

Monitoring Coral Bleaching:

Assessing the Ecological Impacts of Mass Bleaching

Acknowledgement: David Obura (CORDIO)

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Why Monitoring a Coral Bleaching Event??



Why Monitoring a Coral Bleaching Event??

- To make timely and effective management decisions
- To communicate and educate
- To assess recovery
- To identify resilient areas



Monitoring Coral Bleaching – Section Online

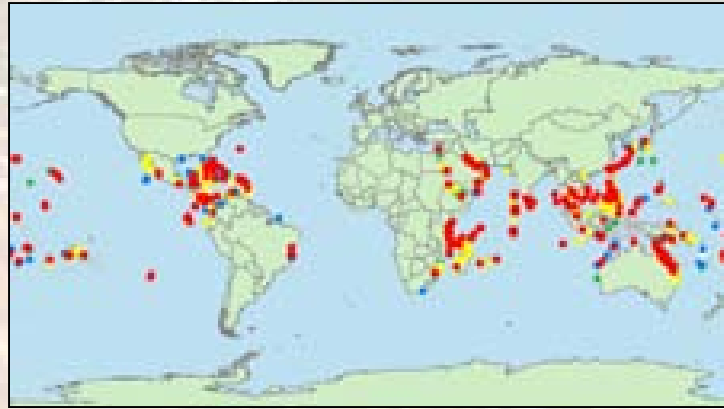
- Techniques for Bleaching Assessment – Spatial Extent and Severity
- Special Considerations for Bleaching Assessments compared to Normal Monitoring
- Protocols for Monitoring Bleaching



Bleaching is a Global Problem...

But, during previous bleaching events....

- Coral bleaching reports were *anecdotal*
- Data was often *semi-quantitative*
- Studies used a wide *variety of techniques*
- Global synopsis
unreliable



Goals for Monitoring:

- Ensure quality of data
- Comparable / consistent methods
- Use standard protocols
- Detect the *onset* of bleaching events
- Measure extent and severity
- Test *resilience principles*
- Inform/influence management
- Resilient MPAs



Techniques for Bleaching Assessment: Estimating the severity of bleaching



Bleaching Is Variable

Bleaching varies at all scales:

Regions, reefs, sites, species, colonies

Numerous sources of variation:

Exposure, including depth & habitat

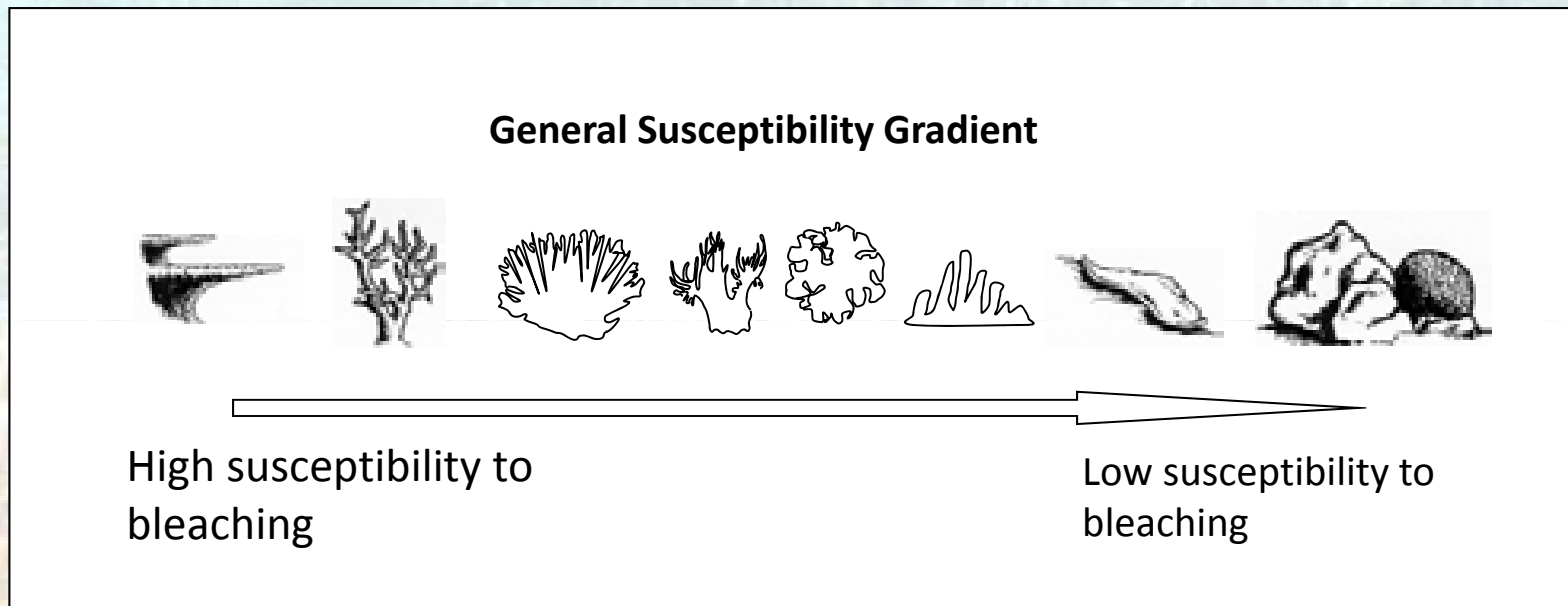
Environmental history

- acclimatization
- shift towards resistant species



NEED TO ASSESS THE EXTENT AND SEVERITY OF THE BLEACHING EVENT

Corals show differential susceptibilities:



- Species vary in susceptibility
- Broad pattern of resistance
- Taxonomic patterns are diagnostic

Recognizing the severity/stage of bleaching:

Low

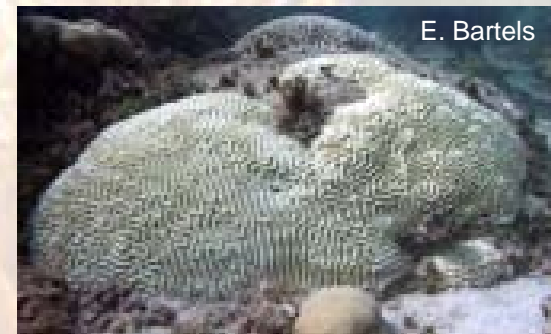
Pale (discoloration of coral tissue)



Partially Bleached (Patches of fully bleached or white tissue)



Bleached (tissue is totally translucent, no zooxanthellae pigmentation visible)



High

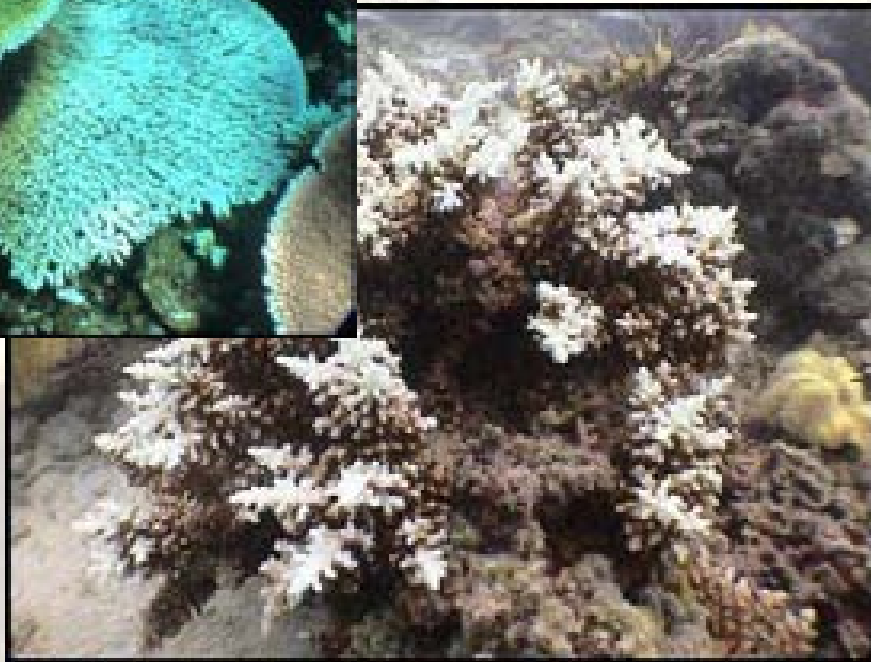
Within Colony Variability in Severity:



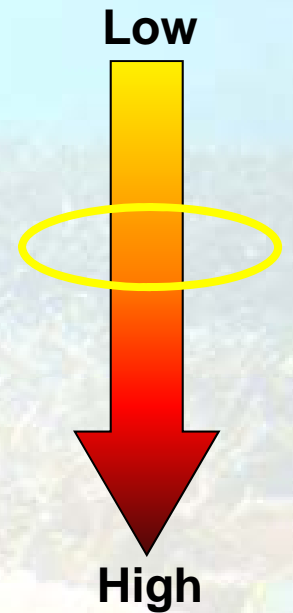
Blotchiness (may indicate recovery)



Exposed Surfaces (Shading)



Upper Surfaces



Within Colony Variability in Severity:

Some bleached corals glow pale **purple**, **pink** or **blue**
Non-zooxanthellae pigments confer color

Partially Bleached



Siderastrea siderea

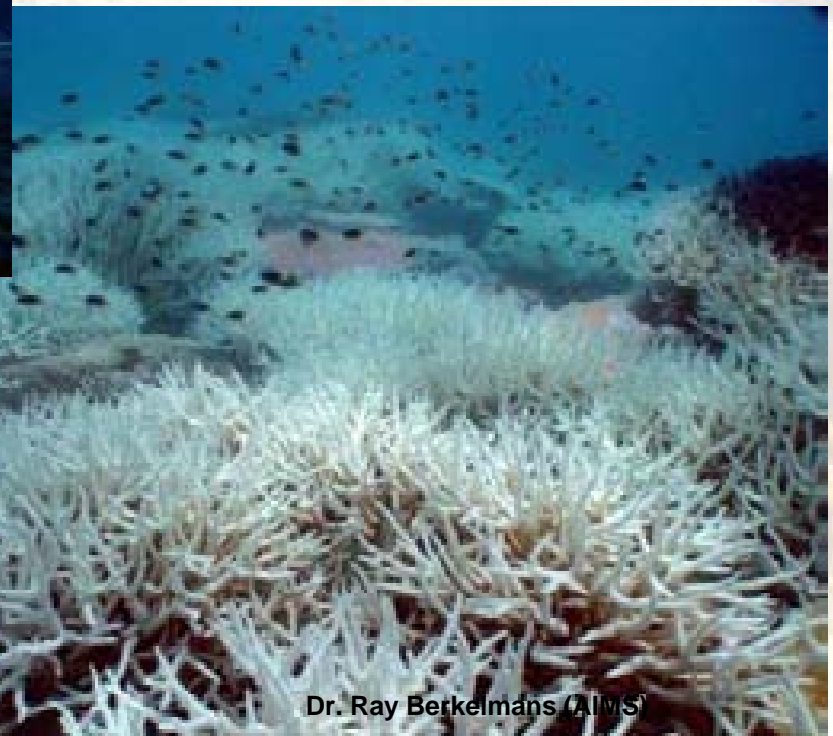
Fully Bleached



Techniques for Bleaching Assessment: Estimating the Spatial Extent of bleaching



Single Colony



Entire Patch Reef

Estimating % coral cover and % bleaching:

Table 1: Amount of Coral or Bleaching

The figure below is designed to assist in estimating percentage cover. It can be used to:

- 1) estimate the percentage of living coral covering the seafloor; and
- 2) to estimate the percentage of living coral that is affected by bleaching.

Whether corals are arranged in clumps, dots, networks or patches, the diagrams can be used to determine which category best describes the area you are assessing.

