

Crisis on the Flower Garden Banks: The Role of Hurricanes, Coral Bleaching and Disease in 2005

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Flower Garden Banks National Marine Sanctuary

R.B. Aronson

Dauphin Island Sea Lab

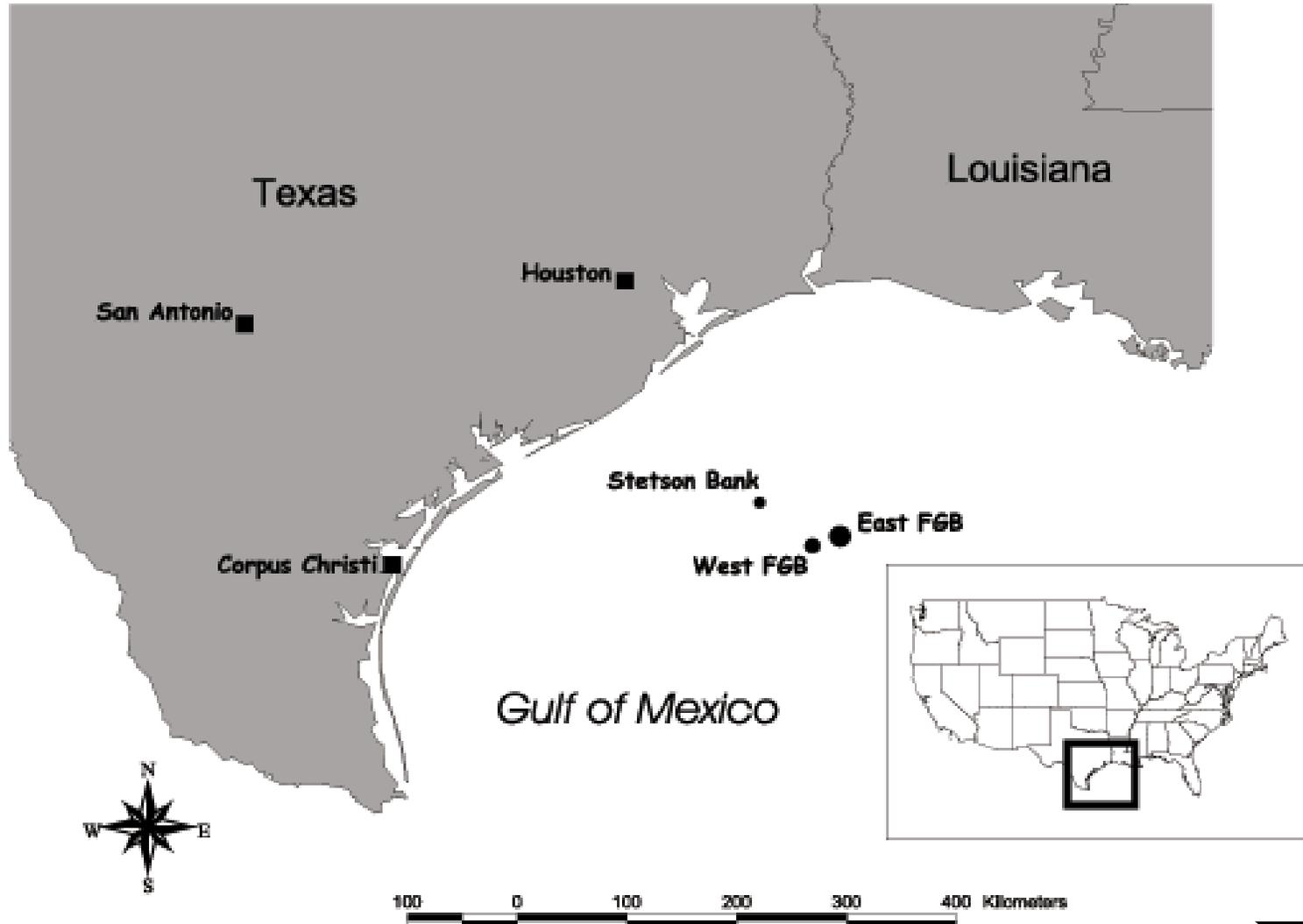


Principal Investigators

- William F. Precht, Chief Scientist
- Richard B. Aronson – Co-P.I.
- Ken J.P. Deslarzes – Co-P.I.



