

Coral bleaching and disease *continue* to cause extensive mortality on reefs in US Virgin Islands



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Tremendous Collaborative Effort



Matt Patterson

Caroline Rogers

Zandy Hillis-Starr

Erinn Muller

Ian Lundgren

Tony Spitzack

My wife -

Bane Schill

Jude Woodcock

Jim Murray

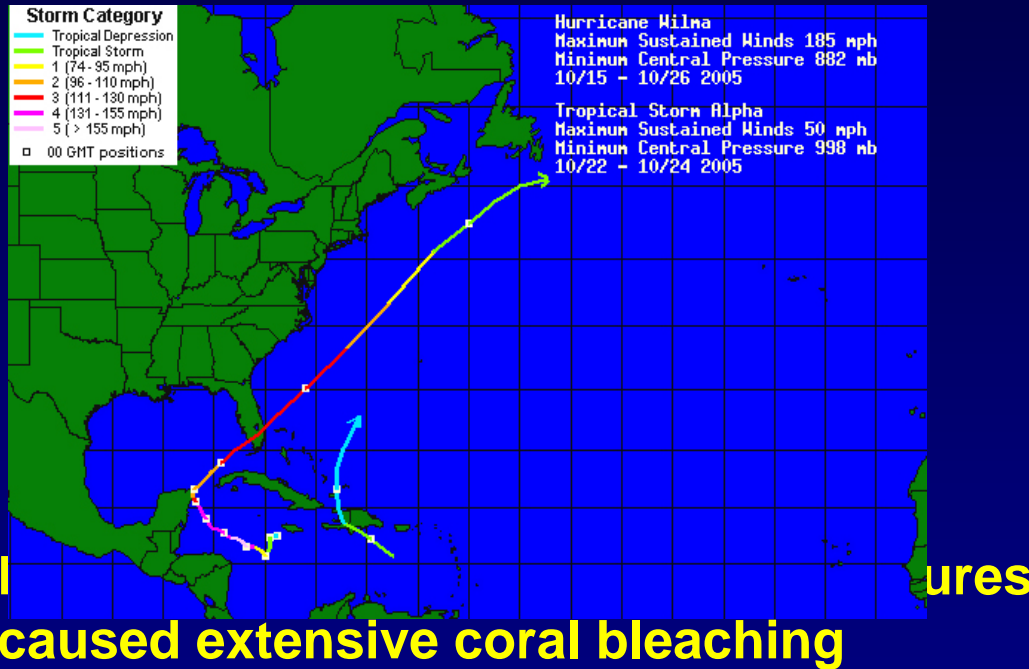
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Last year at this time.....

Coral Reef Task Force Meeting in Palau

Hurricane Wilma (cat 3) and TS Alpha





90%

Coral Cover
Bleached

Monitoring 120 transects
at 6 reefs sites (~31 acres)
at Buck Island Reef NM &
Virgin Islands NP



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Five Months Ago.....

