which are expressed relative to the site assessed as having the greatest potential. Map graphics and spatial data layers were produced for display of the data and further analysis.

Used a canonical analysis of principal coordinates to identify the resilience indicators most driving differences among sites in relative resilience potential.

Used resilience assessment results to identify targets for management actions including high-priority conservation areas, bleaching-vulnerable sites that should be monitored and may require actions to support recovery, and sites where conditions are optimal for reef restoration/coral translocation.

Chaired a workshop at the Department of Environment (DoE) of the Cayman Islands Government. We shared the results of the historic and projected future exposure mapping exercises as well as our ecological resilience assessment and resultant decision-support framework. We set other criteria to query our data to identify sites that are targets for various management actions. We discussed plans to expand the analysis completed under this project to include assessing the relative resilience of reef sites near Grand Cayman and Cayman Brac.

Built project results into the weekly lecture series and the education curriculum at the Central Carribean Marine Institute on Little Cayman. The educational materials developed include: fact sheets about resilience and climate change, handouts and posters that depict threats to coral reefs, a project overview, and a 15-minute presentation for tourists.

Outcomes

- Describe progress towards achieving the project outcomes as proposed. and briefly explain any discrepancies between your results compared to what was anticipated.
- Provide any further information (such as unexpected outcomes) important for understanding project activities and outcome results.

Our project narrative identified four long-term outcomes. Each outcome is listed below, followed by a description of our progress towards achieving the outcome.

1) Improved spatial understanding and identification of areas for improved protection of corals, and specifically EDGE and IUCN Red Listed coral species.

We used our vulnerability assessment framework to identify the island in the Caymans with the lowest historic and projected future exposure to coral bleaching conditions, which is Little Cayman Island. We then used our field-based ecological resilience assessment results to identify the sites with the greatest relative resilience potential. Our decision-support framework queried the resilience assessment results with set criteria and identified targets for conservation, bleaching monitoring and supporting recovery, and reef restoration/coral translocation.

The field-based ecological assessments followed the AGRRA protocol which includes the identification of corals species along six 10-m transects within each survey site. These records indicated the abundance (spatial ecology) of EDGE (*Orbicella annularis, O. faveolata, O. franski, Dichocoenia stokesi, Dendrogyra cylindricus,* and *Mycetophyllia ferox*) and IUCN Red-list (*Acropora cervicornis* and *A. palmata*) corals. We also conducted scouting surveys through which we identified the locations of 8 previously unknown *D. cylindricus* colonies, dozens of live acroporid colonies, and an extensive area on the northeastern side of Little Cayman with long-dead standing skeletons of *A. palmata*. The field-based assessments and scouting efforts have improved our understanding of the spatial distribution of EDGE and IUCN Red-listed corals around Little Cayman.

2) Development of a useful ranking tool (based on factors such as diversity, abundance, recruitment, health/stress, resilience) for improving ecosystem-based management of vulnerable coral species.

Our ecological resilience assessment results identified the reef sites near Little Cayman Island with greater relative resilience potential. These results were used to identify targets for ecosystem-based management that can support site and system resilience (i.e., reduce vulnerability). Our assessment approach is akin to a tool in that we have described our process in such a way that DoE staff can now undertake the analysis using their reef monitoring data.

3) New knowledge about environmental factors and processes that drive resilience.

Our canonical analysis of principal coordinates indicates that differences among sites in relative resilience potential are most greatly influenced by: macroalgae cover, bleaching resistance, coral recruitment, and herbivore biomass. Without exception, sites we assessed as having high resilience potential have high bleaching resistance, coral recruitment and herbivore biomass. We discussed with DoE staff that these factors need to be built into long-term monitoring programs throughout the Cayman Islands.

4) More engaged community of stakeholders who understand that local protection is a priority for sustaining coral reefs.

Coral reef resilience to climate change has been added to the weekly Reef Lecture Series, which is delivered at a dive resort in Little Cayman. The objectives and findings of the study are also being shared with visiting residential grades 4-12 student groups, six university level programs, our SeaCamp for local high school students, and our Young Environmental Leadership Course. We have developed an in-house lecture on "EDGE" species which we give to our university and citizen science programs.

Our newspaper articles in the Cayman Compass and Cayman Reporter and the Cayman 27 "Into the Blue" television interview shared the details of this project with over 10,000 residents and visitors throughout the Cayman Islands, who now have a better understanding of the importance of research and local protection to coral reef sustainability.

3. Lessons Learned

Describe the key lessons learned from this project, such as the least and most effective conservation practices or notable aspects of the project's methods, monitoring, or results. How could other conservation organizations adapt similar strategies to build upon some of these key lessons about what worked best and what did not?

Vulnerability-based decision-support frameworks that combine remote sensing, climate modeling, and ecological resilience assessments are increasingly needed. However, guidance is lacking on how to combine these disparate information layers to identify high-priority conservation areas most likely to benefit from management as disturbance frequencies increase under climate change. Other conservation organizations could adapt our process to their own data and use similar prioritization schemes to develop unique solutions to local and regional conservation challenges.

Resilience assessments are necessarily relative; i.e., sites are compared only to sites included within the analysis. The consequence is that the data have to be re-analyzed if more sites are included at a later date. We learned this early and have set up our data tables to ensure more sites can be added to our analytical framework with minimal data processing time and costs.

We have written the first spreadsheet-based algorithms to automate the calculation of herbivore biomass in g/100m2 for data collected and stored using AGRRA protocols. Other conservation organizations could benefit from use of our algorithm.

Our Coral Reef Early Warning System (CREWS) buoy records long-term environmental data which are not easily accessible to the general public. We have created "dashboards" to provide 60-day snapshots of the data which may be used by students, local stakeholders, and other interested parties.

4. Dissemination
Briefly identify any dissemination of project results and/or lessons learned to external audiences, such as the public or other conservation organizations. Specifically outline any management uptake and/or actions resulting from the project and describe the direct impacts of any capacity building activities.

Project results have been and will continue to be shared with elementary school, high school, and university-level students, as well as citizen scientists, through the CCMI education curriculum.

Project results have been and will continue to be shared with tourists and local dive staff via our weekly Reef Lecture Series at a local dive resort in Little Cayman.

External audiences include the general public (>10,000) who read the newspaper articles, watched the television interview, and followed us on Facebook and the CCMI website.

- Cayman Reporter newspaper article http://www.caymanreporter.com/2014/12/29/national-fish-wildlife-foundation-supports-ccmis-research/

- Cayman Compass newspaper article http://www.compasscayman.com/caycompass/2014/12/30/Scientists-explore-secret-of-Little-Cayman-s-coral-reef-success/

- Cayman 27 television interview http://www.cayman27.com.ky/2015/04/29/into-the-blue-ccmi-surveys-caymans-reef

Project results were shared and collaboratively discussed with DoE staff in a workshop setting in May, 2015. We developed criteria for querying our data that identified target sites near Little Cayman for various management actions. are discussing plans with our manager partners for potential expansion of the project to include ecological resilience assessments for the reefs near Grand Cayman Island and Cayman Brac.

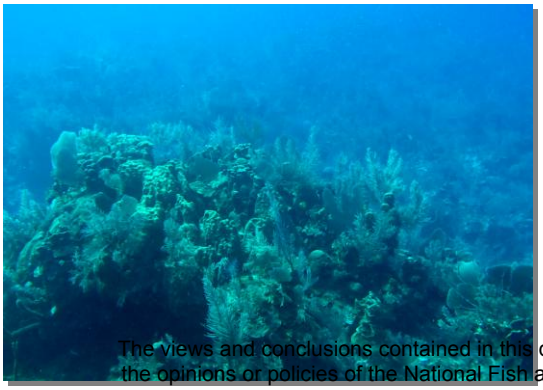
Our capacity building activities (at our May 2015 workshop) increased capacity among managers to: undertake an ecological resilience assessment of coral reefs, compile and analyse the data, and use the data to identify targets for various management actions.

