An underwater photograph of a coral reef. The coral appears mostly white and bleached, with some dark patches. A black and yellow fish is visible in the center. The water is clear blue.

Climate Change and Coral Bleaching in Puerto Rico: Efforts and Challenges

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Aileen T. Velazco-Domínguez, MS
Puerto Rico Department of Natural and Environmental
Resources

Ernesto Weil, PhD
Dept. of Marine Sciences, University of Puerto Rico

Andy Brückner, PhD
NOAA

Climate Change and Coral Bleaching in Puerto Rico: Efforts and Challenges



“More coral reef related disturbances occur in the Caribbean than in any other region.”

Status of Coral Bleaching in Puerto Rico

Chronology Based on:

Williams, E. H., Jr. and L. Bunkley-Williams. 2000. Caribbean marine major ecological disturbances. *Infectious Diseases Review* 2: 110-127.



Winter A. , R.S. Appeldoorn, A. Bruckner, E.H. Williams, and C. Goenaga. 1998. Sea surface temperatures and coral reef bleaching off La Parguera, Puerto Rico (northeast Caribbean Sea). *Coral Reefs* 17:377-382.



Status of Coral Bleaching in Puerto Rico:

Chronology of Events

(after Williams and Williams, 2000)

- **1979 - 80 Bleaching Complex (poorly documented)**
- ○ Limited in severity and extent, either partial mortalities within colonies or no mortality.

- **1982 - 83 Bleaching Complex**
- ○ Most of the bleaching for the Western Caribbean occurred in 1983, with partial mortalities within colonies, but few whole colonies died. (Major impact in the Eastern Pacific.)

Status of Coral Bleaching in Puerto Rico: Chronology of Events

- **1986 - 88 Bleaching Complex (circumtropical/subtropical event due to temperatures above normal annual maximum)**
- ○ 1987 - Major bleaching in the Caribbean, mass bleaching in Puerto Rico, minor bleaching in 1988. Reports for PR included extensive partial coral mortalities and some total mortalities of coral reef organisms, including death of some 400-500 year old colonies.
- **1989 - 91 Bleaching Complex**
- ○ 1989 – Minor bleaching (Hurricane Hugo)
- ○ 1990 - Most severe bleaching ever experienced in the Western North Atlantic (from Bermuda, Texas, Florida, throughout the Caribbean, down to Brazil). Mass mortalities of fire corals and stony corals. Over the long term, corals, gorgonians, sponges, and other coral reef organisms died.

Status of Coral Bleaching in Puerto Rico: Chronology of Events

➤ 1994 - 96 Bleaching Complex

- ○ 1995 – Severe and widespread bleaching throughout Caribbean. A few places reported corals were bleached for the first time. Few mortalities reported. Event not as destructive in the Caribbean as in 1990.

➤ 1997 - 99 Bleaching Complex

- ○ 1998 – **Strongest bleaching event in Puerto Rico** (July-September). Severe bleaching in the Caribbean, moderate damage in northwest Caribbean (Hurricane Georges).
- ○ 1999 – Bleaching event in Puerto Rico (August- September).
 - Most of the colonies bleached in many reefs, but without significant mortality. Few colonies suffered partial mortality (less than 5 % of the live surface area on average).

Coral bleaching and recuperation in Puerto Rico from 1998 – 2000.