Coral Reef Task Force Meeting in DC





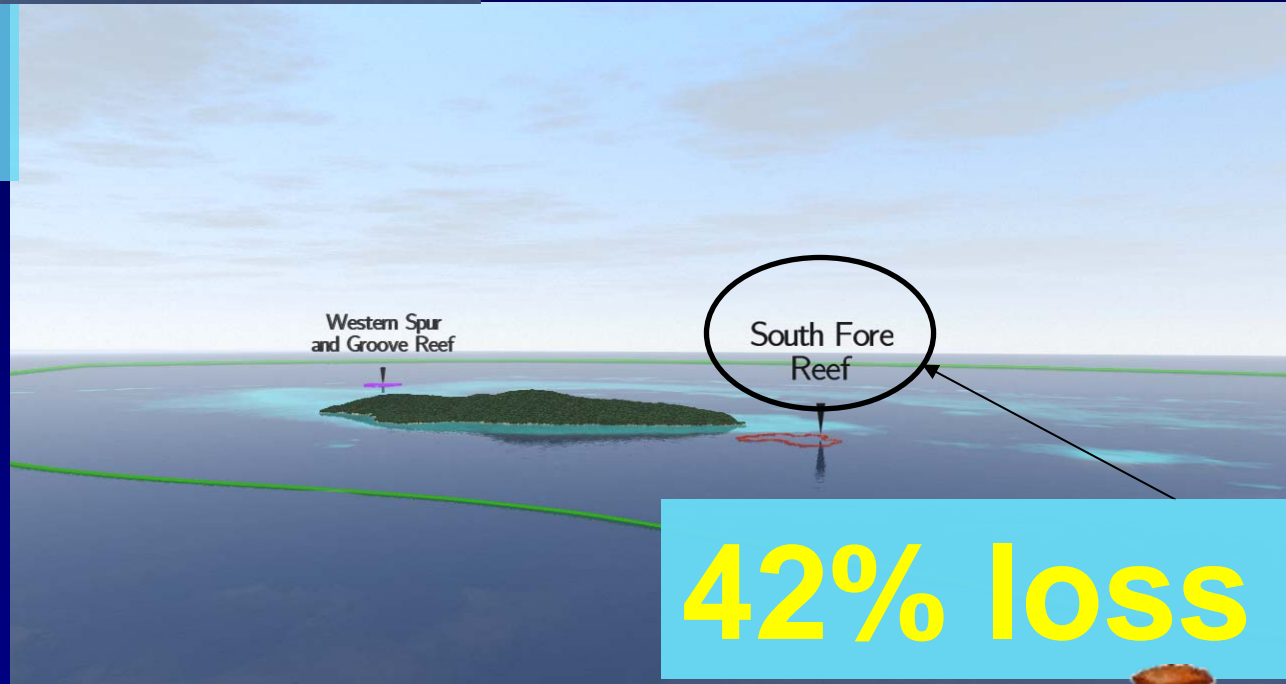
23% loss

28% loss

48% loss

**AVERAGE
LOSS**

35%

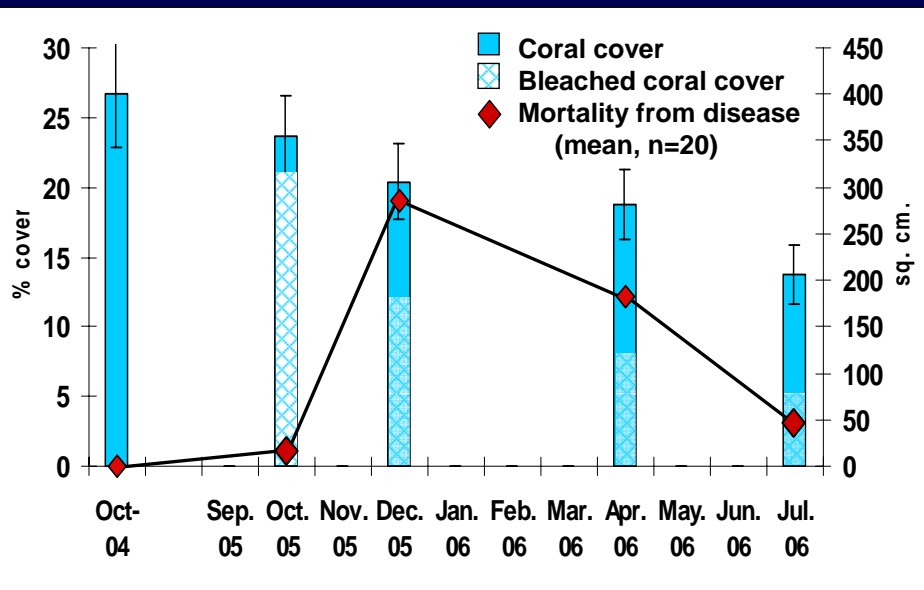


42% loss

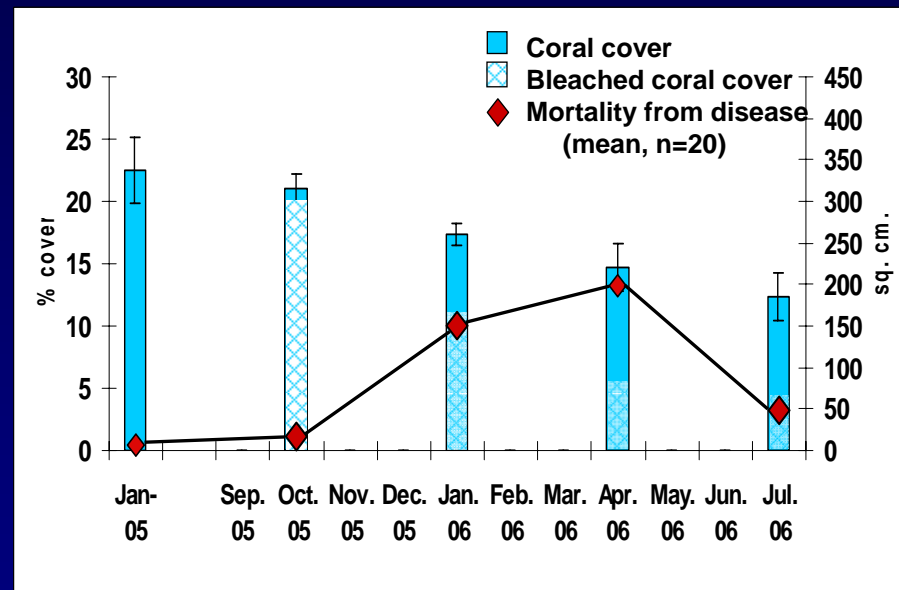


What we learned from this event

This “event” is not over – decline continues



Mennebeck Reef

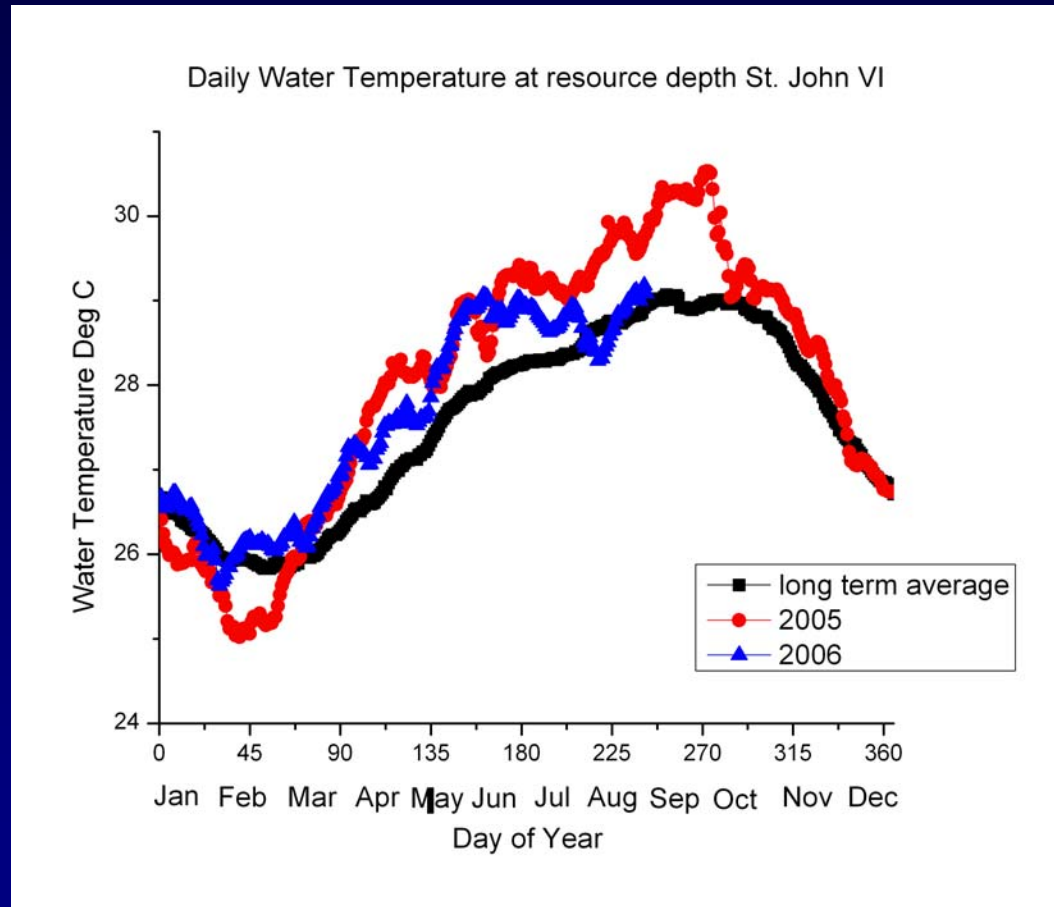


Haulover Reef



What we learned from this event

This “event” is not over – decline continues





45% loss

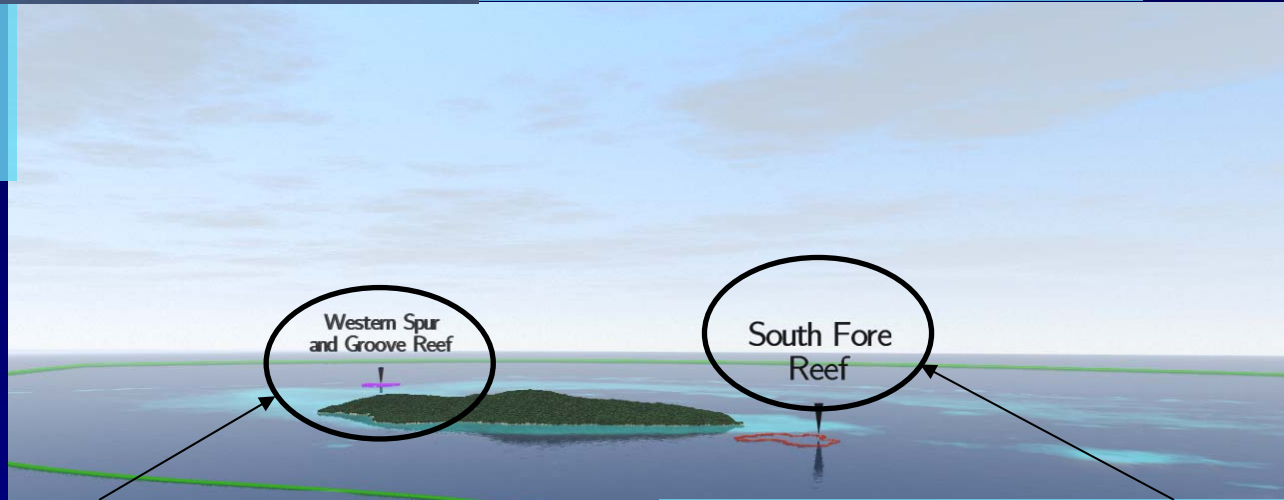
53% loss

49% loss

54% loss

**AVERAGE
LOSS**

45%



39% loss

42% loss



What we learned from this event

This was not just a coral bleaching event.

Tony Spitzack USGS following fate of 4153 colonies

Small proportion of these colonies died from bleaching

Most mortality occurred after coral began to regain color

If “just” coral

(=no m

m



e).....

al



What we learned from this event

Coral disease caused majority of coral mortality.

Erinn Muller of USGS monitored **6061** lesions

disease lesions “pre”17 (range: 8-33)

disease lesions “peak”**727** (range: **569-1213**)

4x – 80x increase in area of mortality from disease

Mortality from  e normal

Mortality from  monitored

What is “normal”  for your reef?