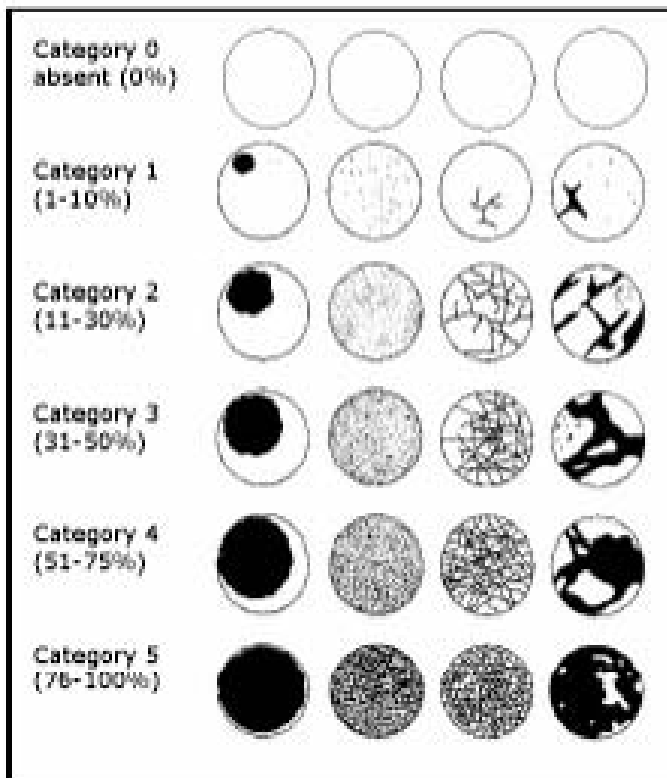
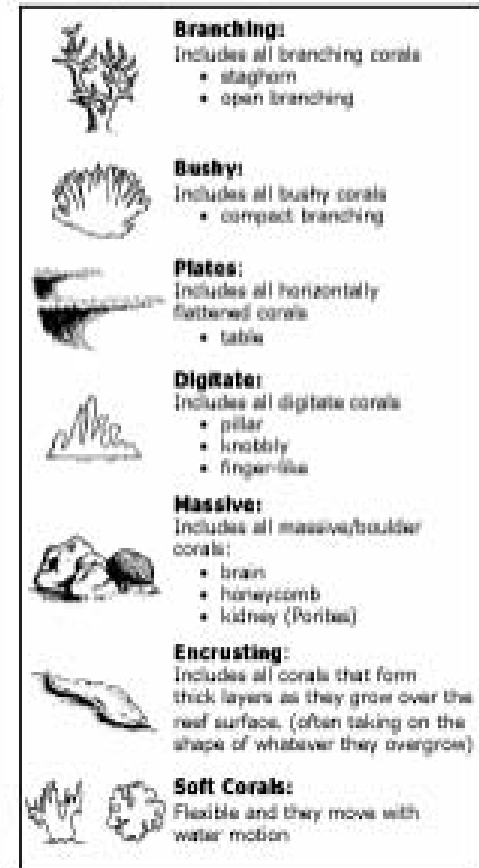


Table 2: Coral ID Key

The diagrams below are a guide to the main lifeforms, or shapes, of corals. Lifeform is a good general indicator of the type of coral, although