5. Project Documents
Include in your final programmatic report, via the Uploads section of this task, the following:

- 2-10 representative photos from the project. Photos need to have a minimum resolution of 300 dpi. For each uploaded photo, provide a photo credit and brief description below;
- Report publications, Power Point (or other) presentations, GIS data, brochures, videos, outreach tools, press releases, media coverage;
- Any project deliverables per the terms of your grant agreement.

We have uploaded a 20-slide presentation about the project that includes a list of the project contributors and acknowledges the US-NFWF as the funding source.

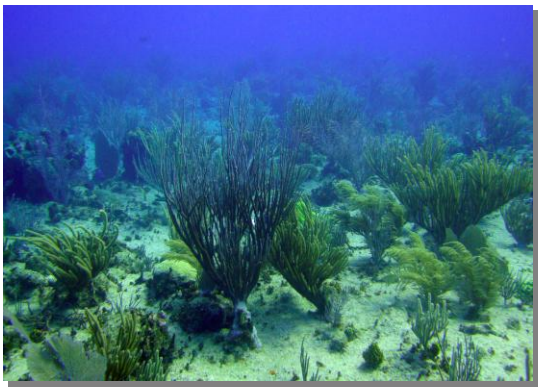
The 3 high-resolution photos we have uploaded are presented as thumbnails below and include a photo credit and caption.



Filename: Martha's Finyard_CCMI.jpg

Photo Credit: *CCMI*

Caption: *Martha's Finyard is located at the western-most tip of Little Cayman Island. Our ecological resilience assessment results suggest this site has the highest relative resilience potential from among the sites surveyed near Little Cayman Island in January-March of 2015.*



Filename: Point of Sands_CCMI.jpg

Photo Credit: *CCMI*

Caption: *Point of Sands is located at the eastern tip of Little Cayman Island. Our ecological resilience assessment results suggest this site has the second-highest relative resilience potential from among the sites surveyed near Little Cayman Island in January-March of 2015.*

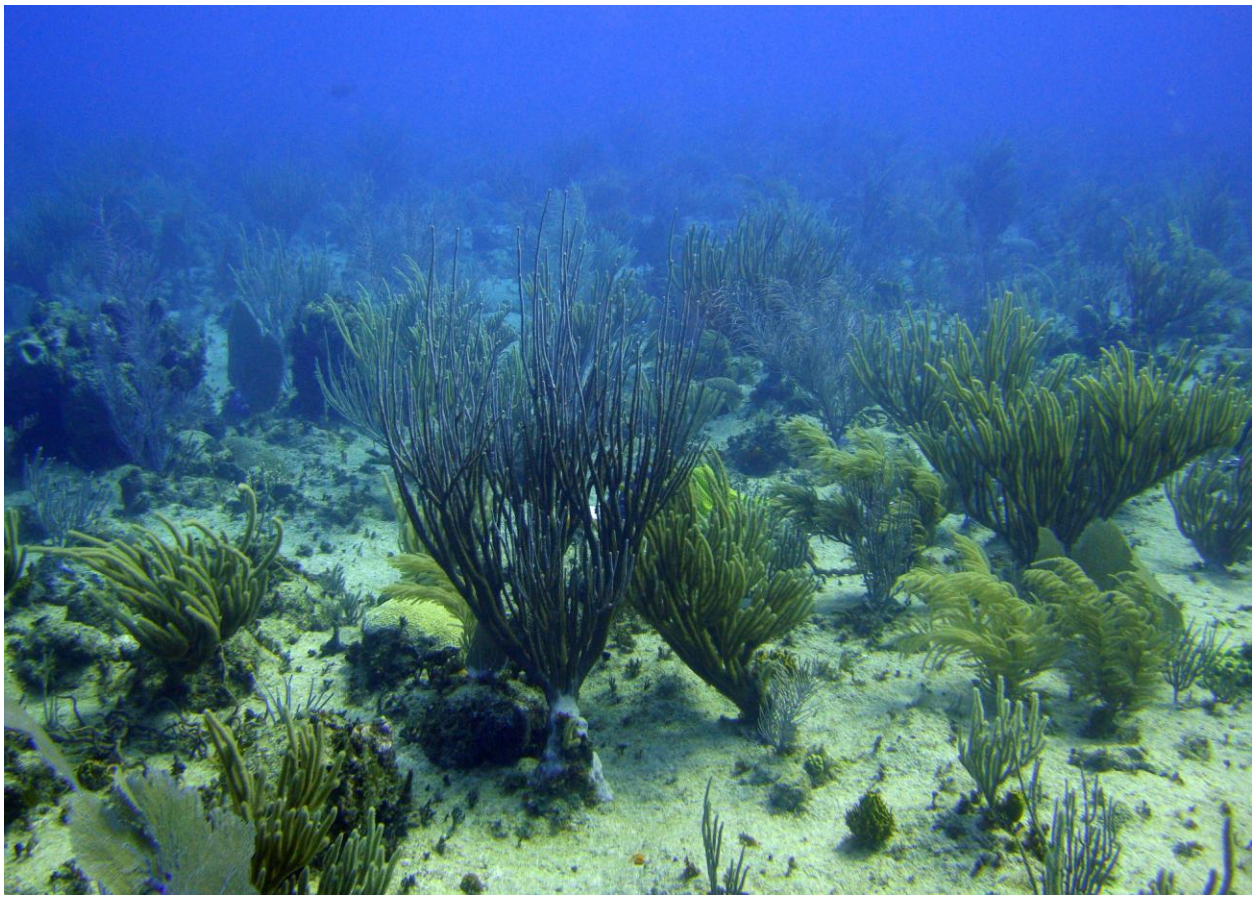
Filename: CCMI workshop with DOE_CCMI.jpg