What we learned from this event

Need well-designed monitoring program in place **before** event takes place

Area of interest (not necessarily entire “park”)

Multi-zone approach (better coverage)

Randomly chosen samples (larger zone of inference)

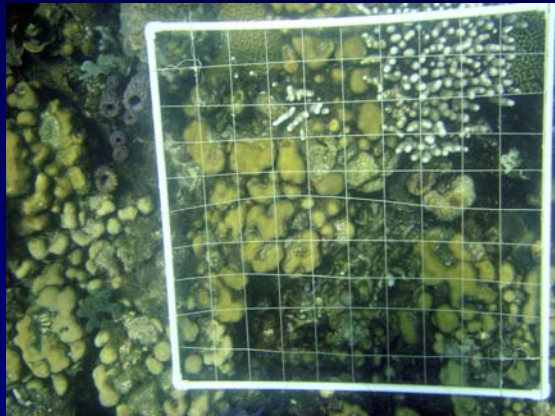
Permanent plots/transects

Knowledge of coral cover trends, and “normal” disease mortality level

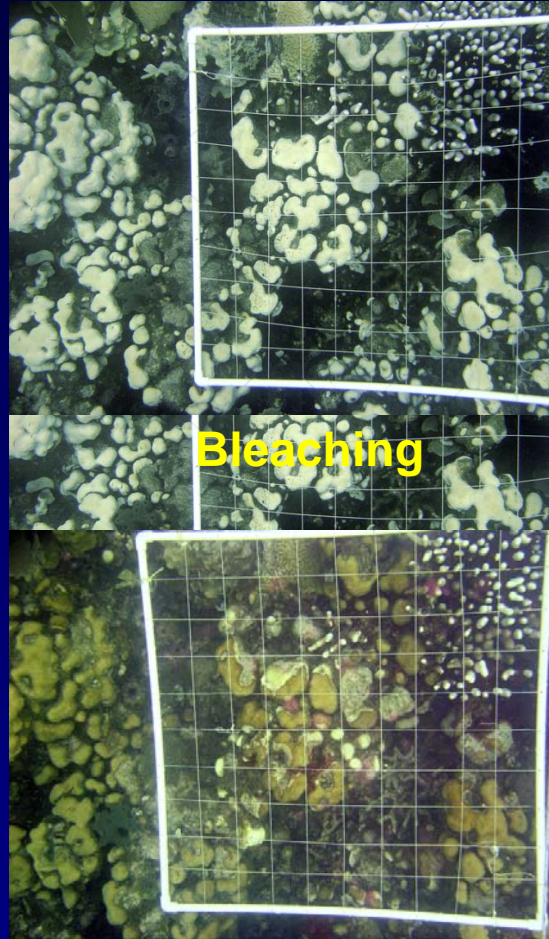


What we learned from this event

Increase monitoring frequency

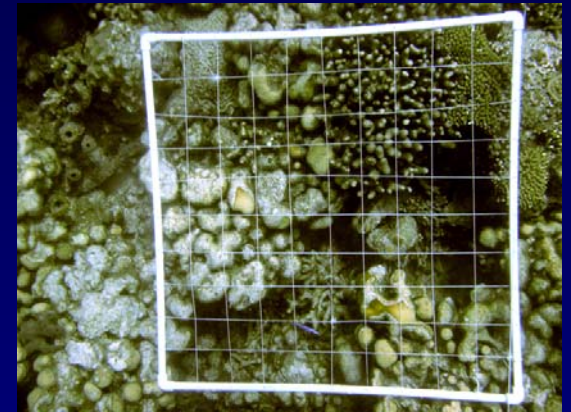


2005



Bleaching

Disease



2006

Much we still need to learn.....

What is the mechanism of mortality and pathogen(s) with coral disease?

Quality of surviving corals....

Ultra-strong? or barely alive?

Fecundity:

Where will the future corals come from?

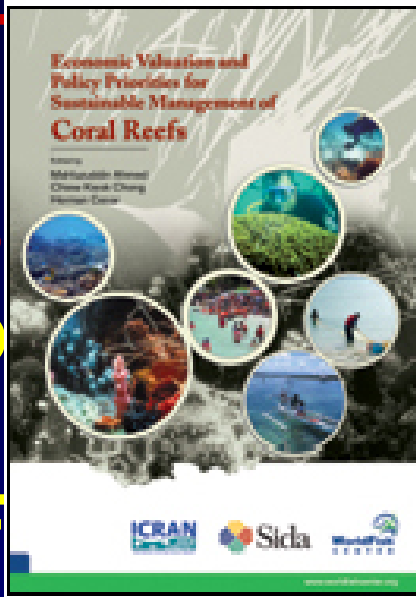
Effect on Fishery:

Dead reef structure = Live reef structure?



Socio-economic impact

8
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F



Economic Valuation and Policy Priorities for Sustainable Management of Coral Reefs

ISBN 983-2348-29-0X

tourism.
(Eco. Resh.)

ing the

nds-VINP)

US

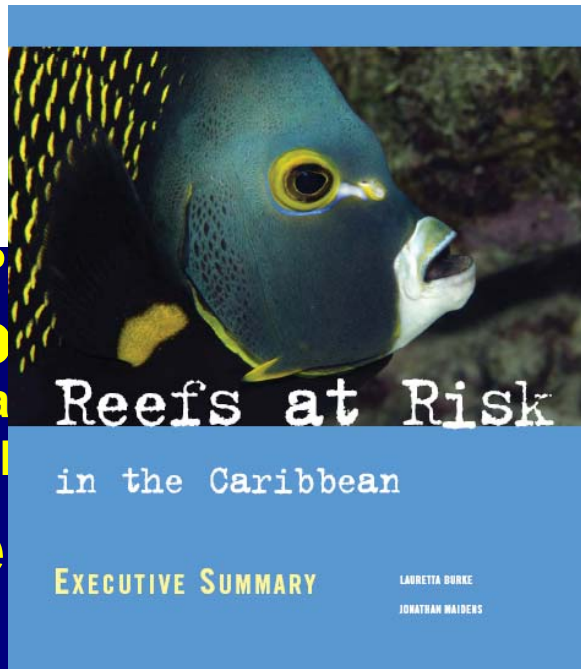
(Virgin Isl. NP, B

Local Job

incl. local area
incl. NPS empl

Park's Be

incl. spending
incl. spending by NPS employees or wages, salaries, benefits



reas.....\$99,966,000

s



Much ~~Swedish~~ ~~to~~ ~~be~~ ~~needed~~ ~~to~~ ~~interact~~

Effect on **Tourism**:

Will **visitors** be attracted to and use

Dead reef structure = Live reef structure

Effect on **Fishery**:

Will fish be attracted to and use

Dead reef structure = Live reef structure?



Socio-economic impact

Reefs provide

Shoreline protection - \$0.7 to 2.2 Billion

Fishing - \$300 Million

Tourism - Dive Tourism: \$2.1 Billion

Biodiversity: ~1,000,000 species

Bio-prospecting: source of new drugs, UVI

Connectivity: where do future reefs come from?

Intrinsic value: what is a healthy reef “worth”?