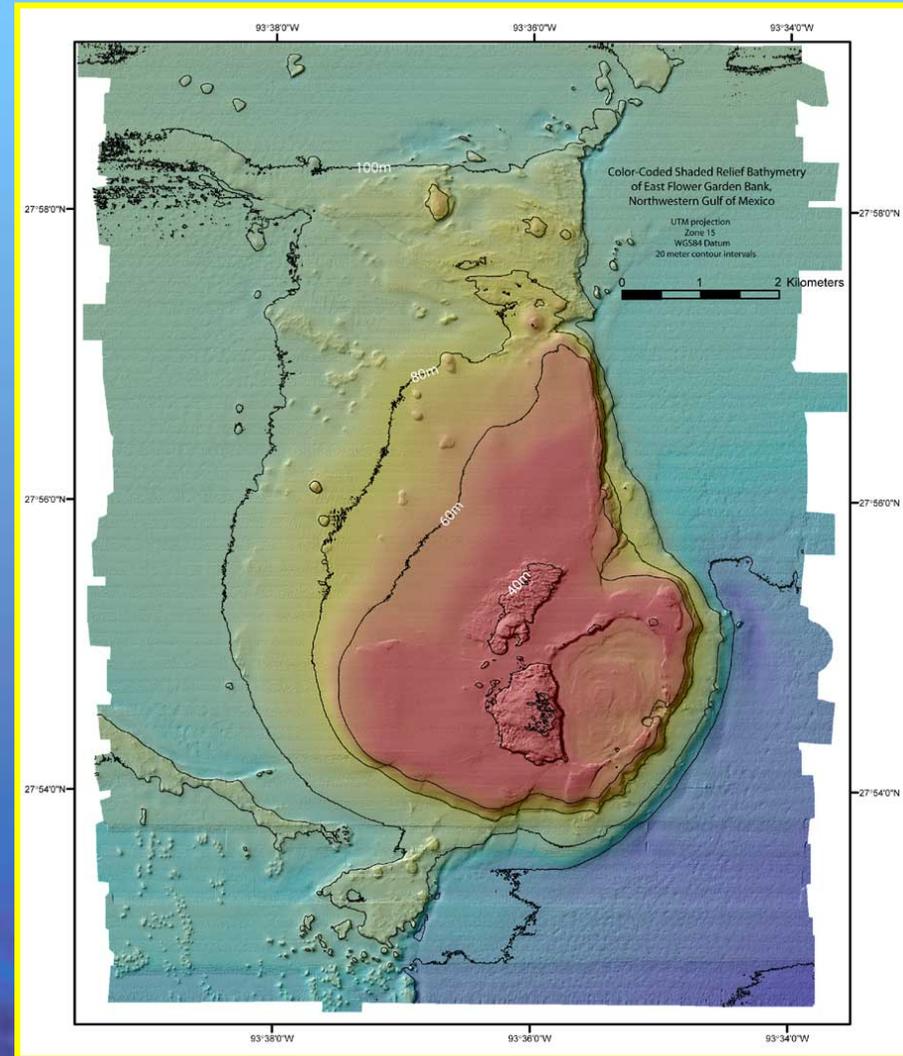
Flower Garden Banks National Marine Sanctuary



The Flower Garden Banks

- **East Bank**

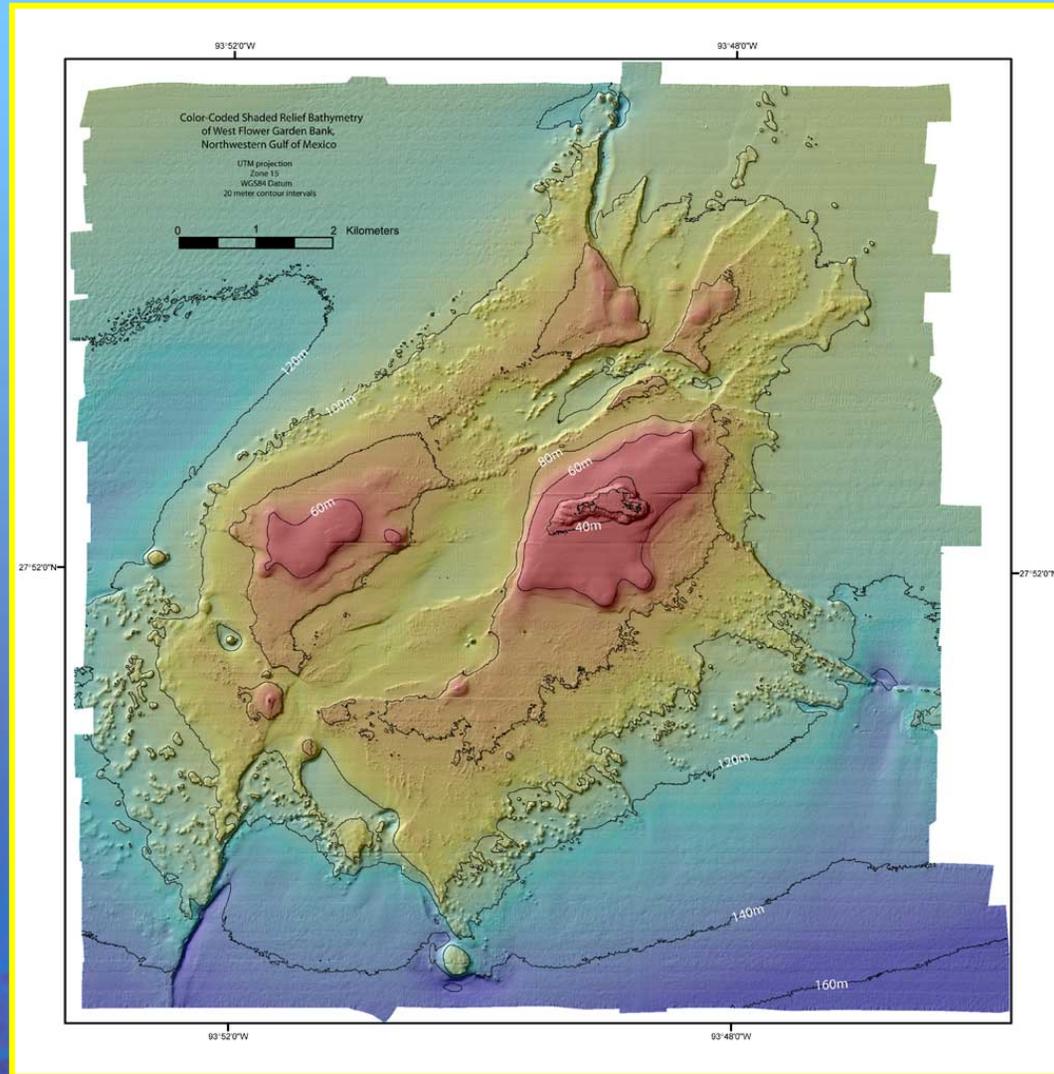
- Total area is approximately 19.2 square miles
- Reef crest is approximately 250 acres
- Active brine seep forms an underwater salt lake about 100 feet diameter and 10 inches deep