Ernesto Weil, Ph.D
Department of Marine Sciences
University of Puerto Rico



Status of Coral Bleaching in Puerto Rico: Chronology of Events

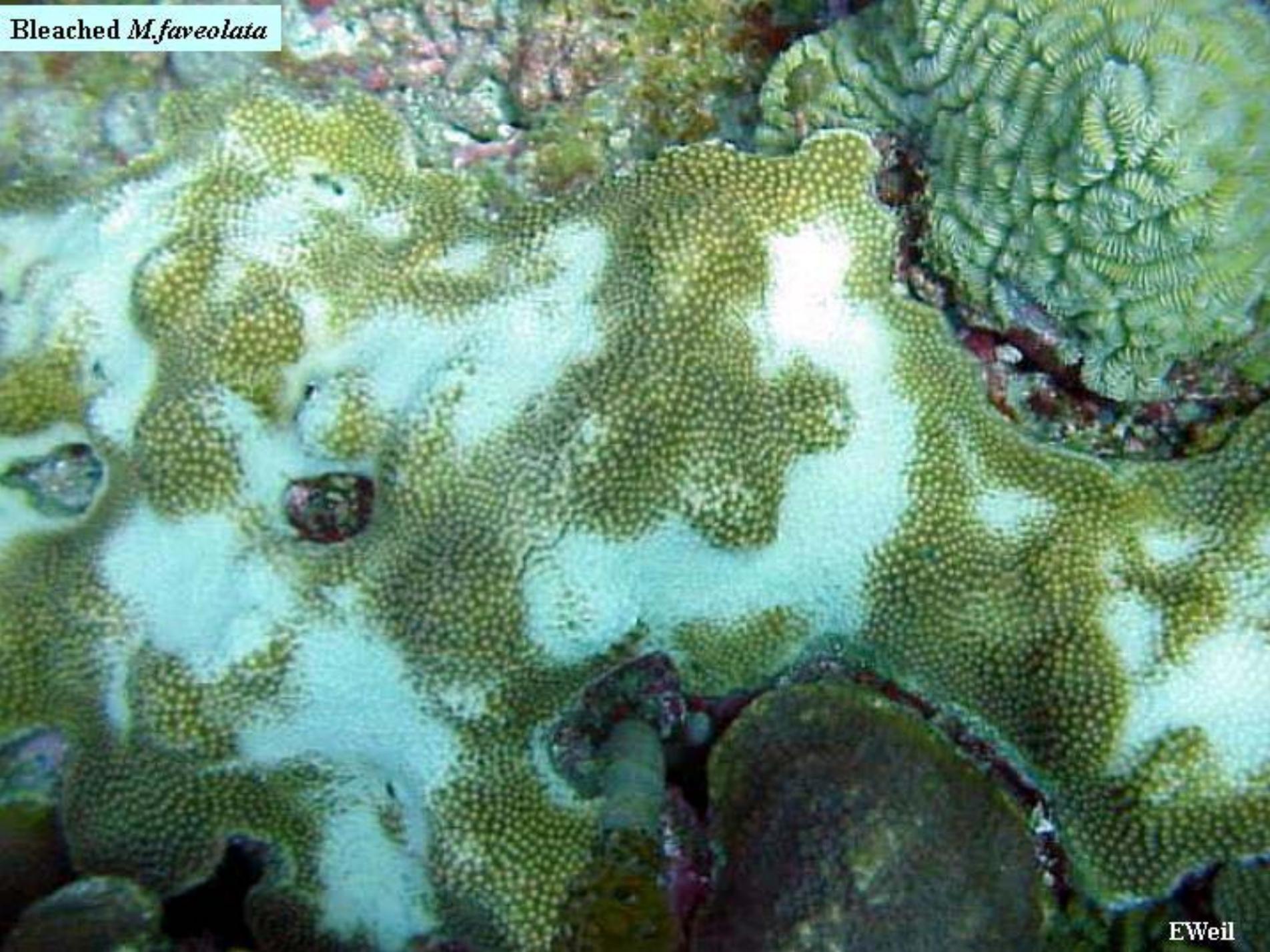
➤ 1997 - 99 Bleaching Complex (cont.)

- Dr. Ernesto Weil tagged 386 colonies of 23 species after they completely bleached in 1998 (July to September; Hurricane Georges) and followed them for 3yrs.
 - 99 % of them completely recovered after 9 months.
 - 15 % of the colonies bleached again in 1999 and recovered by January 2000.

Dr. Weil considers that there has not been a "deadly" bleaching event in Puerto Rico. Even the strongest one in 1998, when most of the colonies bleached in many reefs, did not have a significant mortality of corals associated with it.

No associated disease outbreak observed.