\$3.1 - \$4.6 Billion (year-2000; source Reefs at Risk)



What we've learned



October 1997

Killed by white plague



October 2006

**Overgrowth by algae
Bio-erosion
Growth of finger and
small plate coral**



Photo by NPS

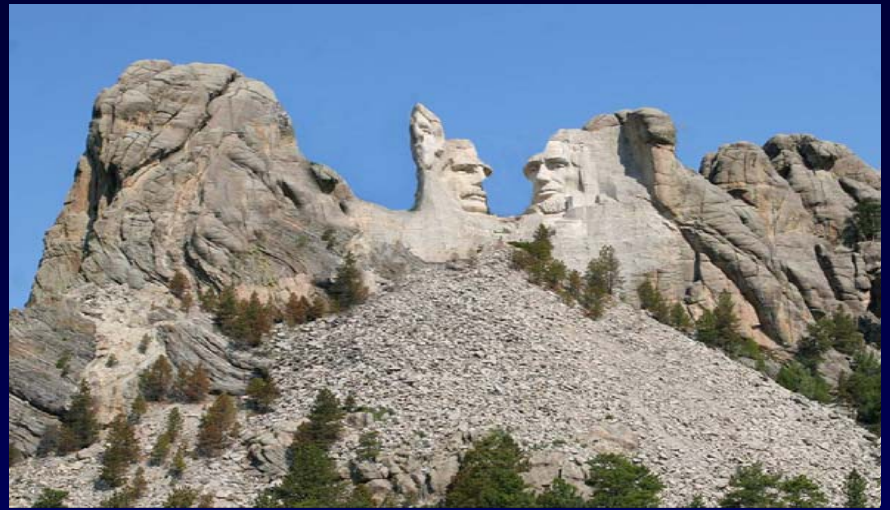


Photo by Judd Patterson



Photo by Judd Patterson

Animations by Judd Patterson

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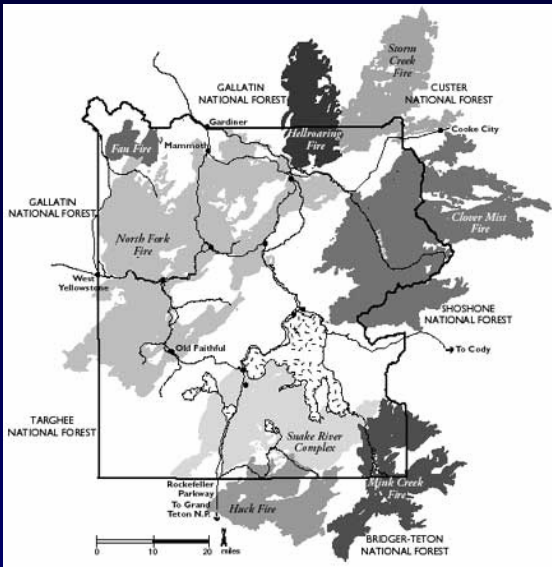
Conclusion

1988 Yellowstone Fire Season

Burned about ~~880,000~~ acres

25,000 firefighters

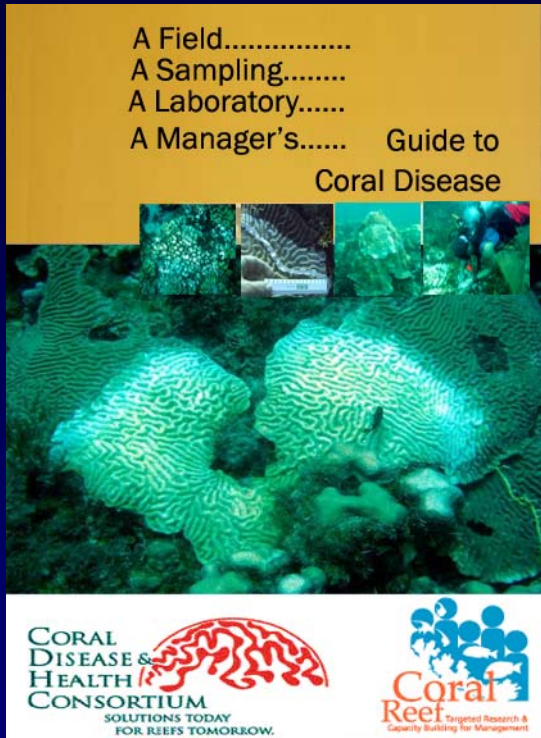
\$120,000,000 logistical support



**RESULT: re-evaluation of
NPS Wildland Fire Management**



Now available for....



A Field Manager's Guide to Coral Bleaching

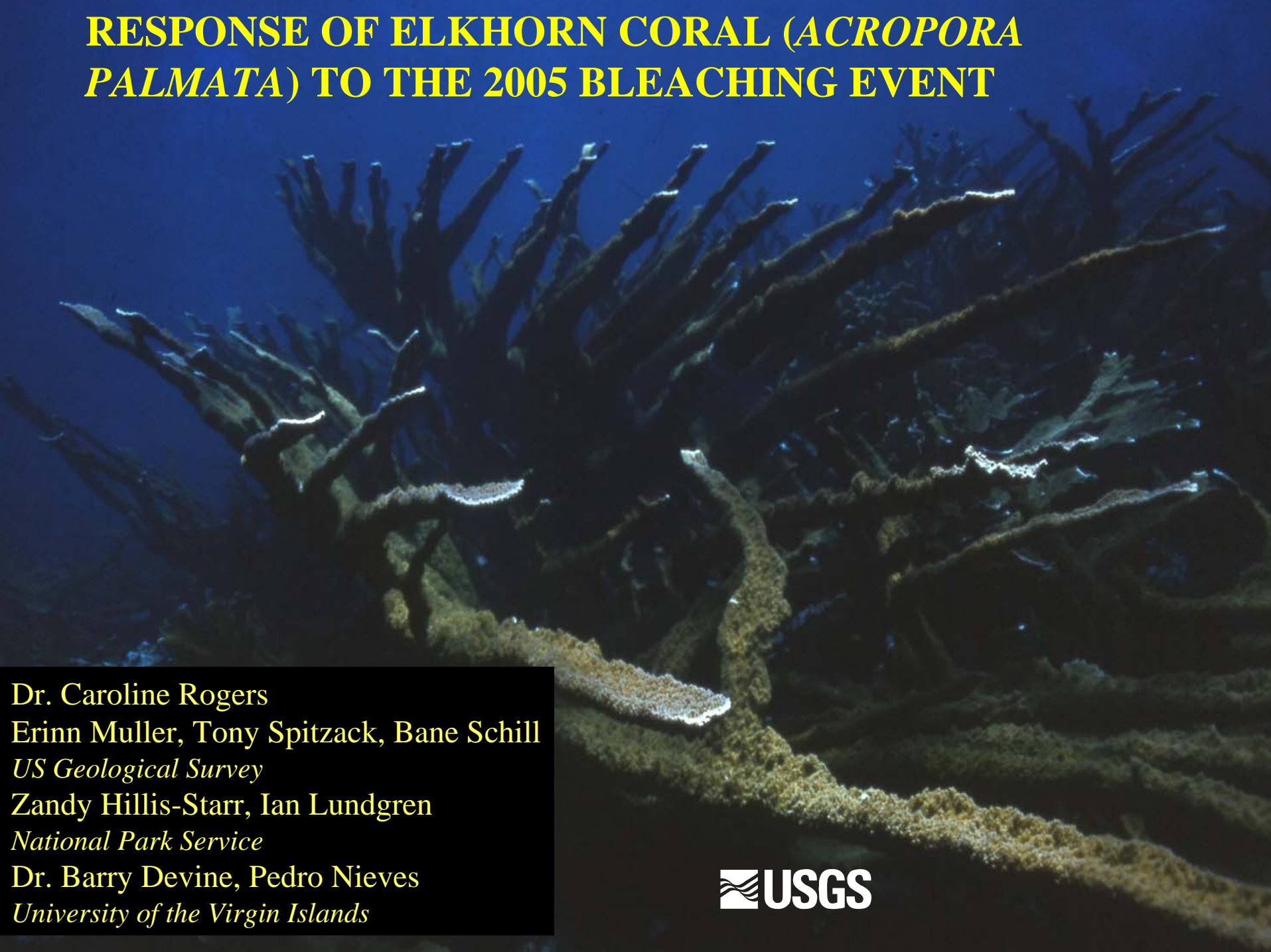
Managing
Responding
Resilience
Causes and Consequences

Well managed areas with undeveloped watersheds
High coral cover, diversity, and complexity sites
Showed little mortality to 1997-98 bleaching

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RESPONSE OF ELKHORN CORAL (*ACROPORA PALMATA*) TO THE 2005 BLEACHING EVENT



Dr. Caroline Rogers
Erinn Muller, Tony Spitzack, Bane Schill
US Geological Survey
Zandy Hillis-Starr, Ian Lundgren
National Park Service
Dr. Barry Devine, Pedro Nieves
University of the Virgin Islands



Why is elkhorn coral important?