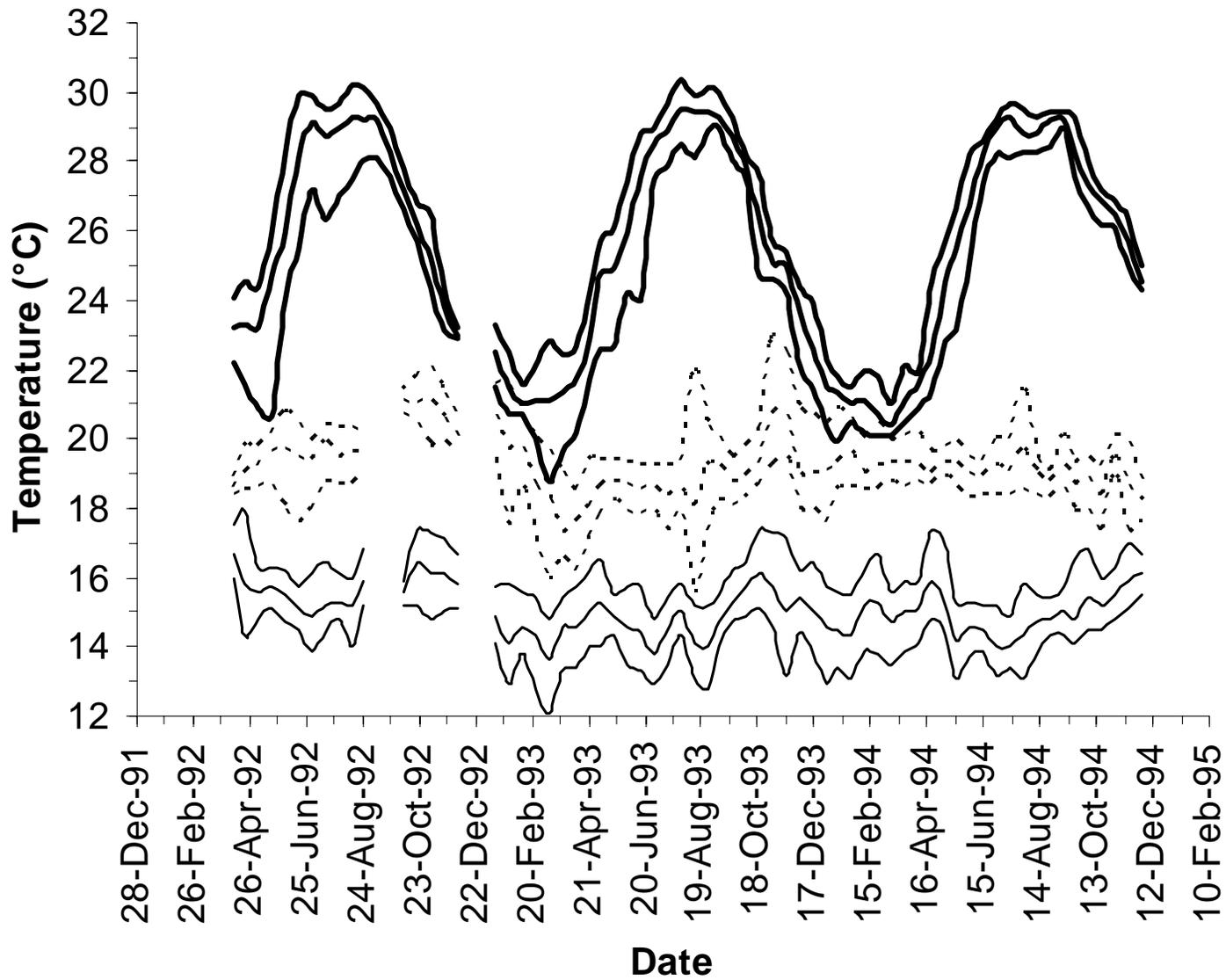


The Flower Garden Banks

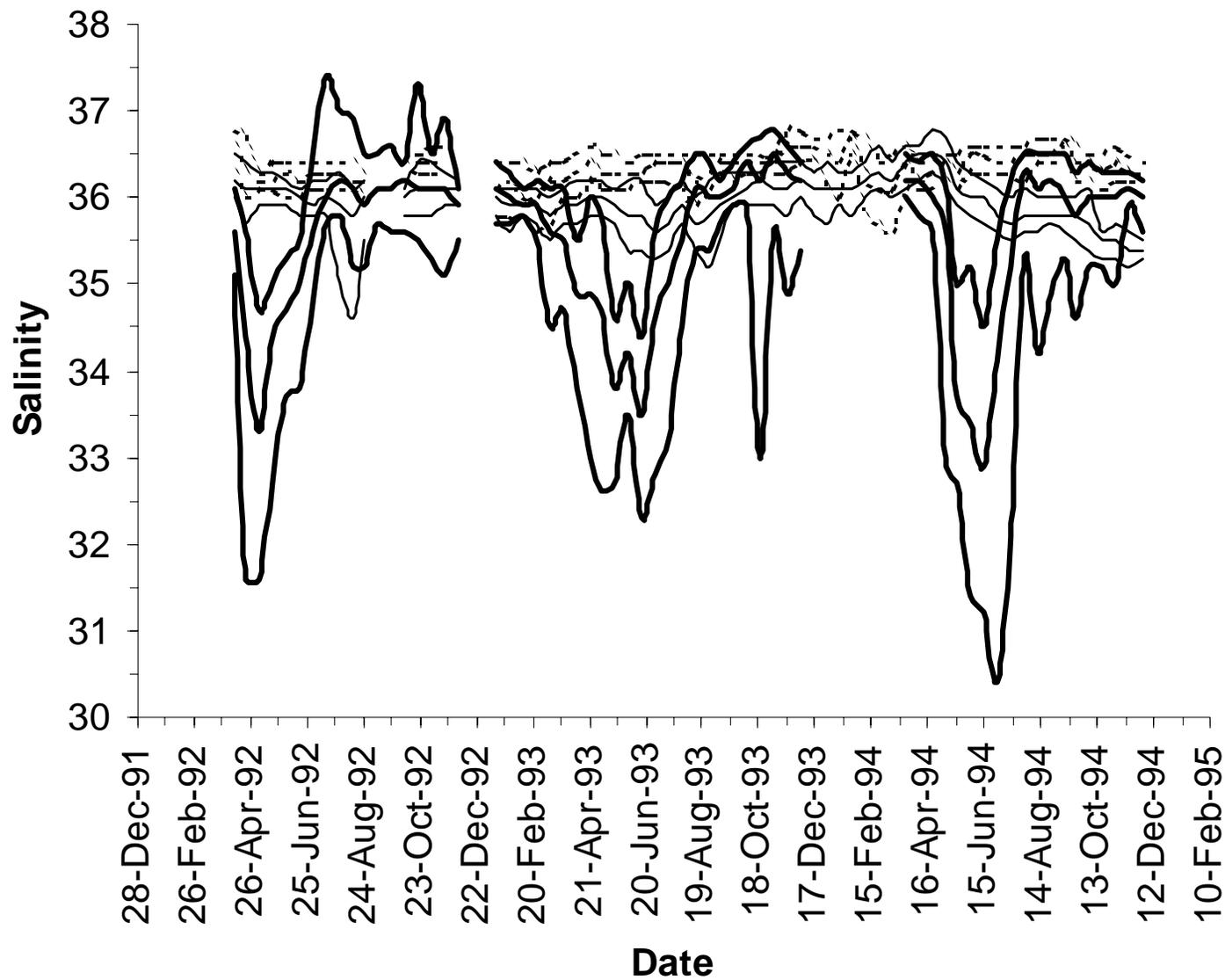
- **West Bank**

- Total area is approximately 22.5 square miles
- Reef crest is approximately 100 acres





Seawater temperature at the FGB: 13 m, 100 m, and 190 m water depths



Salinity at the FGB: 13 m, 100 m, and 190 m water depths

2005 WAS A BAD YEAR

Winter – Spring 2005: coral disease outbreak