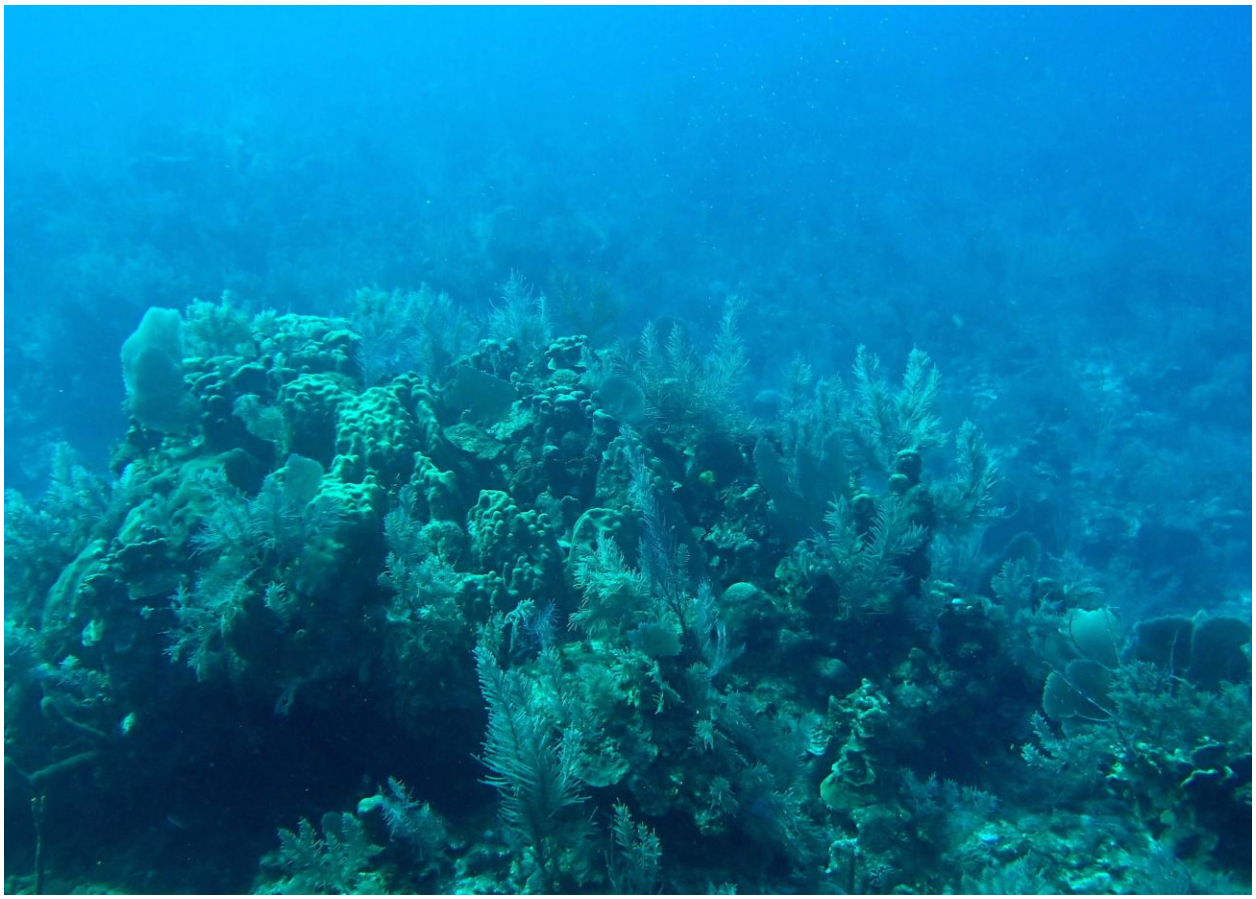
Photo Credit**:** *CCMI*

Caption: *CCMI staff led a workshop with the Cayman Islands Government Department of Environment in May of 2015 to discuss a vulnerability assessment framework method and results.*

POSTING OF FINAL REPORT: *This report and attached project documents may be shared by the Foundation and any Funding Source for the Project via their respective websites. In the event that the Recipient intends to claim that its final report or project documents contains material that does not have to be posted on such websites because it is protected from disclosure by statutory or regulatory provisions, the Recipient shall clearly mark all such potentially protected materials as "PROTECTED" and provide an explanation and complete citation to the statutory or regulatory source for such protection.*

Thank you for your support of our applied research. –CCMI Staff.





Vulnerability-based coral reef management planning in the Cayman Islands

*Major contributors: Jeffrey Maynard**, Kristi Foster**, Sabrina Schmalz*, Tom Sparke*, Peter Quilliam*, Gabriella Ahmadia, Scott Heron, Ruben van Hooidonk, Gareth Williams, John Bothwell and Carrie Manfrino***

**CCMI staff, Little Cayman Island, Caymans.*
***Project Leaders*

Presentation Outline

Climate change and coral reefs
Project objectives
Introduction to vulnerability assessment frameworks

Results:

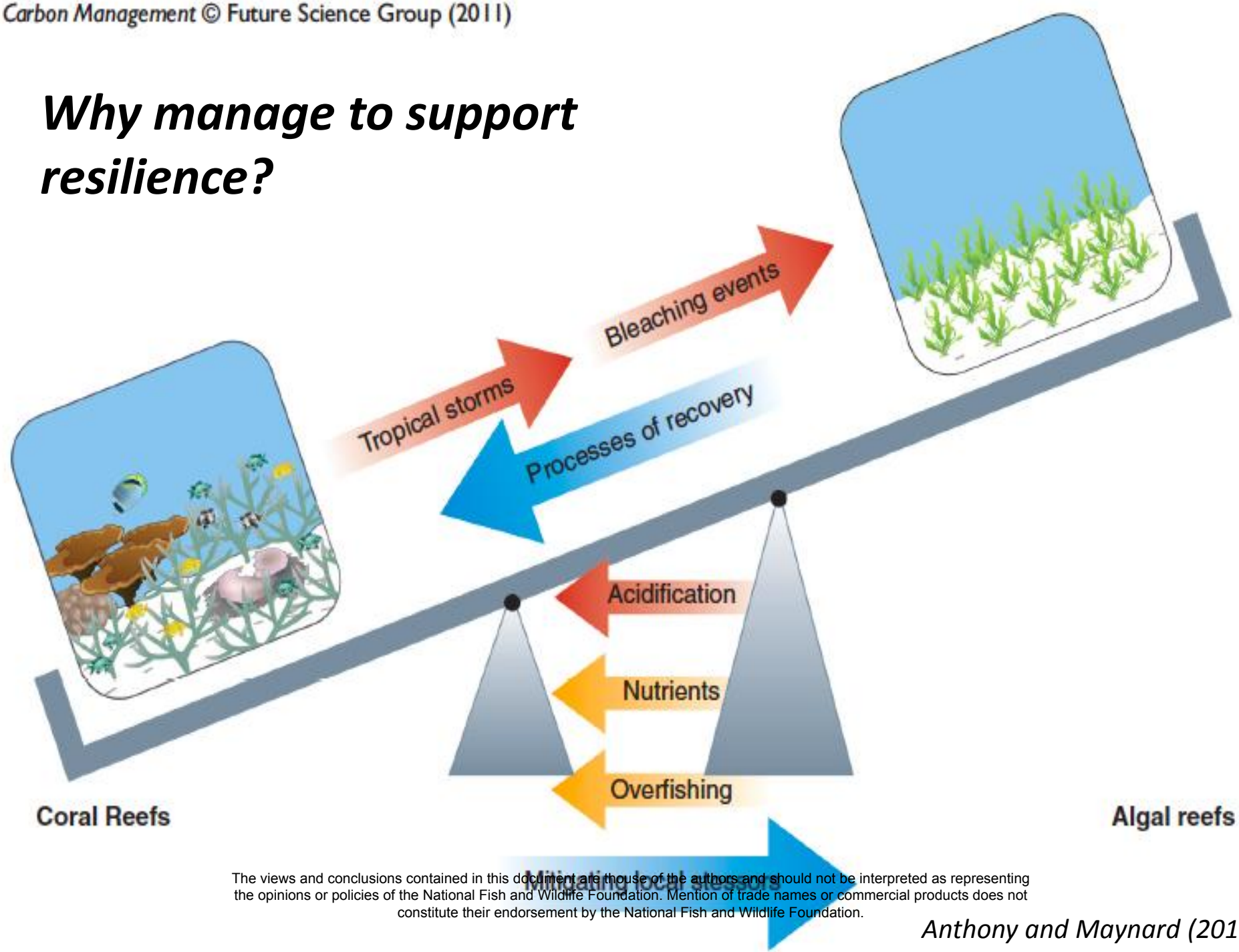
Part 1 – Historic and projected future exposure to disturbance (focus on temperature)

Part 2 – Ecological resilience assessments

Part 3 – Decision-support framework; MPA planning on Little Cayman

Carbon Management © Future Science Group (2011)

Why manage to support resilience?