more experienced observers are encouraged to identify corals to higher levels of resolution (ie. family or genus) where possible.



Estimating % coral cover and bleaching

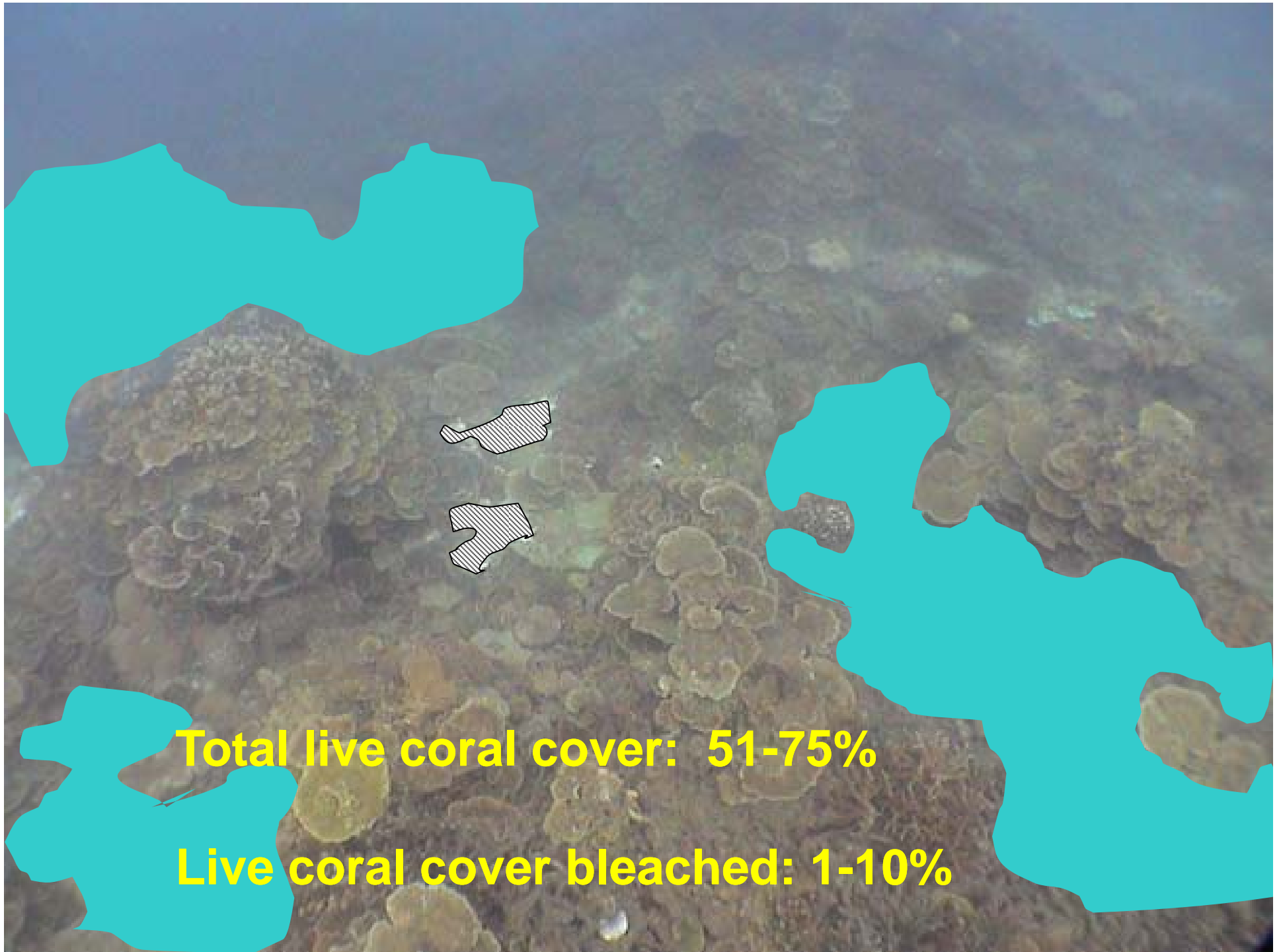
Practice in the field:

- Use location visited regularly (e.g. snorkel trail)
- Target areas with reported bleaching
- Estimate % cover in set area or field of view
- Remember it is % LIVE coral cover



An underwater photograph of a coral reef. The coral is primarily brown and green, with some white patches visible. The water is clear and blue. Yellow text is overlaid on the bottom left of the image.

Total live coral cover : 51-75%



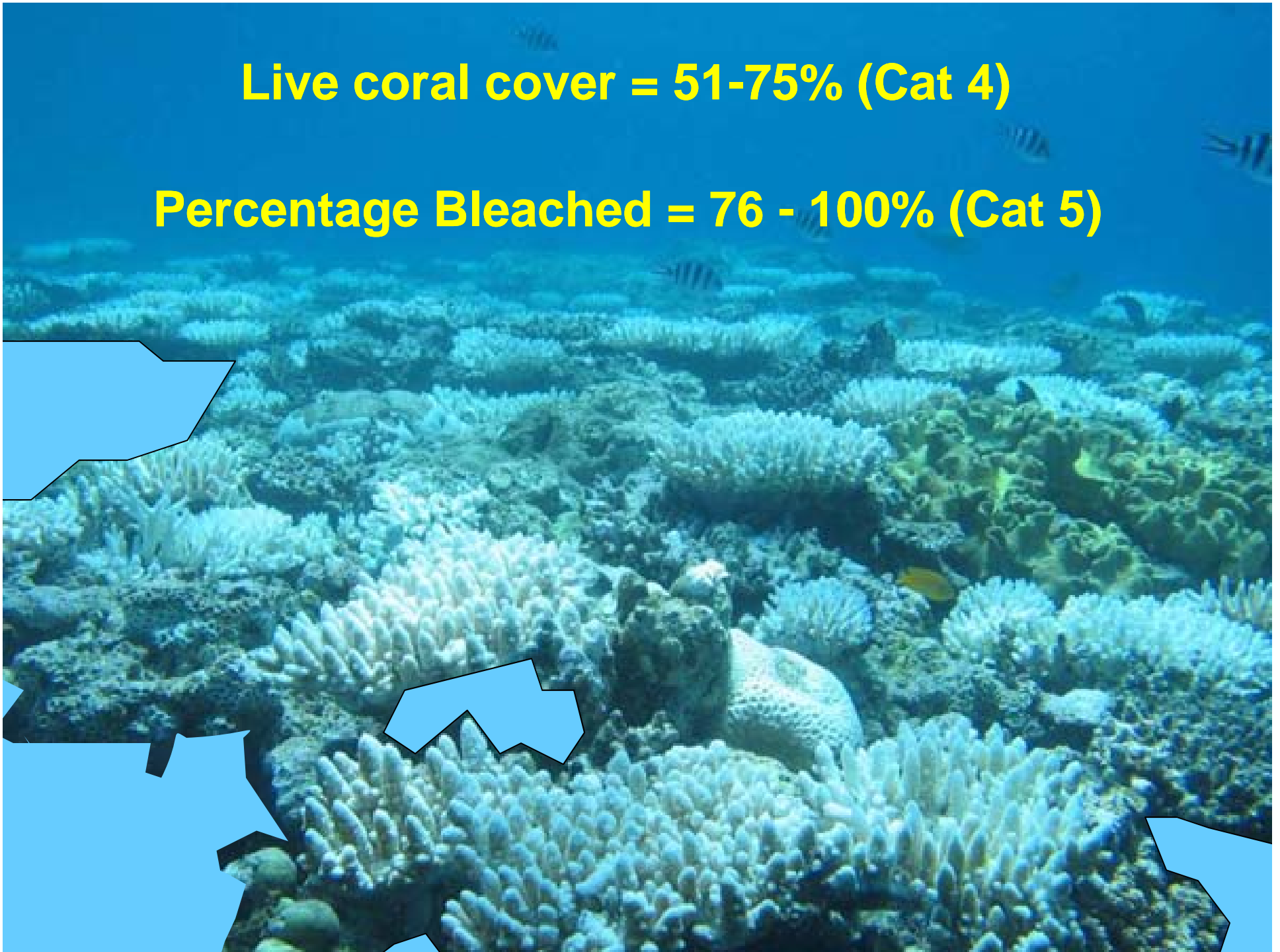
Total live coral cover: 51-75%

Live coral cover bleached: 1-10%



Live coral cover = 51-75% (Cat 4)

Percentage Bleached = 76 - 100% (Cat 5)



Broad-scale surveys

- Manta-tow
- Aerial
- Semi-quantitative
- Bleaching severity index
- Large spatial coverage
- Low resolution



Survey methods

LIT or Video Transects

- standard AIMS/GCRMN method
- 2 depths (crest & slope)
- 3 replicate transects



Survey methods

Rapid Assessment

- Summary observations2 depths (crest & slope)
- Detailed observations
- 3 replicate transects
- + notes and photographs

[illegible]

Bleaching Response Program

Why different types of survey?

Method	Extent	Average Severity (+mortality)	Maximum Severity (+mortality)
Broad-scale	Yes	No	No
Underwater (fixed)	Yes	Yes	No
Underwater (targeted)	No	No	Yes

LOCATION LOCATION LOCATION !!!

Reef Flat bleached

Back Reef did not bleach





Species susceptibility is important !!

76 – 100% (Cat 5 Bleaching)

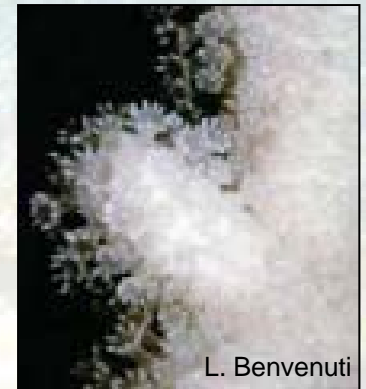
Mass bleaching is very hard to miss!



Special Consideration: Identifying Bleached Corals

Current bleaching :

- Coral tissue still present/alive
- Pale, fluorescent or completely white appearance
- Areas of pale/white tissue across exposed parts of whole colony (rather than starting from tips or base)
- Numerous colonies over large reef area



Porites



S. Siderea

Previous bleaching : harder to distinguish

- May be due to other factors (salinity, freshwater etc.)

Distinguishing Bleaching from Other Issues



Growth Tips



E. Bartels

Disease



J. Lang

Fish Bites



Predation



Distinguishing Bleaching from Growth Tips



**Confusing bleaching with
Growth tips and margins**



Distinguishing Bleaching from Diseases

Black Band Disease:

- black mat (a few mm to cm) wide
- moving across the surface of the skeleton
- leaving behind bare white skeleton



White Band Disease:

- Tissue peels or sloughs off the skeleton
- progressing **from the base** of the branch towards the tip
- Band can be 5 to 10 cm wide
- several mm per day



Don't confuse with growth at the tips!!