Summer – Fall 2005: SSTs above normal

Fall 2005: Hurricanes Katrina and Rita



Coral Disease Documented on Flower Garden Banks, Winter – Spring 2005



April 2005



May 2005



2005 WAS A BAD YEAR (cont.)



April 2005



May 2005



2005 WAS A BAD YEAR (cont.)

April 2005

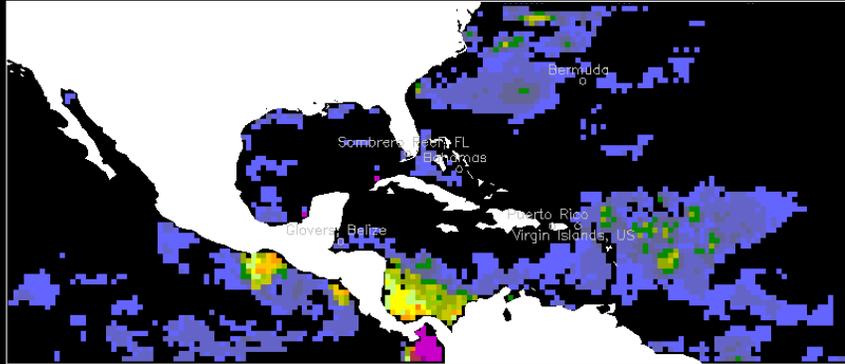


May 2005



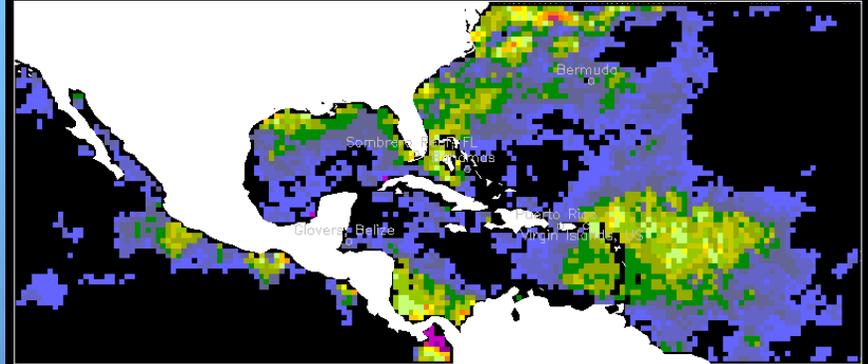
NOAA/NESDIS Degree Heating Weeks for last 12 Weeks - 8/2/2005