Bleached *M. faveolata*



Normal *M.memoralis*

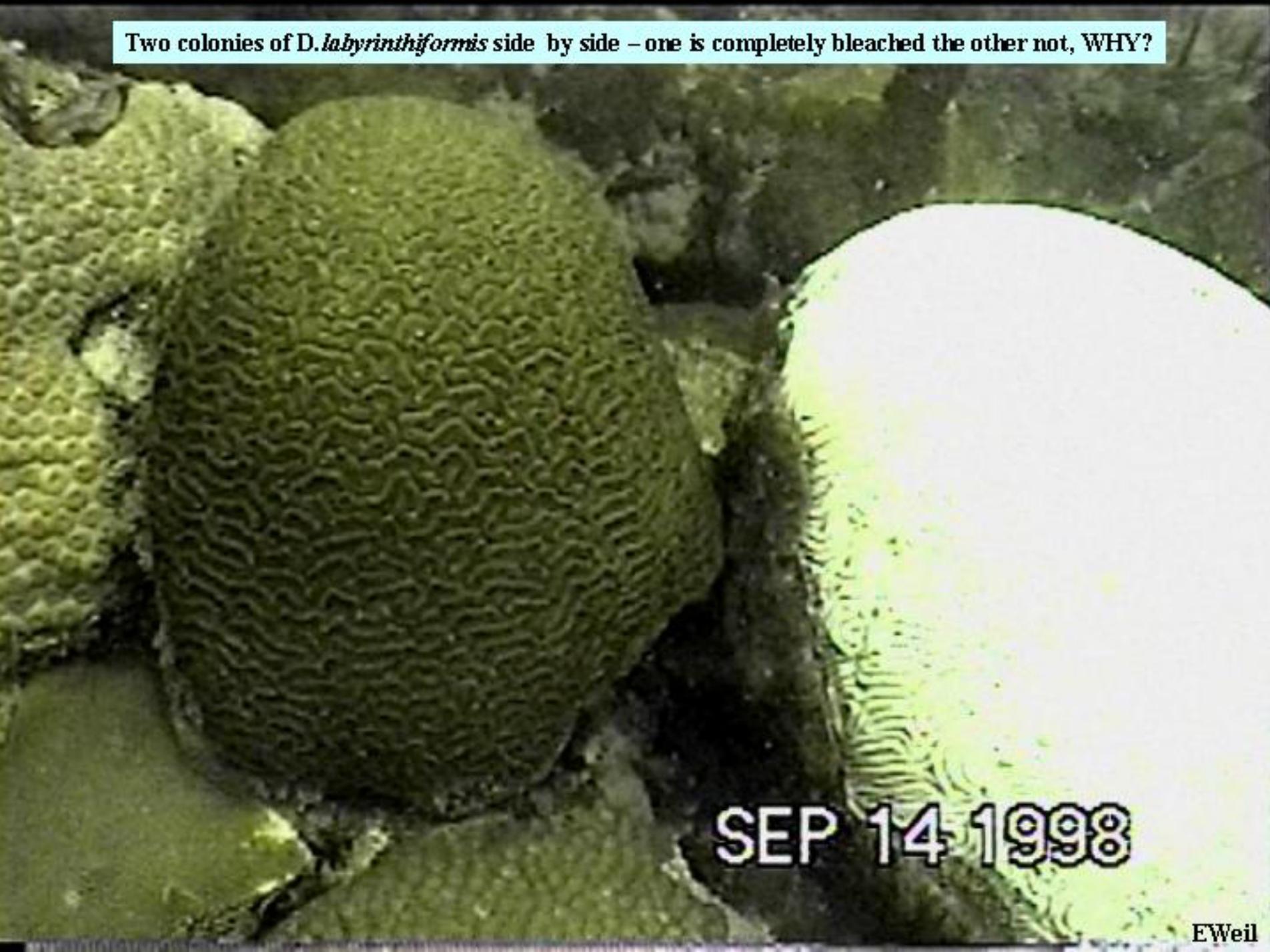


Bleached *M.memoralis*



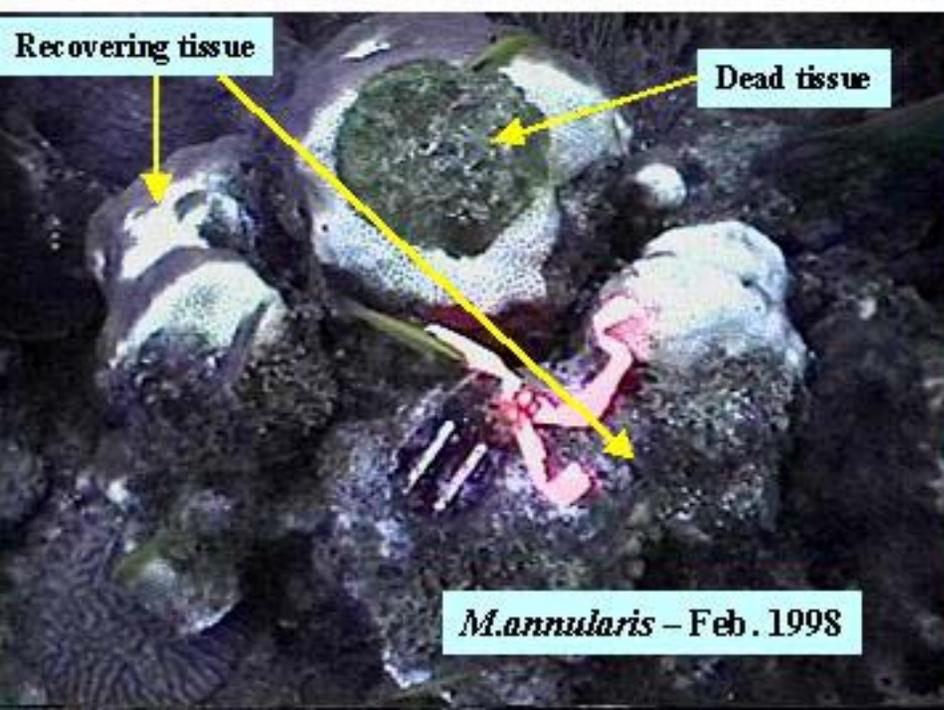


Two colonies of *D. labyrinthiformis* side by side – one is completely bleached the other not, WHY?



SEP 14 1998





Research and Information Needs

- Establish good baseline data and consistent monitoring; Are some coral reefs --or species of corals-- more prone to bleach? Could we predict that event and implement preventive management actions for coral bleaching?
- Need to know how cumulative stresses reduce the ability of reefs to recover from bleaching.
- Analyze historical data on mortalities of major coral reef related organisms (like fishes, sponges, sea urchins, gorgonians, and others).
- How do these events compare to coral bleaching and/or disease outbreaks and what about their response to hurricanes?
- Do corals recover after the combined effects of bleaching and hurricanes?

Research and Information Needs

- Are there any differences in the capacity of corals to recover between areas of the same region? If so, what causes this to happen? Do these areas also have more incidence of diseases?
- Why are some colonies of the same species more resilient?
- Any genetic differences?
- Are there any disease outbreaks after a bleaching event?
- Are there any differences in the pattern of circulation of ocean currents that may be associated with the onset of major marine ecological events?
- Scientists need to communicate more with managers. Managers need to communicate their concerns to scientists. Maybe there are some answers to the questions we ask. Or maybe “anecdotal” information may harbor the clue for scientists to find the answers.

Resource Managers Needs