What's going on here?



Bleaching + recent death from black-band disease

Distinguishing bleaching from Predation

Parrotfish Bites

- Tissue loss and skeletal scarring in patches or strips



Montastraea annularis



stoplight parrotfish (*Sparisoma viride*)
biting *Montastraea annularis*

Distinguishing bleaching from Predation

Damselfish Bites

- Look for small, circular (<1cm diameter) lesions in the coral



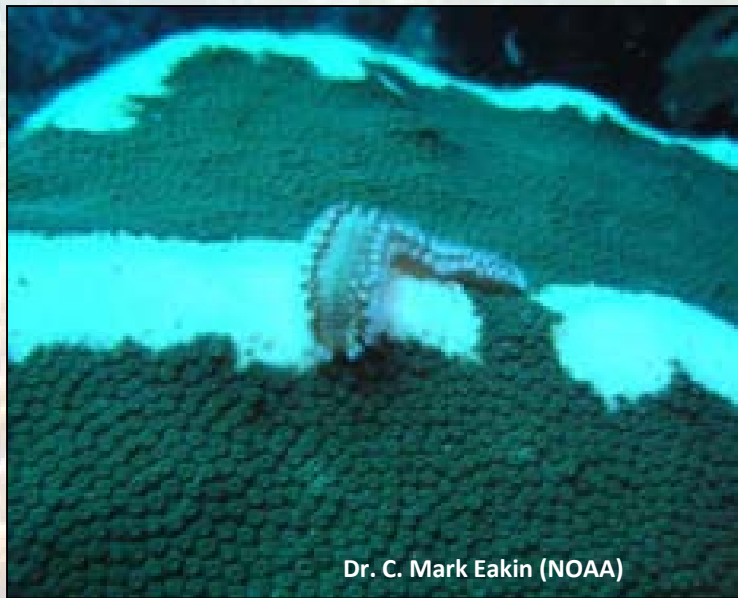
Stegastes planifrons (threespot damselfish)



damselfish bites in *Montastraea*

Distinguishing bleaching from Predation

Predation by Fireworms (*Hermodice carunculata*)



Dr. C. Mark Eakin (NOAA)

H. carunculata on *M. faveolata*



H. carunculata on *M. faveolata* with white plague

Distinguishing bleaching from Predation

Predation by *Coralliophila* spp.

Look along tissue margins; can be hard to find as often camouflaged by algae



Feeding on *A. cervicornis*



Coralliophila abbreviata



Distinguishing Recent vs Old Mortality

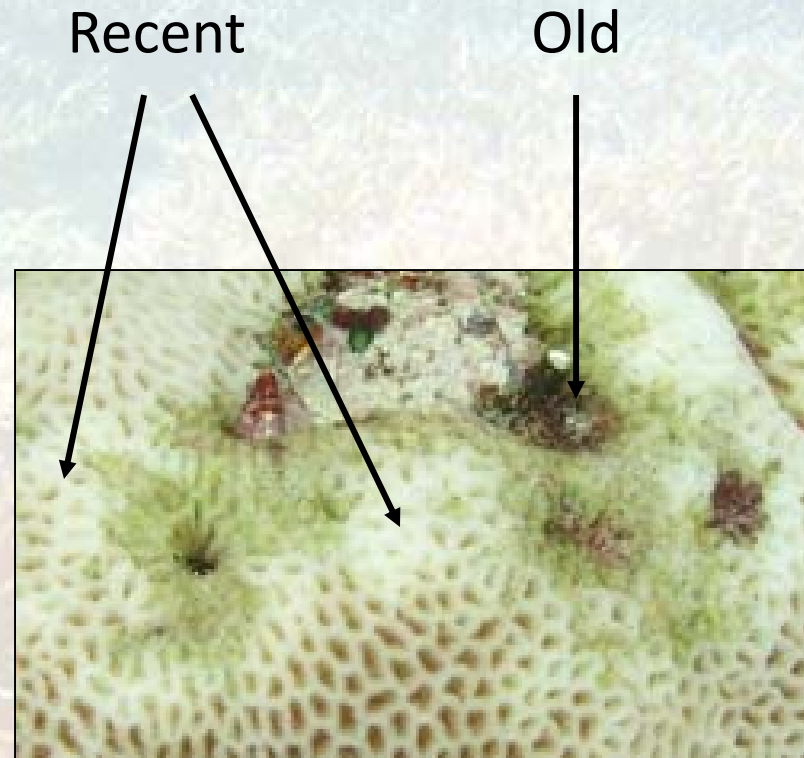
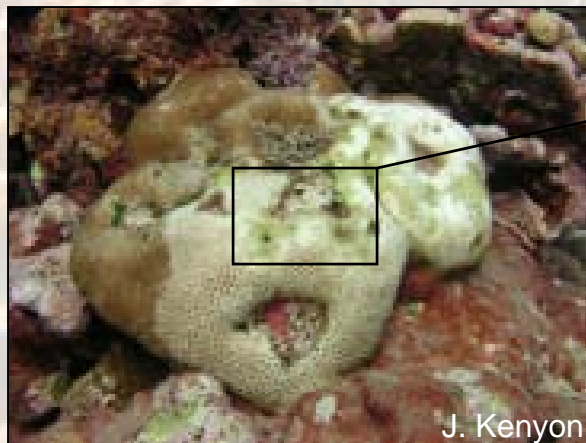