2 August 2005



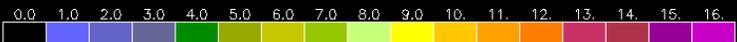
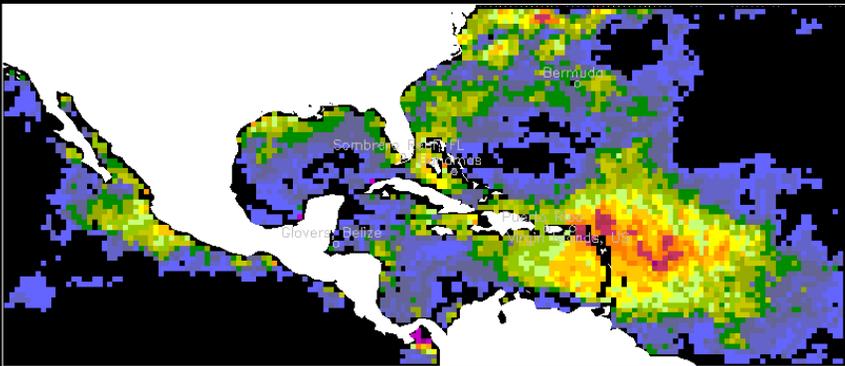
NOAA/NESDIS Degree Heating Weeks for last 12 Weeks - 9/2/2005

2 September 2005



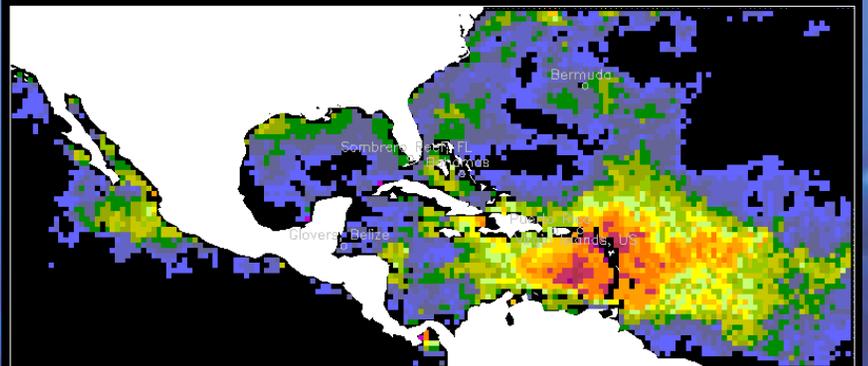
NOAA/NESDIS Degree Heating Weeks for last 12 Weeks - 10/4/2005

4 October 2005



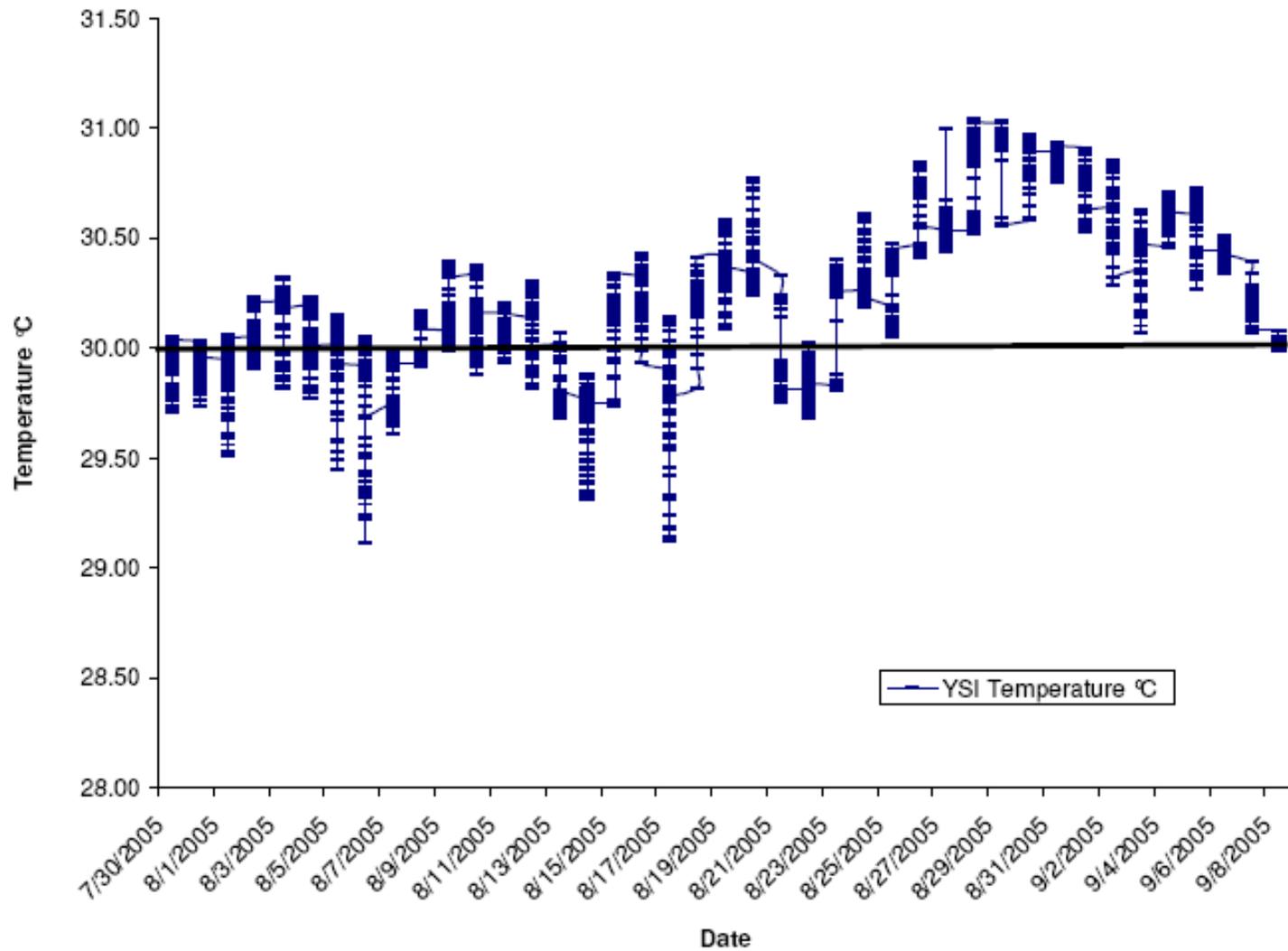
NOAA/NESDIS Degree Heating Weeks for last 12 Weeks - 11/8/2005