- **Establish Standard Rapid Bleaching Assessment and Monitoring Protocols:** Define and characterize bleaching, differentiate from other conditions. Prepare field photo id. guide. Define minor, moderate, severe, major bleaching.
- **Establish Uniform Reporting Protocols.**
- **Establish or Improve Alert System:** To call on authorities or work in coordination with authorities (Eg. Local and federal agencies, academy, others) if there's a need to close or restrict activities in some of the areas.

CREWS Stations in Puerto Rico: Possible locations: Culebra, Parguera, and Mona Island.

Resource Managers Needs

- **Establish Media Response Protocols:** To address public perception and reduce potential economic impacts.
 - What should we tell the public? How? Who should address the media?
- **Workshops or Seminars: Develop local expertise.** Train key individuals and designate a Rapid Response Team. All should utilize and follow standard protocols, utilize same terminology, and clearly identify or distinguish bleaching from a disease.
- **Inform Managers of Research Findings:** Communicate regulatory and management authorities of any management actions recommended.

What can be Done?

- **Work on controlling stress factors:**
 - **Land based sources of pollution: impacts from watershed area such as sediment runoff, pesticides, nutrients, direct human impacts, and others that will reduce the natural recovery capacity of reefs.**
- **Reduce or Eliminate**
 - ✓ Over-fishing
 - ✓ Discharges
 - ✓ Recreational and Commercial Overuse and Misuse
 - ✓ Vessel Groundings and Improper Anchoring
 - ✓ Military Activities
- Encourage Reforestation
- Designate Marine Protected Areas
- Restore Coral Reef Areas
- ¹⁹ Awareness through Education and Information

Any Solutions?

“ Conditions do not appear to be conducive to coral bleaching today.”