Anthony and Maynard (2011)

Project Title: *Enhancing Capacity for Coral Reef Resilience Management*

Project Objectives:

1. Tool Development (Vulnerability assessment and Resilience rankings)

1. Improved Management Practices

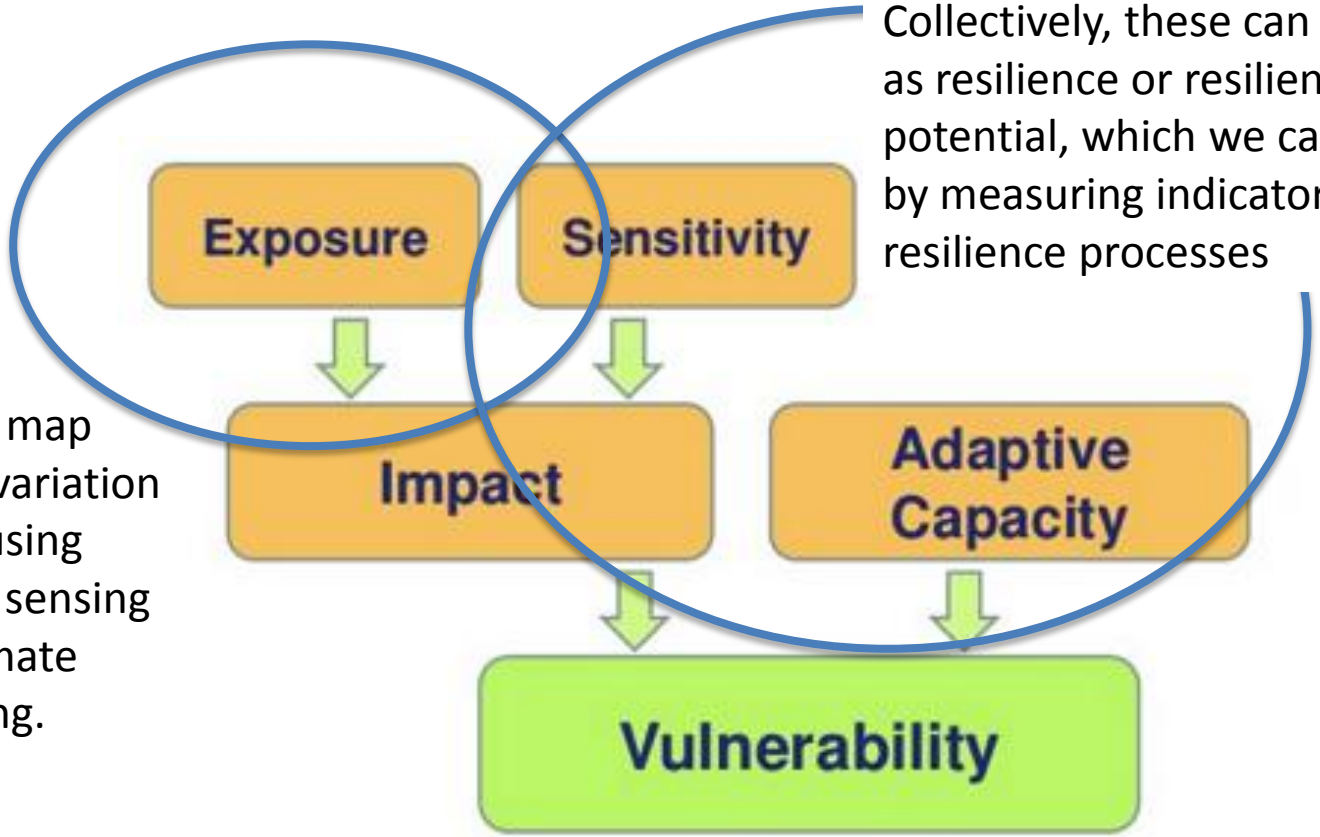
3. Building Institutional Capacity

4. Outreach/Education/Technical Assistance

SUSTAINING BIODIVERSITY THROUGH RESEARCH, EDUCATION, OUTREACH AND CONSERVATION

CCMI

Intro – Vulnerability Assessment Framework

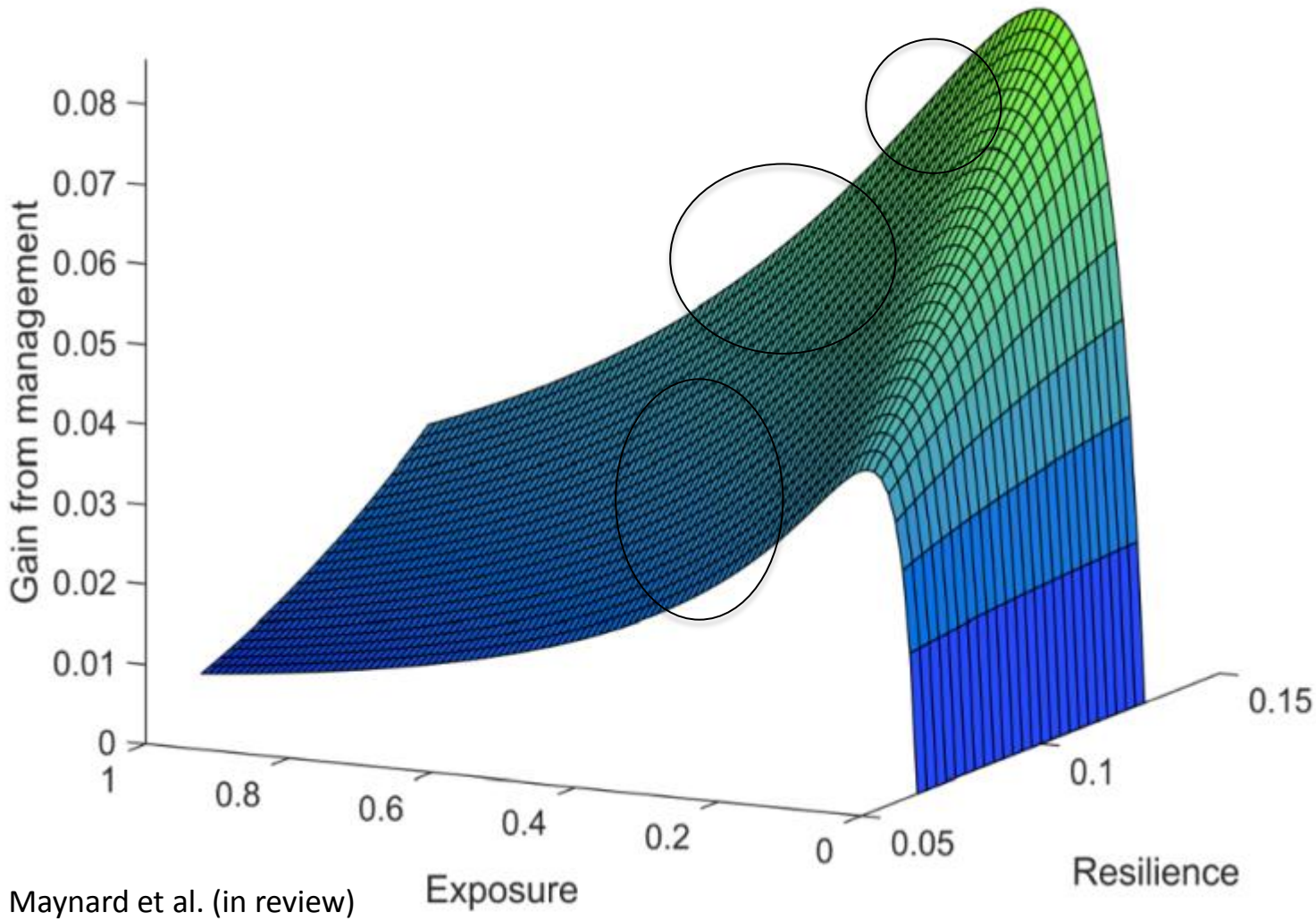


Collectively, these can be seen as resilience or resilience potential, which we can assess by measuring indicators of resilience processes

We can map spatial variation in this using remote sensing and climate modeling.