8 November 2005

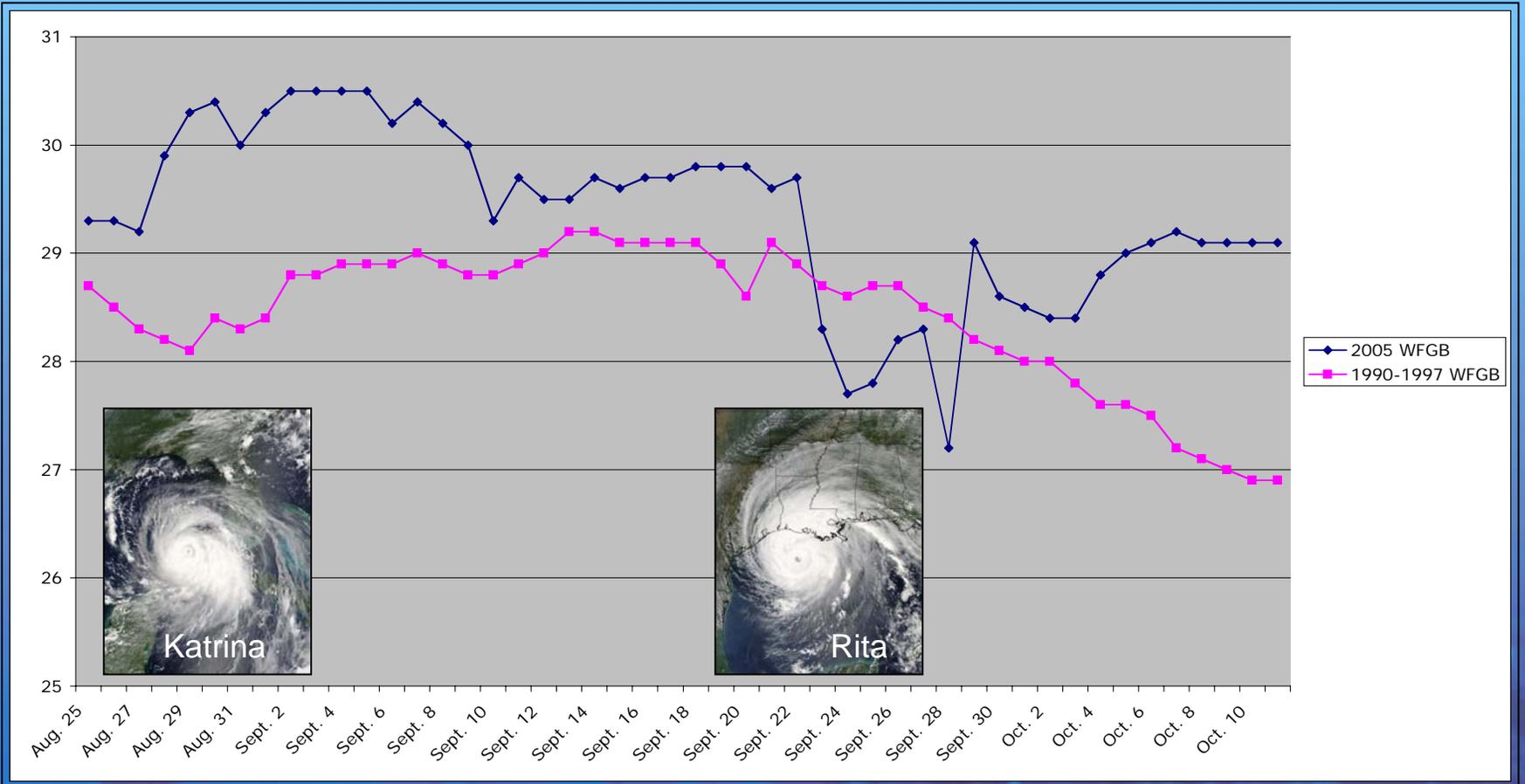


“Degree Heating Weeks” Caribbean, August – November 2005

Temperature near and above 30°

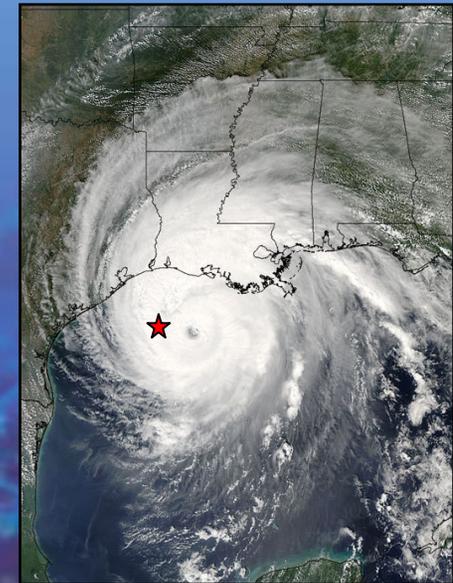
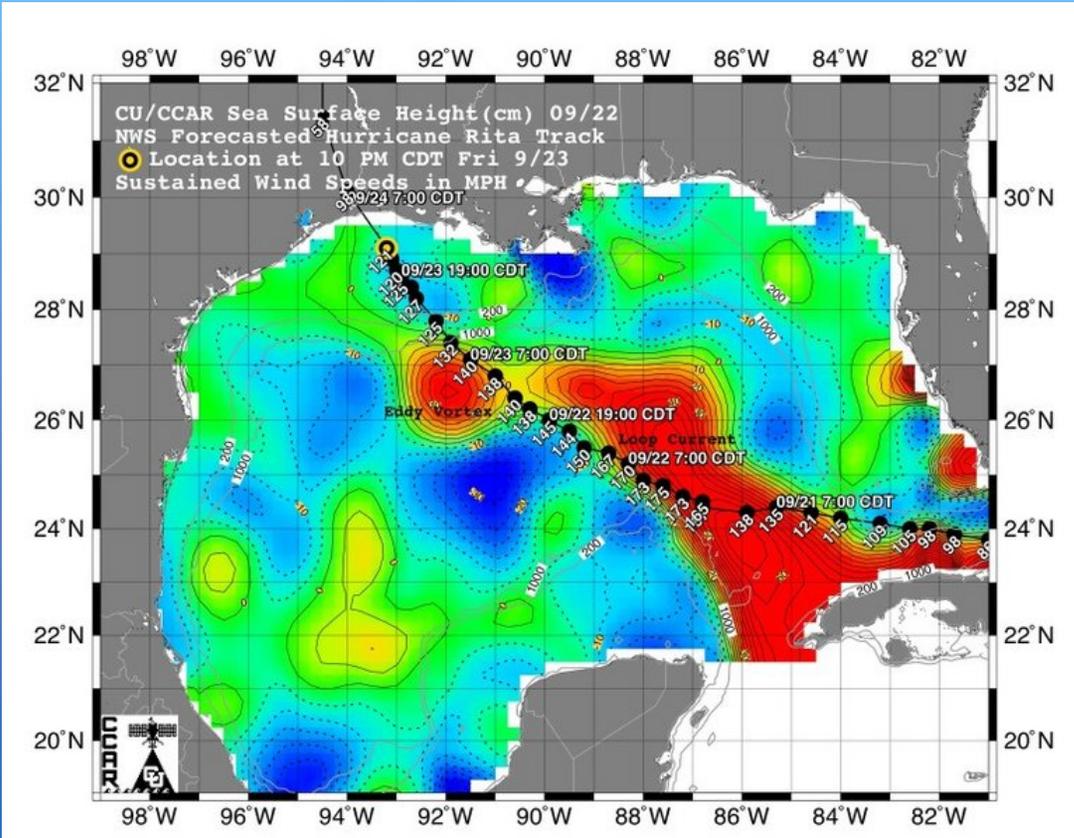


Temp (C)