- *Listed as threatened under the ESA (losses from disease and storms)*
- *Large, complex colonies create the architecture of the reef*
- *Habitat for high diversity of organisms—fishes, sea turtles*



Monthly monitoring of individual elkhorn colonies starting in 2003

460+ individual elkhorn colonies

4 sites within Virgin Islands National Park

Photographs of each colony, each month

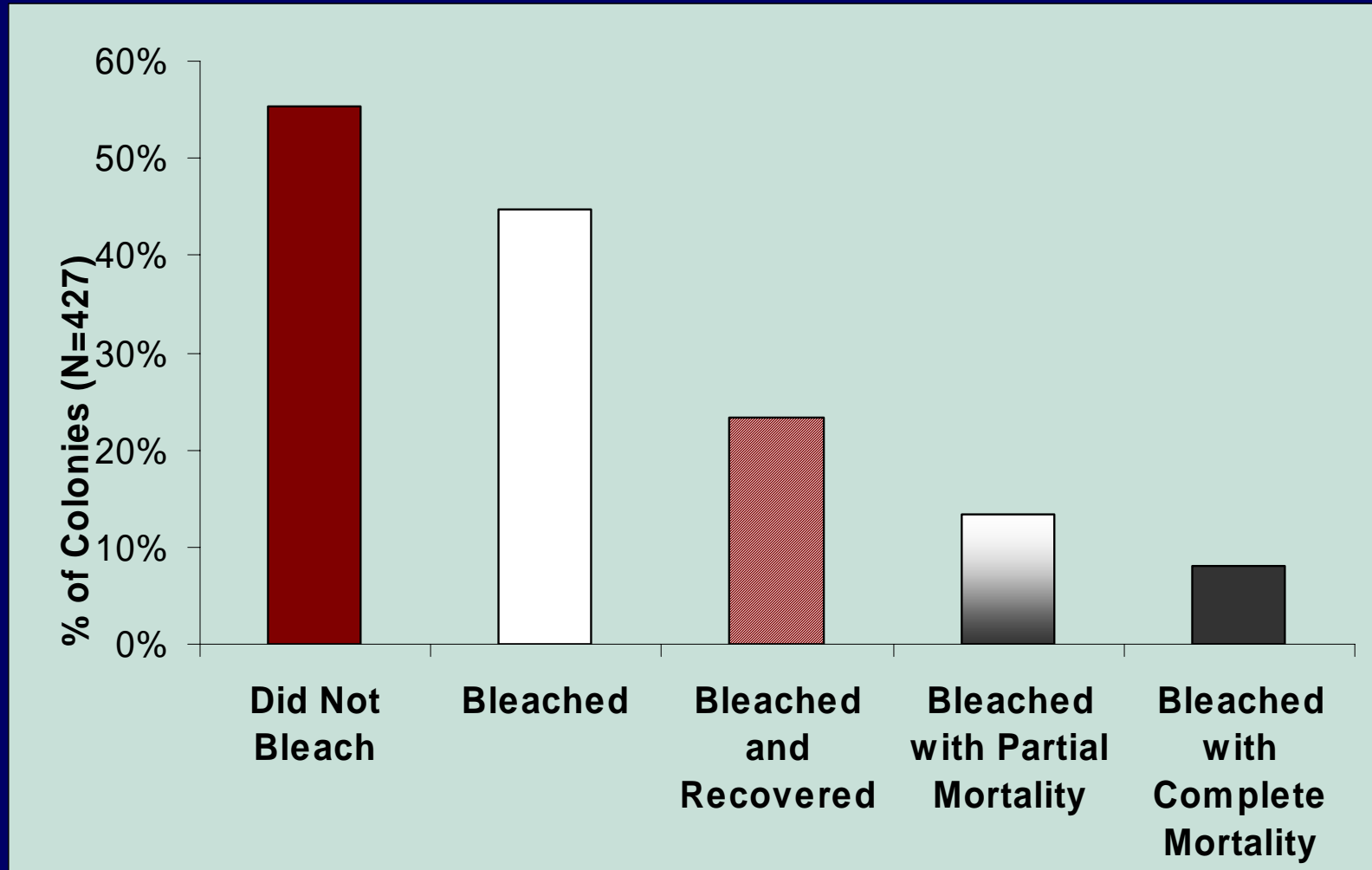


Disease, physical damage, other factors that could limit recovery

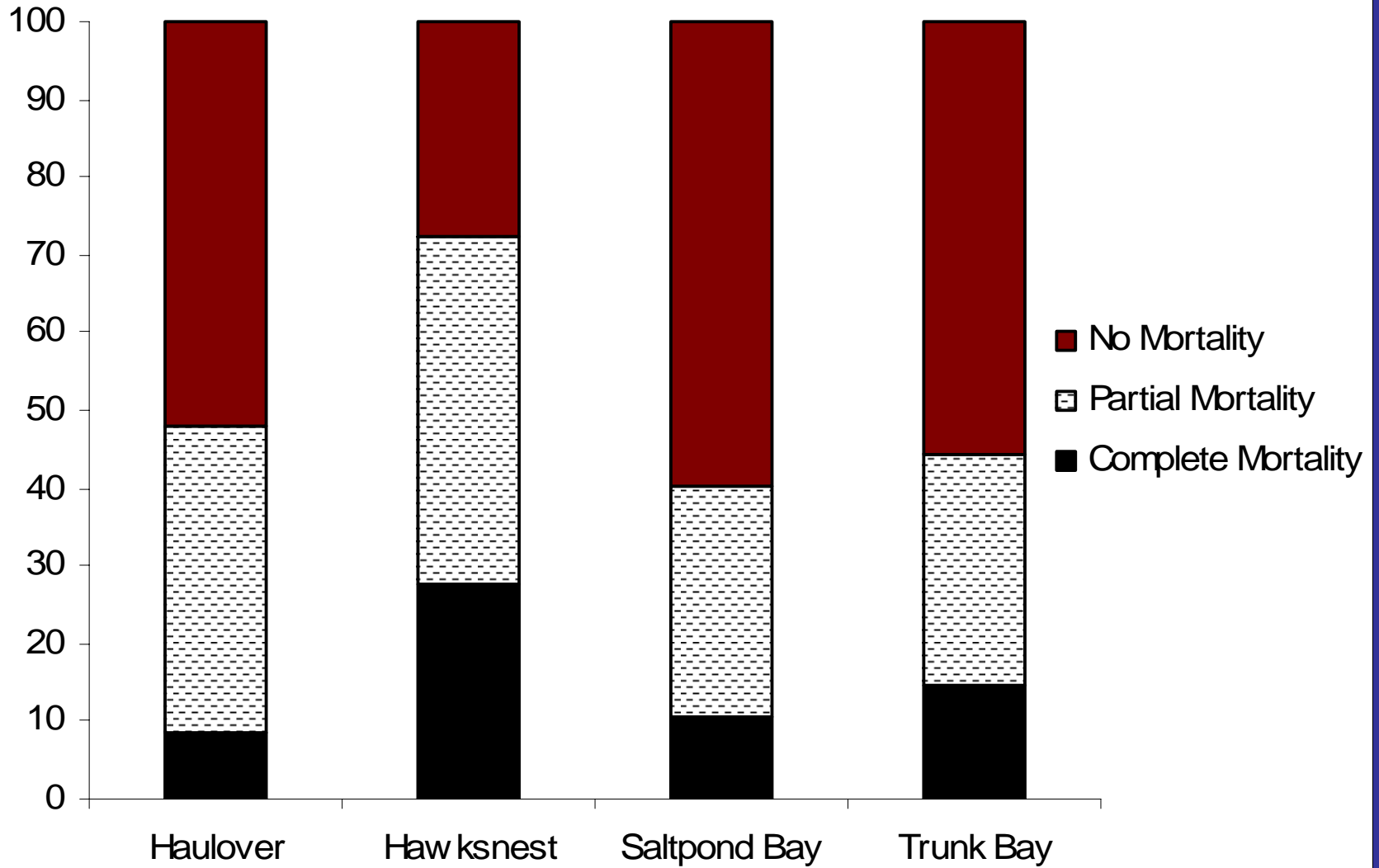


Response of elkhorn coral from St. John study sites

★ The first time elkhorn bleached in the VI



FATE OF BLEACHED ELKHORN COLONIES



Buck Island Reef National Monument, St. Croix USVI





SUPER-SIZED (“Venti”) ELKHORN COLONIES HARD HIT BY BLEACHING

Buck Island Reef National Monument, St. Croix USVI