Turner et al. (2003); now widely used by the IPCC.

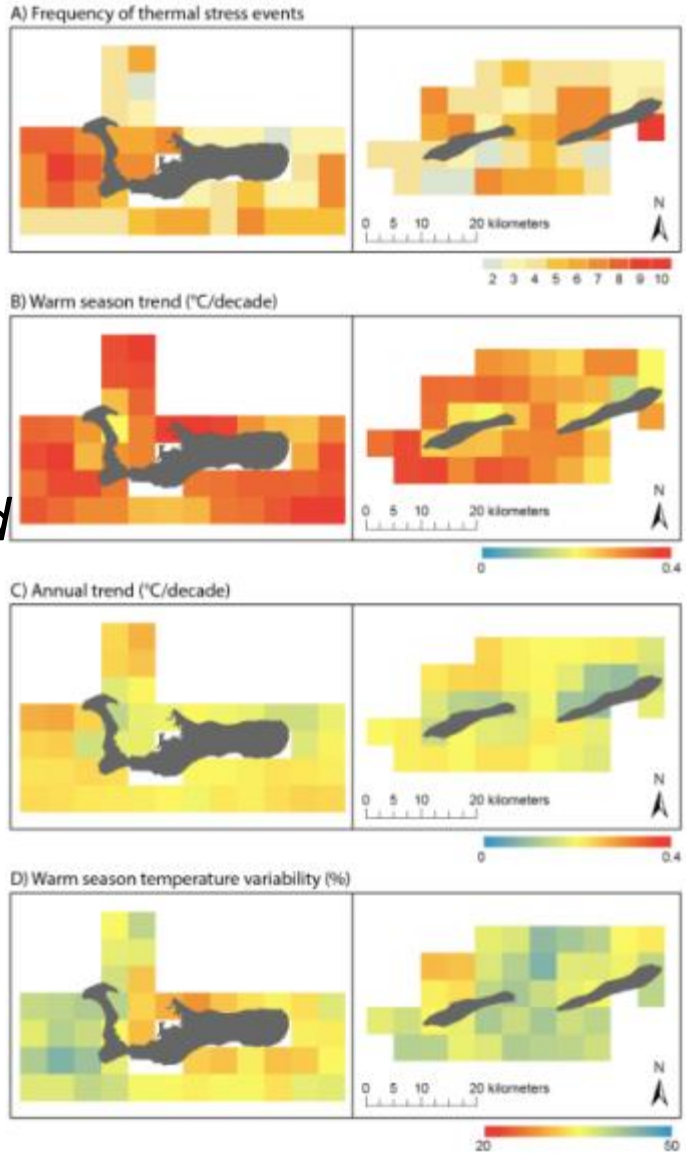
Putting the VA framework into action to maximise gains…



Maynard et al. (in review)

Historic exposure:

"Reefs at Little Cayman are among those with the greatest temperature variability; the frequency of thermal stress events is low in the southwest and northeast, and the annual and warm season rates of increase in SST these last 30 years are well below the average for the Caymans at nearly all reefs in Little Cayman."



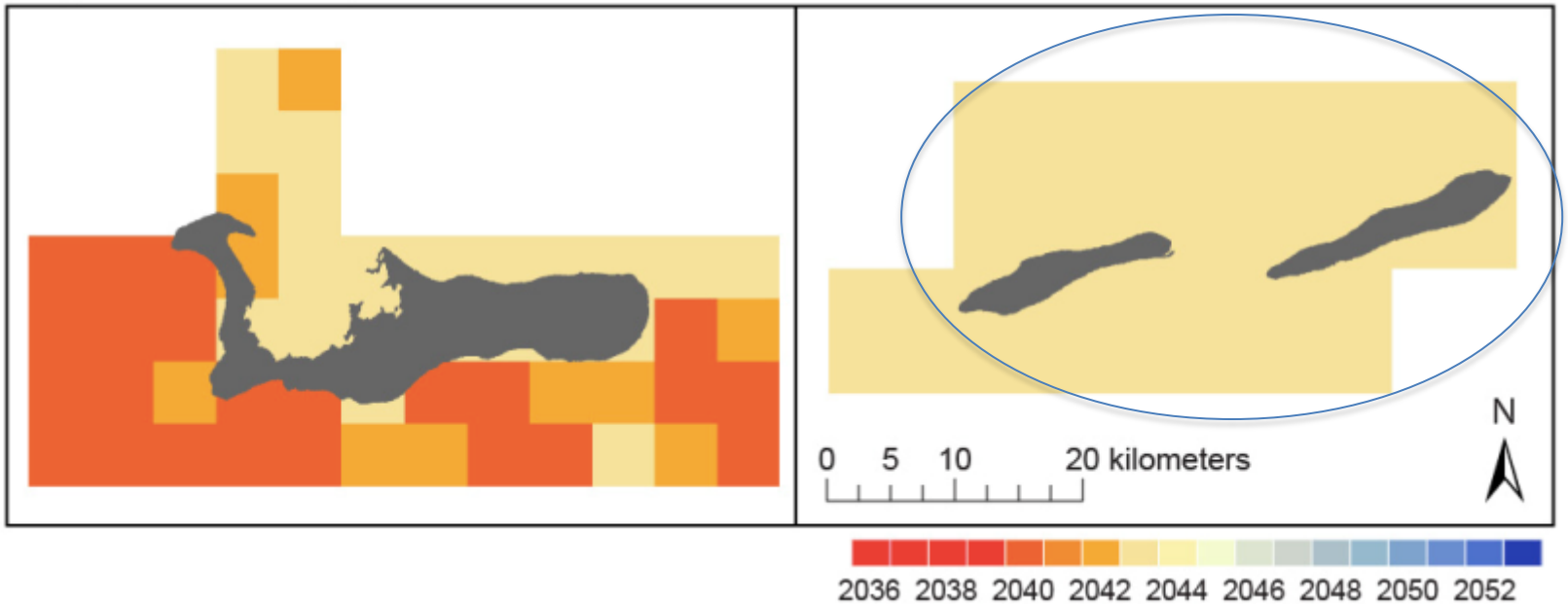
Little Cayman reefs have been the relative winners of the past.

Collaboration with S. Heron of NOAA Coral Reef Watch.

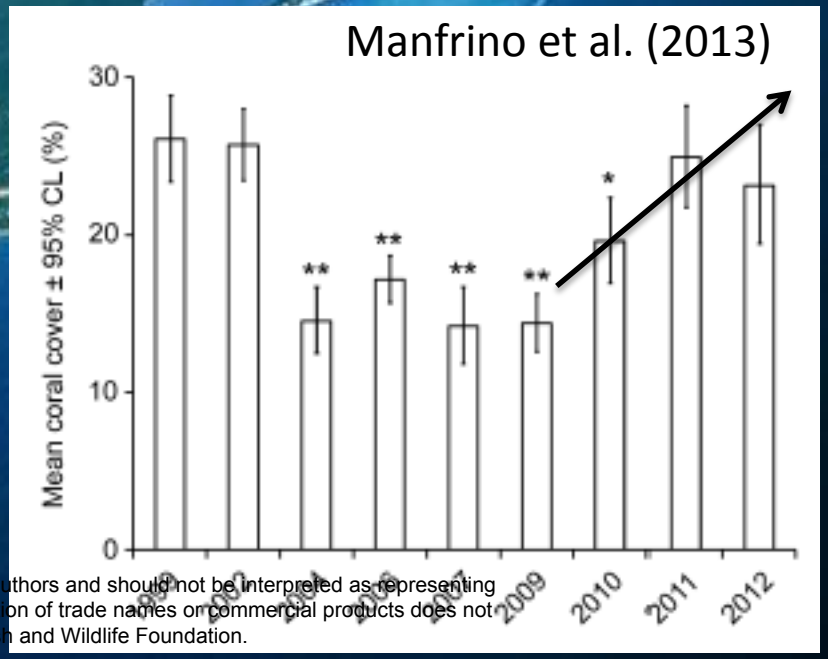
Downscaled projections

Summary: What we know about the future suggests Little Cayman and Cayman Brac will have lower/later exposure to annual bleaching conditions.