Recently dead - is defined as any non-living parts of the coral in which the corallite structures are either white and still intact or slightly eroded but identifiable to species.

Old dead - is defined as any non-living parts of the coral in which the corallite structures are either gone or covered over by organisms that are not easily removed (certain algae/invertebrates).

Distinguishing Recent vs Old Mortality

Recent mortality
(intact skeleton) vs. old
mortality (eroded
skeleton)





It is not only corals that bleach



Identifying bleached corals: Challenges

Pitfalls:

- Natural growth at tips
- Confusing normally pale corals
- Patchy bleaching
- Old versus recent mortality
- Disease
- Damage
- Recognising recovery

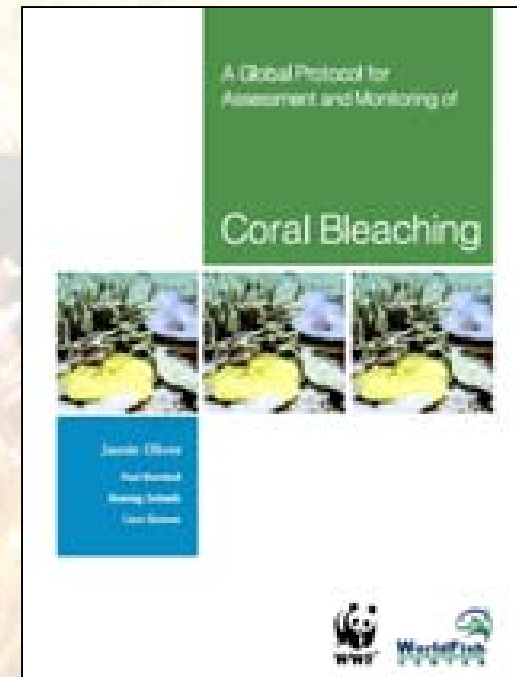
Main messages:

- Know your local corals
- Bleaching is dynamic & prolonged
- Bleaching is variable

Monitoring Tools & Protocols

- Global Protocol for Assessment & Monitoring of Coral Bleaching
- Monitoring Coral Reef Marine Protected Areas
- Methods for Ecological Monitoring of Coral Reefs
- Reef Check Bleaching Monitoring Protocol
- Australian Institute of Marine Science – Coral Bleaching Index
- AGRRA: Atlantic and Gulf Rapid Reef Assessment Bleaching Protocol
- TNC Florida Reef Resilience Program, Expert Response Protocols
- Wildlife Conservation Society Bleaching Assessment Protocol

Plus various regional manuals.....



Why so many different survey protocols?

- Different questions/objectives
- Different levels of observers (scientists, rangers, resource users)
- Different resources (financial, time, boat, diving, plane)
- Different spatial scales (small, large)
- Different opportunities for partnership (communities, dive operators, glass bottom boats)

MANAGER'S GUIDE and R2 Toolkit useful to help you develop a protocol

Special Considerations for Bleaching Assessments

- Recognizing bleaching vs other impacts
- Accurately Describe Severity
- Decide when to Survey (before, during and after) to understand full impacts
- Statistical rigor
- Need a plan in place and be ready to go!
Bleaching is imminent!