Bleaching, Mortality, and Recovery – **Barrier Reef**

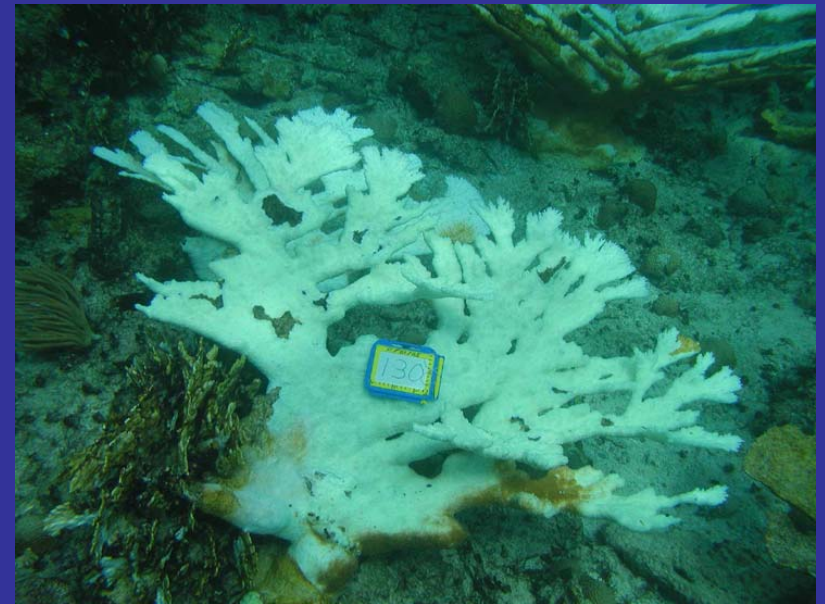
Bleaching

- 23/35 colonies (66%) bleached

Mortality

- One-half of the colonies died completely between August 2005 to January 2006

Depth =
average 2 m



Buck Island Reef National Monument, St. Croix USVI

Bleaching, Mortality, and Recovery – **Outside the Barrier Reef**



Bleaching

- 178/289 colonies (62%) bleached



Mortality

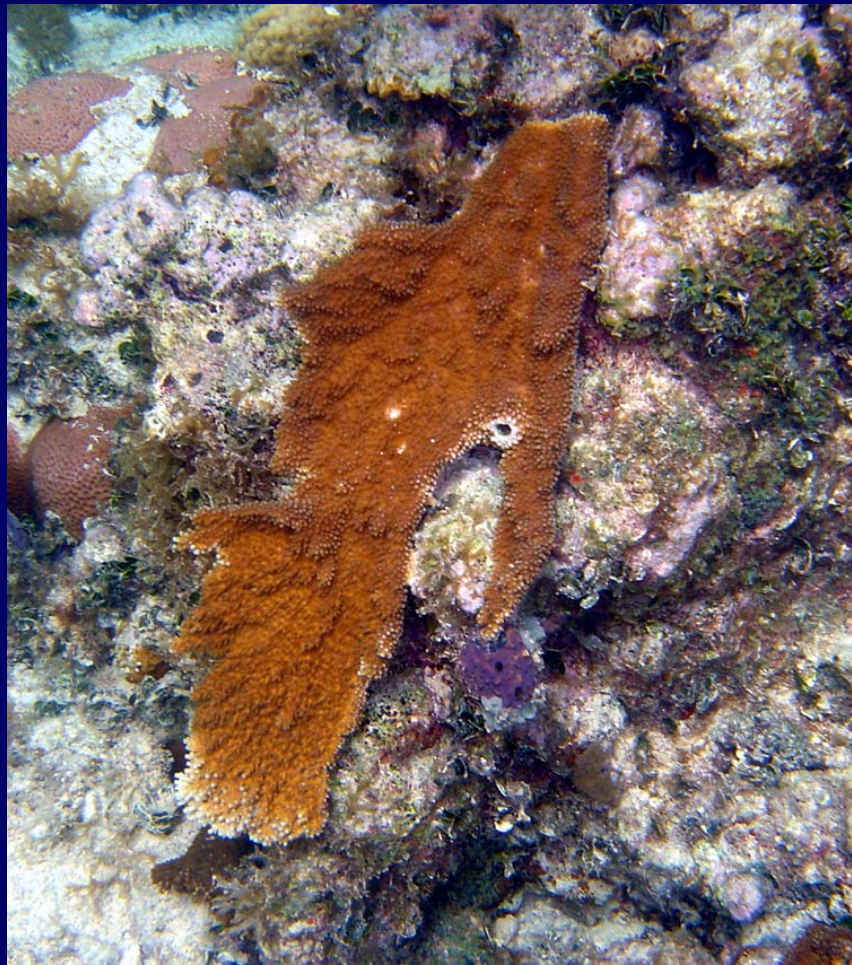
- 6 of 76 (8%) of the colonies died completely between August 2005 and January 2006



Depth = maximum 10 m



- **Elkhorn coral reefs (< 6m) responded differently than deeper reefs (max. 20 m) dominated by star and brain corals**
- **Elkhorn corals that bleached did NOT begin to recover and then suffer major outbreak of disease**
- **Coral cover losses are continuing on the deeper reefs**