Projected future exposure (RCP 8.5)



Collaboration with R. van Hooidonk of NOAA AOML and CIMAS at RSMAS at U of Miami



Drivers of variation in resistance and recovery potential

West and Salm (2003)

Resilience indicators *are "Factors that:*

- *reduce temperature stress*
- *enhance water movement*
- *decrease light stress*
- *correlate with physiological tolerance, and provide physical*

OR

- *biological enhancement of recovery potential. (i.e., due to the substrate and connectivity)."*

Ecological resilience assessment at Little Cayman

'Resilience indicators':

Coral diversity	Unitless
Macroalgae cover	%
Coral cover	%
Bleaching resistance	%
Coral recruitment	#/m^2
Temperature variability	Unitless
Herbivore biomass	grams/100 m^2

Anthro stressors excluded

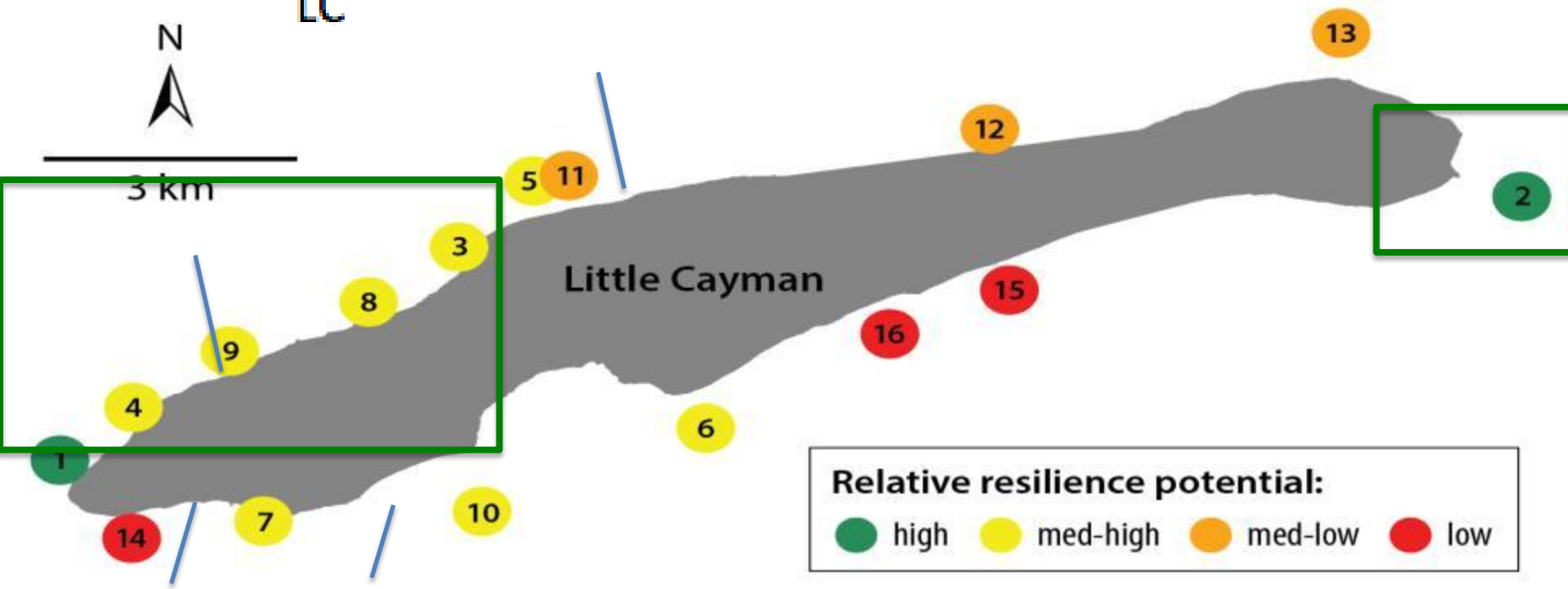
No coral disease / Coral cover included

Martha’s Finyard

Point of Sand

Hardpan

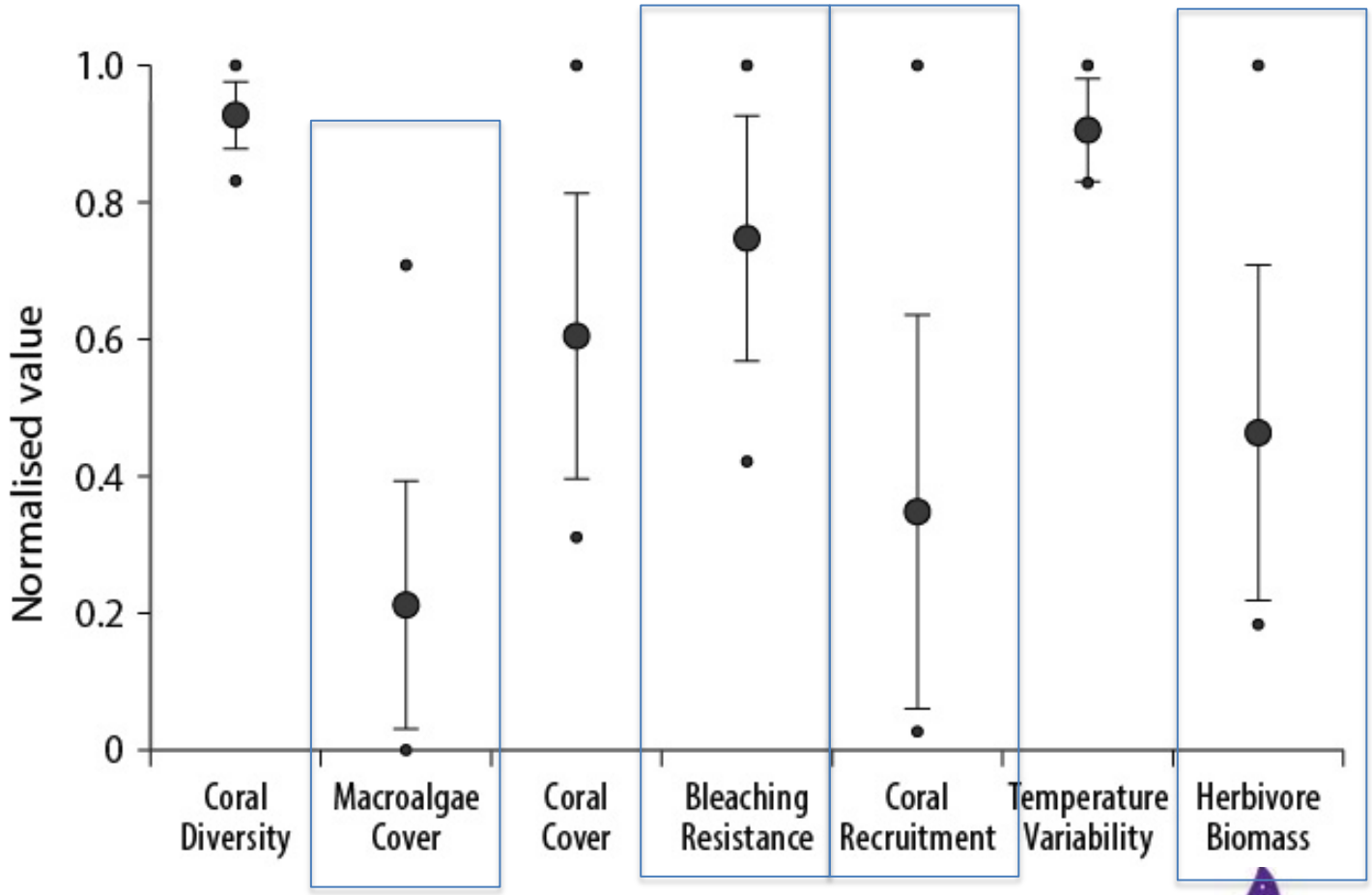
1) Assess relative resilience potential at reef sites around LC