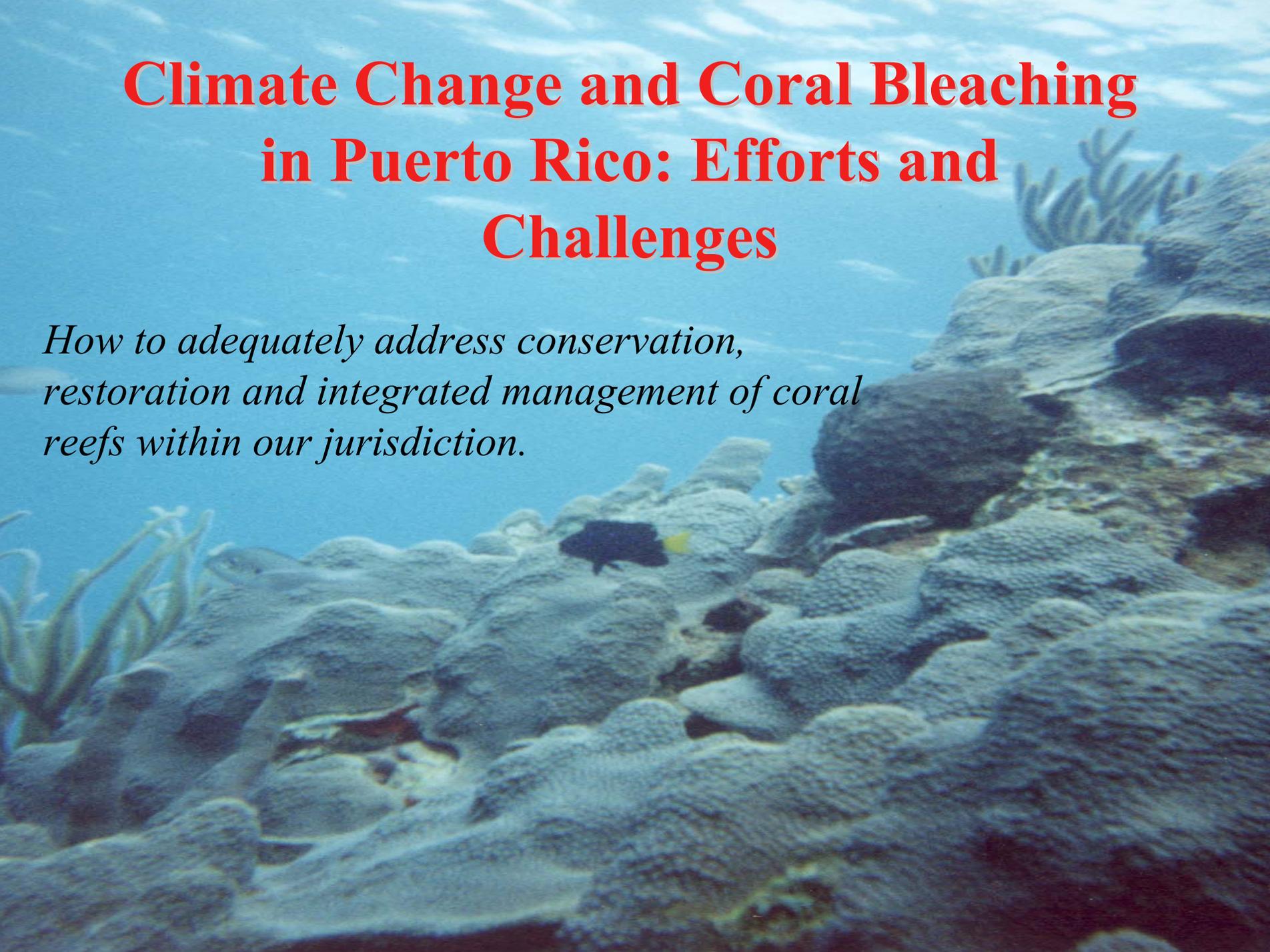
Coral Reef Watch

CREWS Station Bleaching Report, Salt River Bay, St. Croix, USVI



Climate Change and Coral Bleaching in Puerto Rico: Efforts and Challenges

*How to adequately address conservation,
restoration and integrated management of coral
reefs within our jurisdiction.*



An underwater photograph of a coral reef. The coral is mostly white and grey, indicating bleaching. There are several fish swimming around, including a prominent black and yellow fish in the center. The water is clear blue.

Coral Reefs, Climate Change and Coral Bleaching:

Developing Partnerships for Science and Management

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