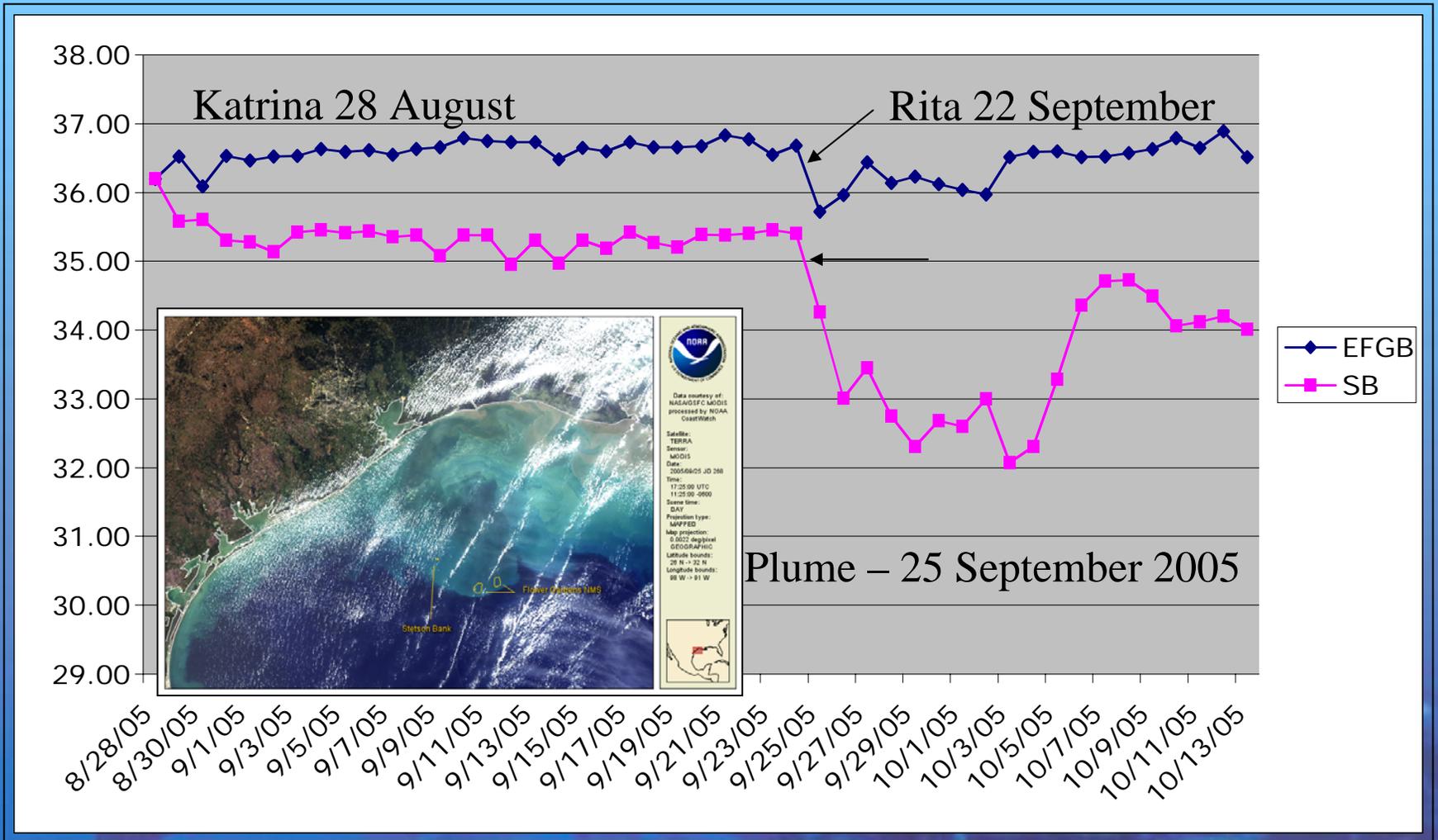
Water Temperature at 24m – WFGB

Hurricane Rita, 21–24 September 2005

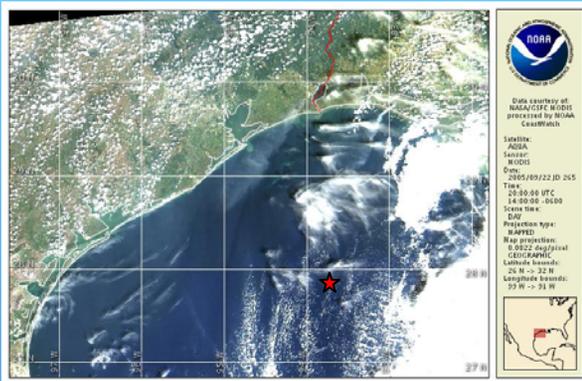


Hurricane Rita: 23 September 2005

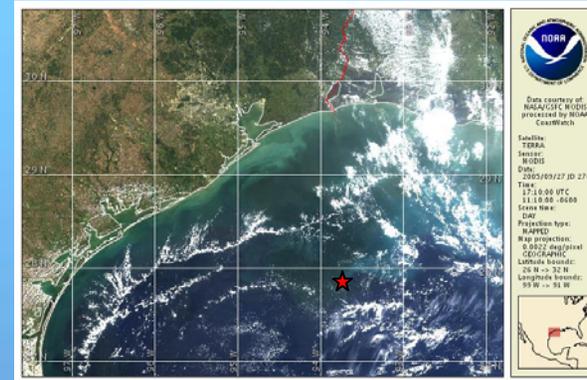
Salinity - PPT



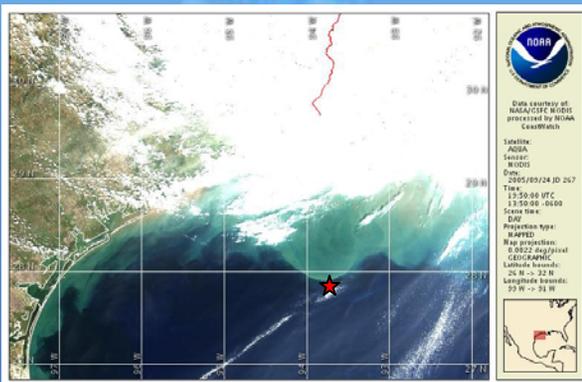