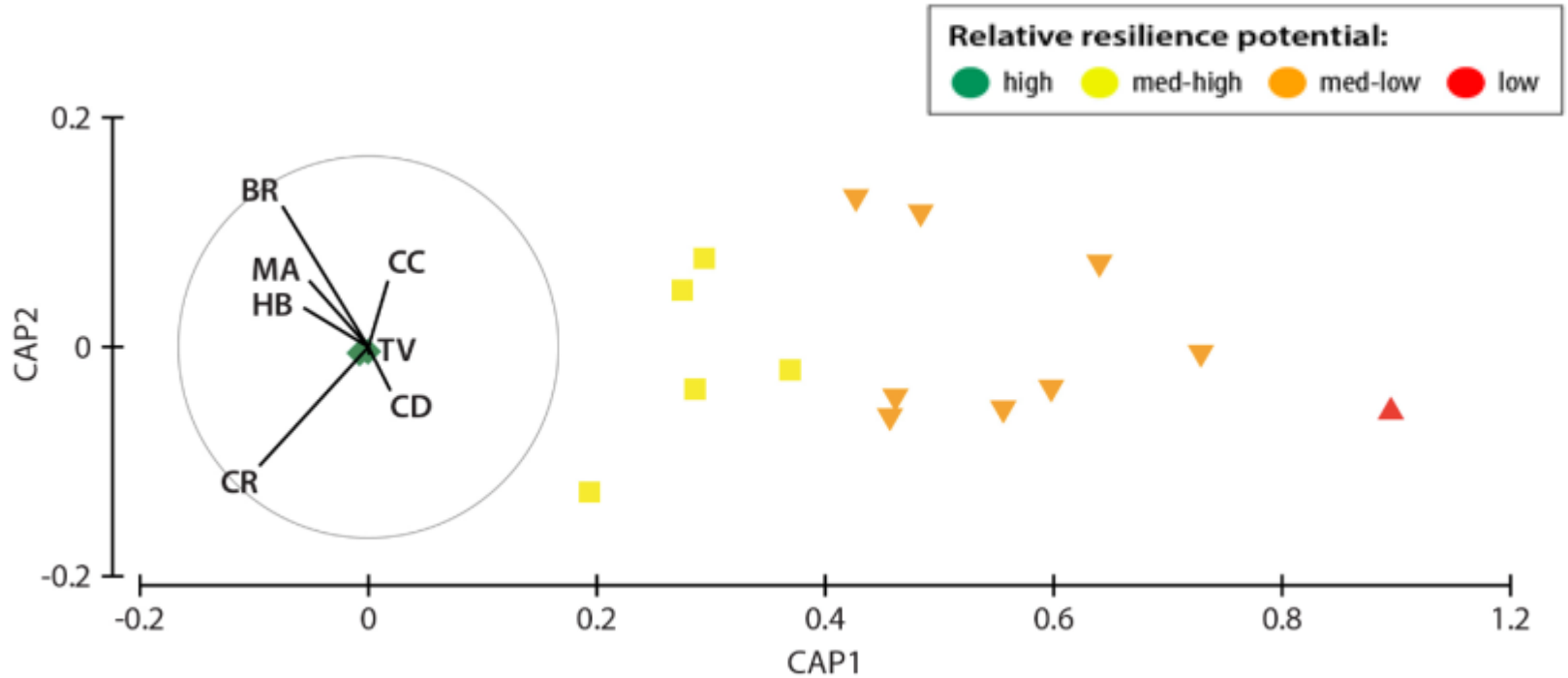
1 - Martha's Finyard
2 - Point of Sand
3 - Meadows
4 - Jigsaw Puzzle
5 - CREWS
6 - Lucas' Ledges
7 - Grundy's Garden
8 - Mixing Bowl
9 - Joy's Joy
10 - Lappy's Leap
11 - Snapshot
12 - Sailfin
13 - Old Barge
14 - West Point
15 - Hardpan
16 - Coral City

Ecological resilience assessment at a point in time; not an analysis of differences in trends through time

2) Identify the variables most driving differences in relative resilience potential.



2) Identify the variables most driving differences in relative resilience potential.



Identifying targets for:

Conservation – high resilience potential and outside established marine protected areas

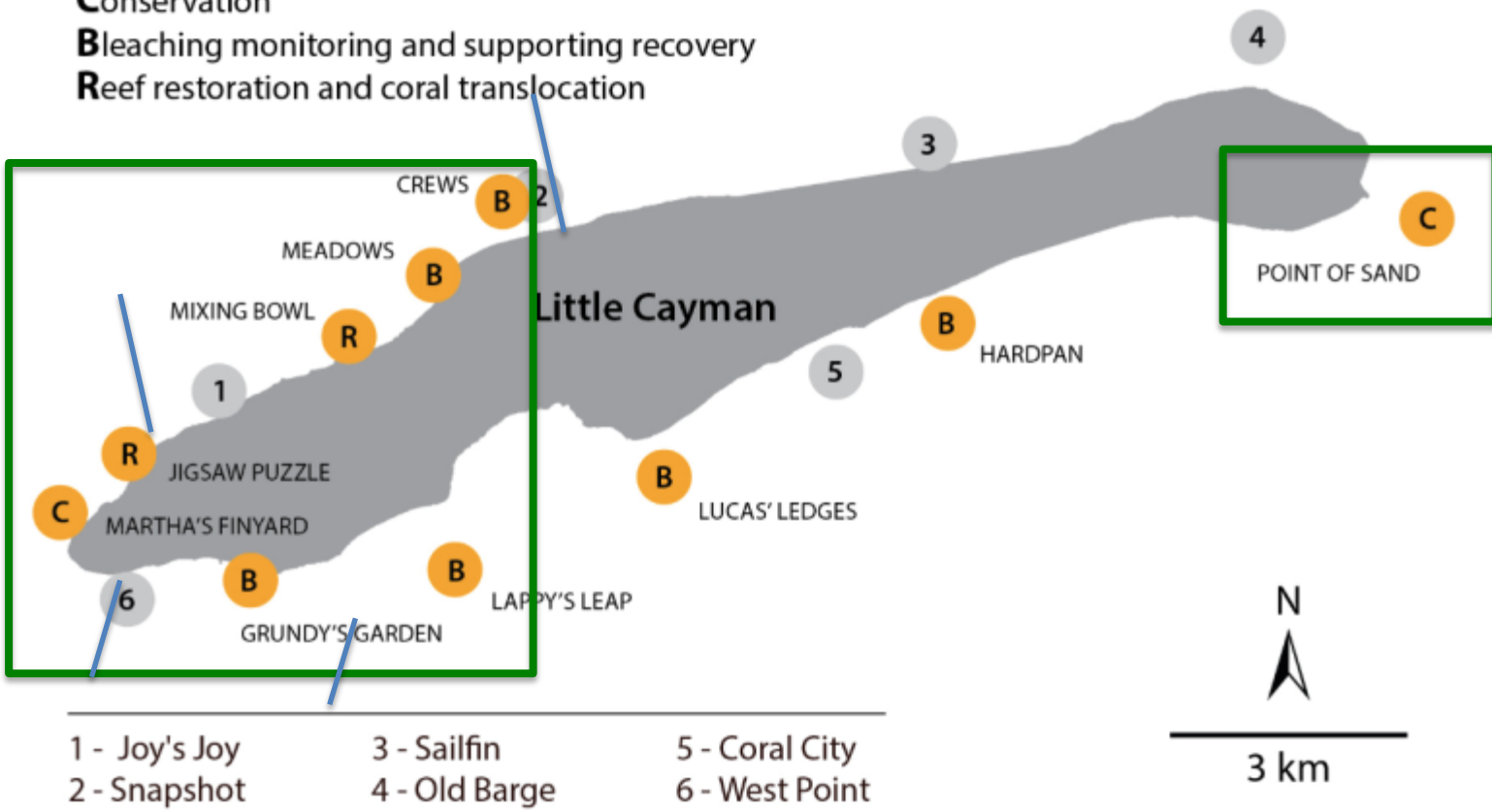
Bleaching monitoring and supporting recovery – below average bleaching resistance and below average herbivore biomass