Elkhorn “clones” are created when branches break off and start new colonies—

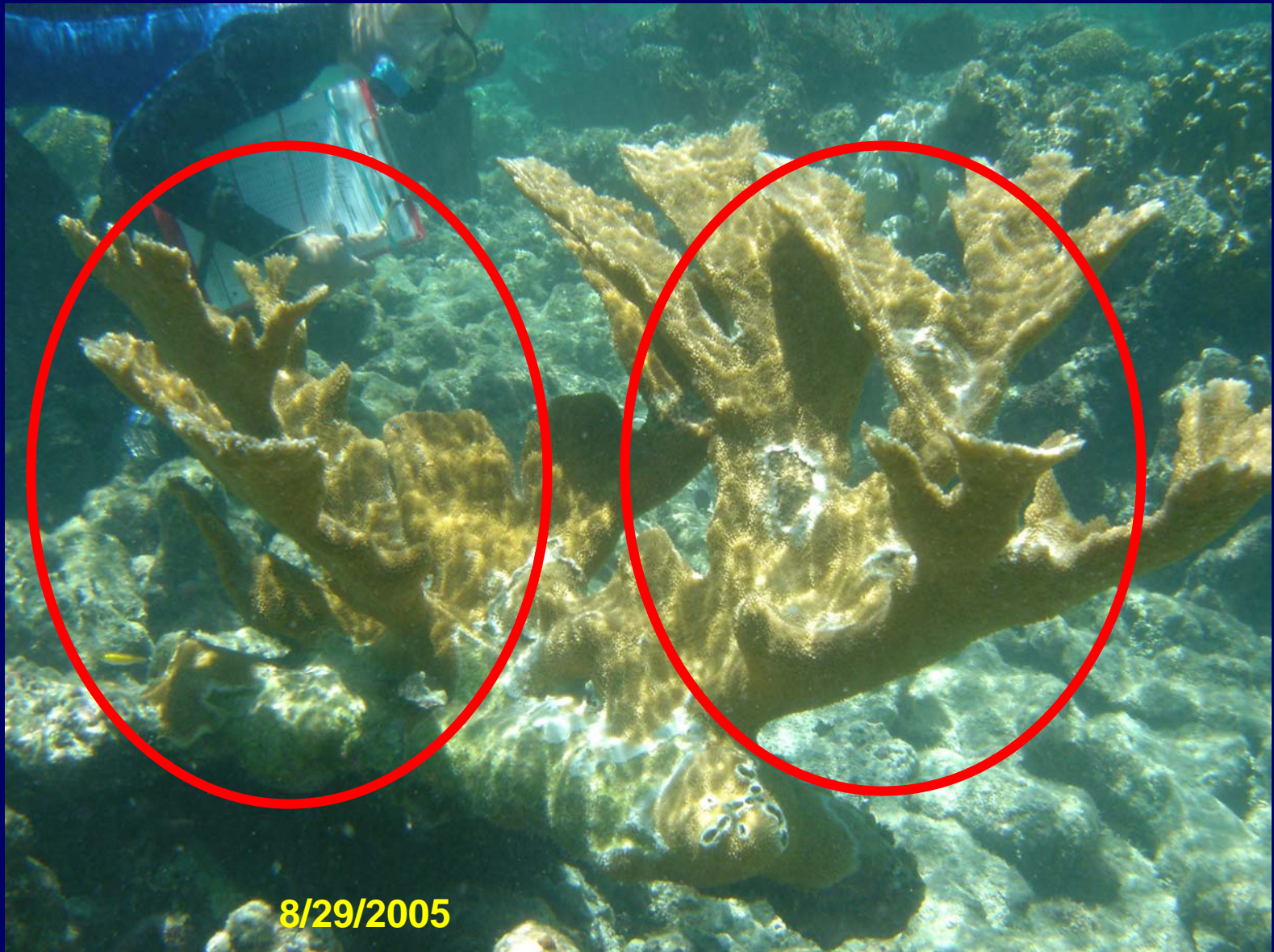
Two colonies near each other with the same genotype
(clones)—
Neither bleached



A SEXUAL RECRUIT (from a larva)



Elkhorn reefs which have colonies of many different genotypes (higher diversity) might be more resistant and resilient to bleaching and disease (*highlighted in Manager's Guide to Bleaching*)

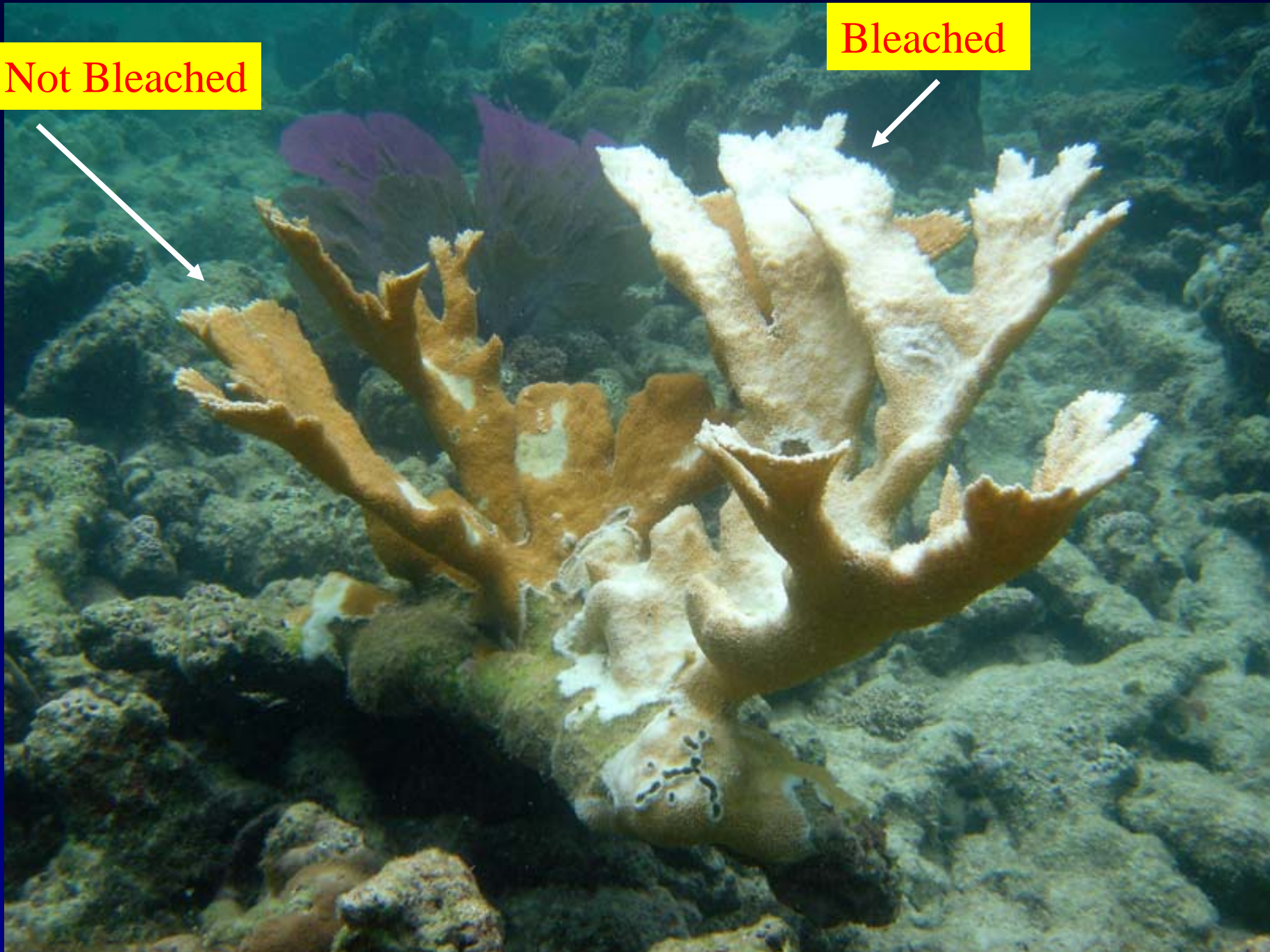


8/29/2005

TWO SEPARATE, ADJACENT ELKHORN COLONIES

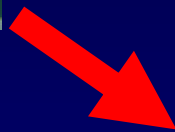
Not Bleached

Bleached





9/29/2005



11/30/2005

PRIORITIES FOR RESEARCH

- Continue research on coral/zooxanthellae genotypes
- Continue research on microbial communities associated with diseased and healthy corals
- Continue research on the basic symbiotic relationship (corals + zoox.= solar-powered animals)