Reef restoration/coral translocation – low coral diversity or coral cover, below average macroalgae cover, above average 'favorable substrate, and above average herbivore biomass (Note: probably warranted everywhere; this is way to use our field data to optimize site selection)

Short summary: *At Little Cayman these areas (in green) have the lowest relative vulnerability, and will benefit from supporting recovery both through protection and transplantation of corals from the CCMI nursery*.

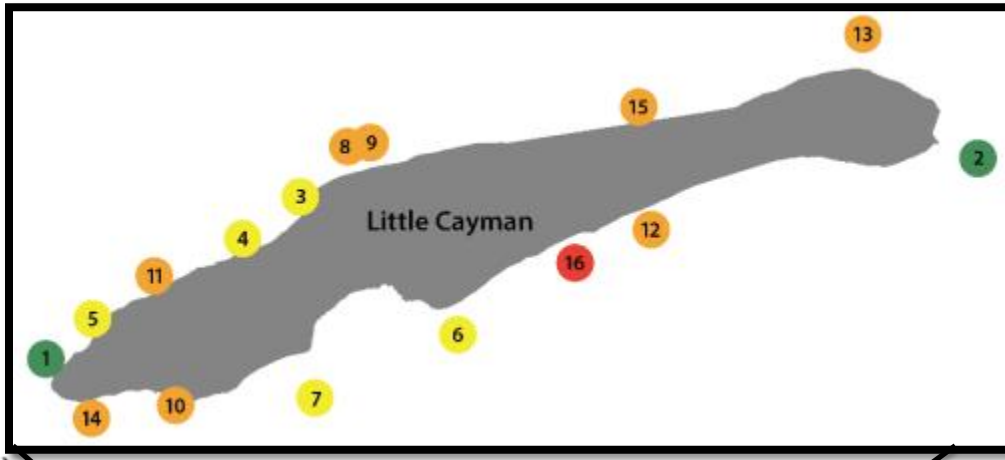
Targets for:

Conservation
Bleaching monitoring and supporting recovery
Reef restoration and coral translocation

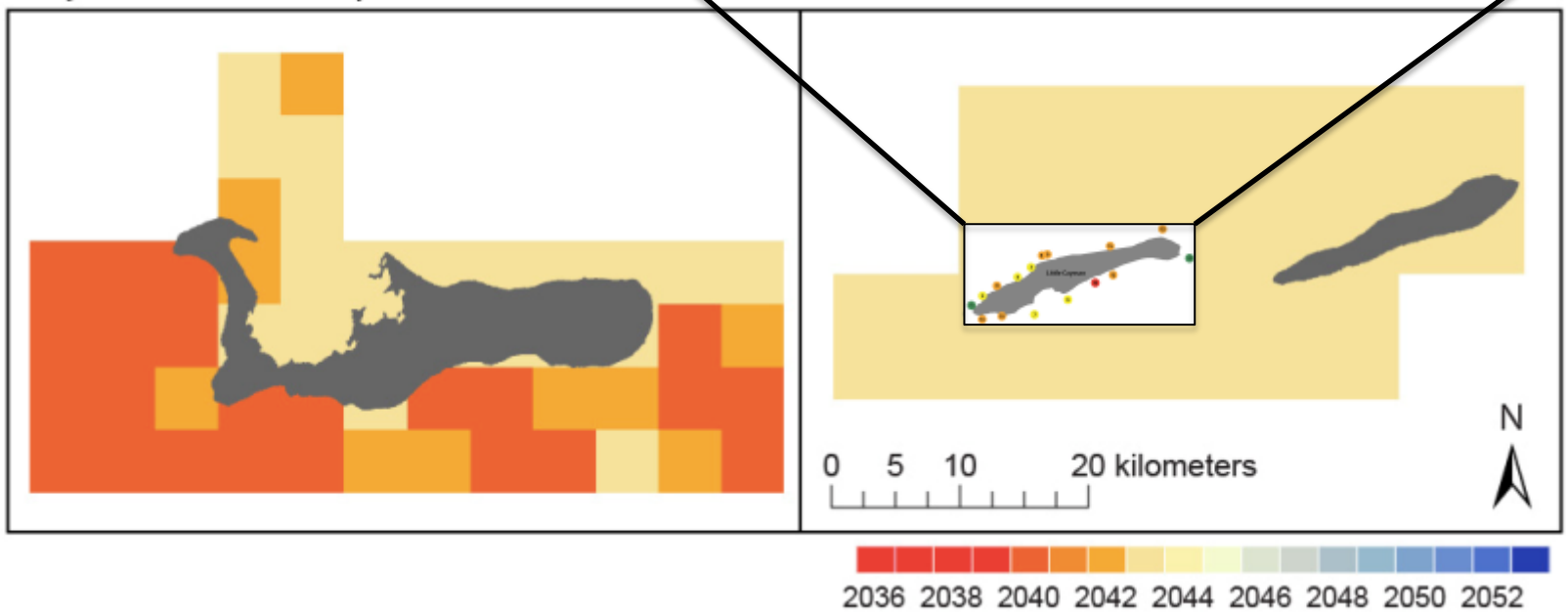


Next steps:

Caymans-wide resilience assessments



Projected future exposure (RCP 8.5)



Project Results Summary

1. Reefs at each of the islands have vary greatly in their historic and projected future exposure to disturbances. Considering all analyses of exposure patterns, reefs at Little Cayman have been the relative winners.

2. The indicators of resilience processes vary greatly among the reefs of Little Cayman as does overall resilience potential. The reefs with the highest relative resilience potential are outside the currently established MPAs.

3. We identify sites where actions can be targeted that would support site and system resilience in Little Cayman. Our data could be used in combination with other criteria to identify other types of management actions (than those we listed).

4. The approach used to compare sites with respect to their resilience potential and identify targets for management actions could be employed Caymans-wide to assist with MPA planning.

Vulnerability-based coral reef management planning in the Cayman Islands

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Enquiries about the project:
CCMI President Carrie Manfrino: cmanfrino@reefresearch.org

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