Non-destructive method for sampling corals

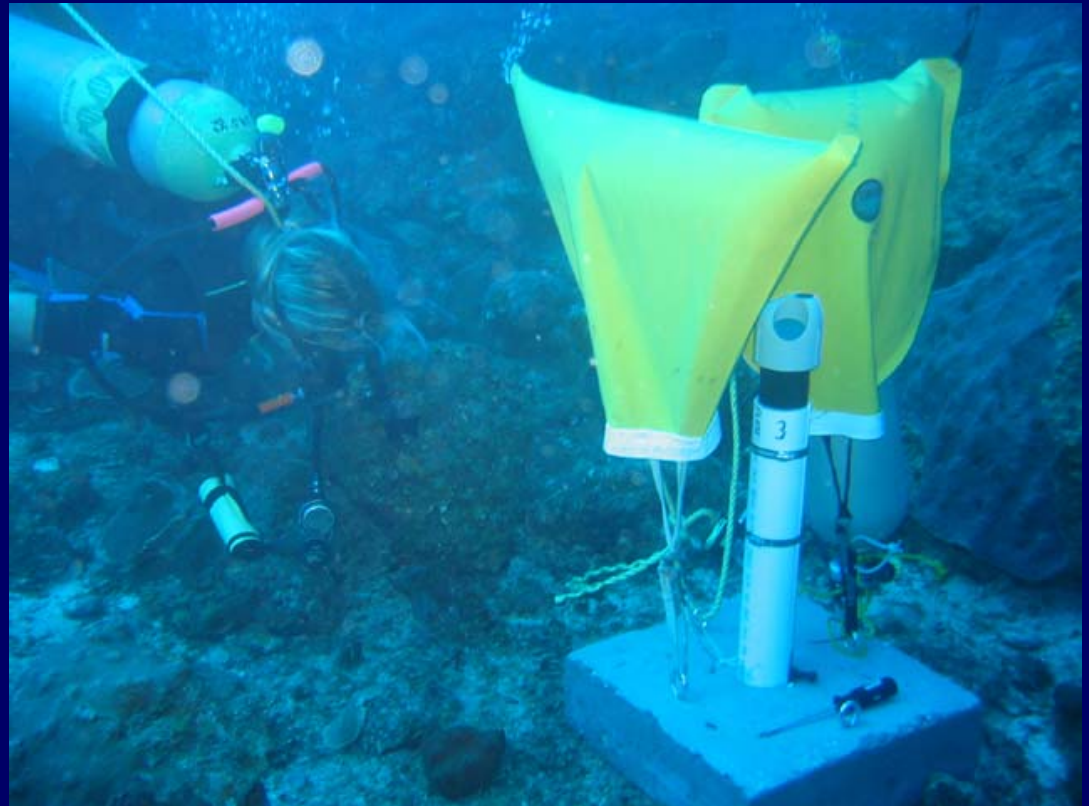
Recent research by Bane Schill (USGS) indicated different microbes (alphaproteobacteria) associated with healthy and diseased corals—(please see Fact Sheet)

OTHER RESEARCH/MANAGEMENT PRIORITIES

- **Build on existing collaborations to integrate long-term monitoring with field sampling of diseases/lab. analysis (“ecological history”)**
- **Determine the links between human activities and bleaching/disease (synergy of stressors assaulting reefs)**
- **Determine the effects of coral losses on fishes and other organisms**



*•Consider identifying more **RESISTANT** and **RESILIENT** corals and coral reefs for greater protection (“TOUGHER” GENOTYPES)*

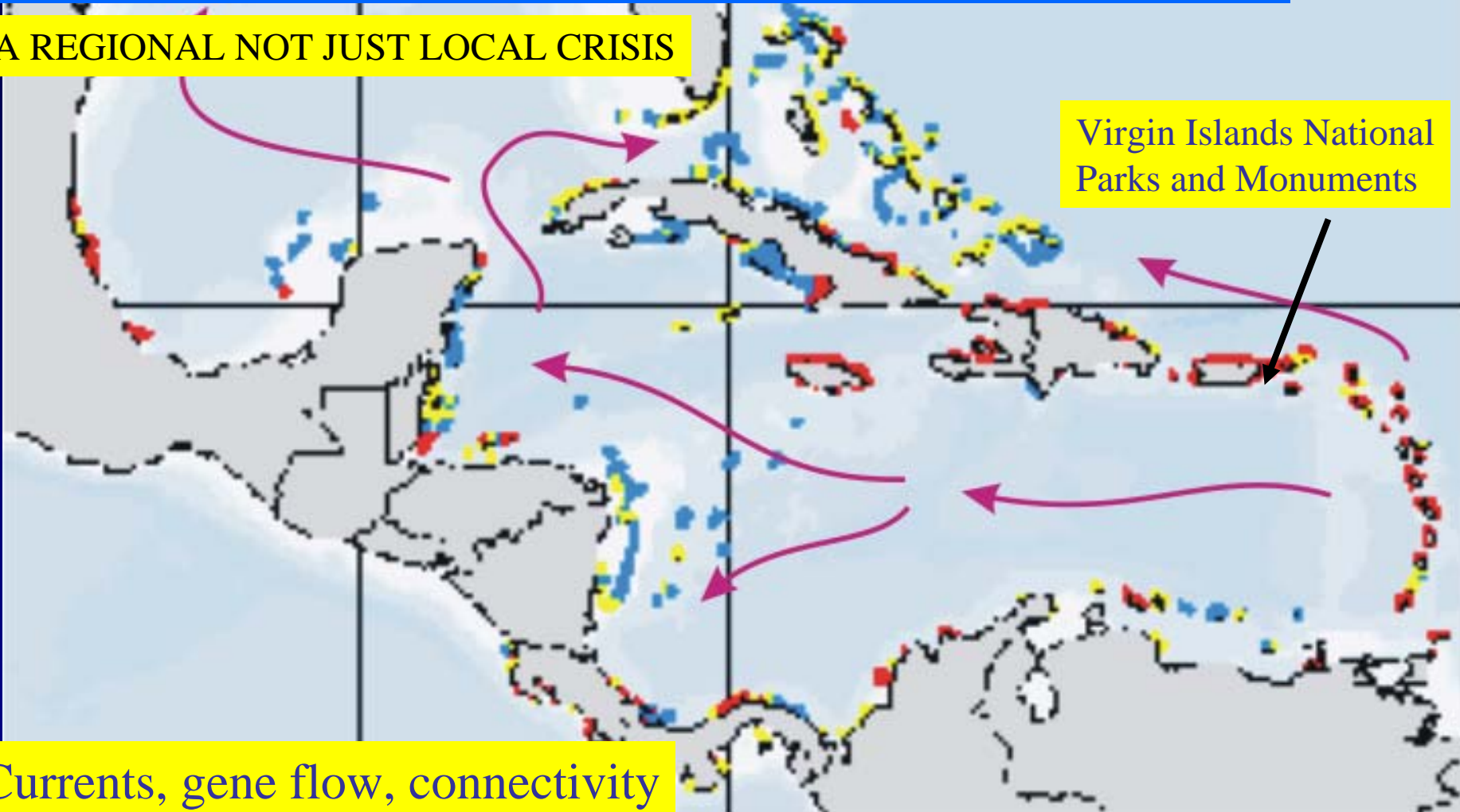


CONNECTIVITY--Where will future corals/fishes come from?

A REGIONAL NOT JUST LOCAL CRISIS

Virgin Islands National Parks and Monuments

Currents, gene flow, connectivity





Support the CDHC as a way to bring a diverse group of scientists and managers together to document aftermath of 2005 event, future events, and “recovery”

Exciting opportunities for collaboration!!

Acknowledgements

- NOAA, NPS, UVI, USGS, Disney Wildlife Conservation Fund, Dr. Mark Monaco, Master Chris Caldow, Dr. Iliana Baums, many others
- Numerous volunteers