**Salinity, EFGB (19m) and Stetson Bank (23m):
28 August 2005 – 13 October 2005**



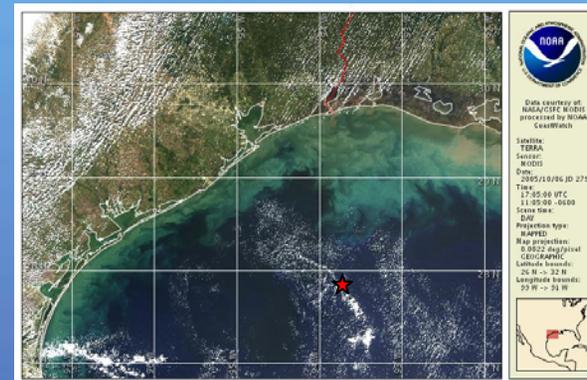
22 Sept 05



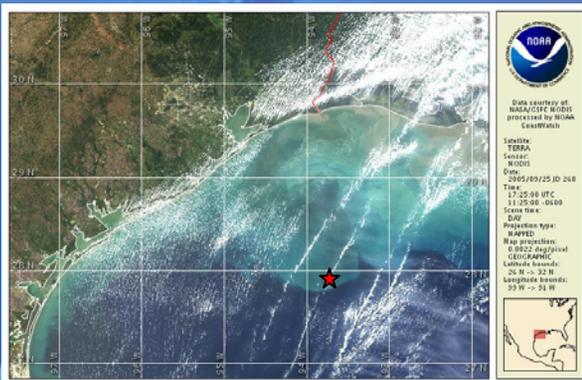
27 Sept 05



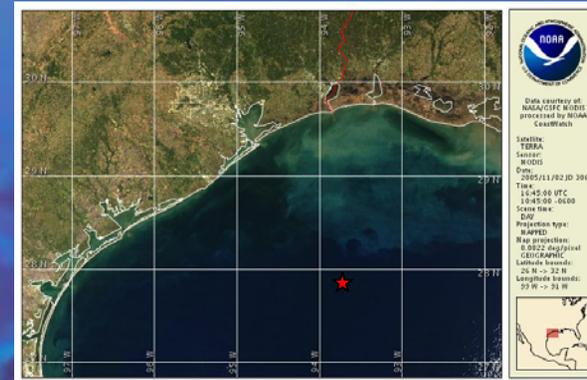
24 Sept 05



6 Oct 05



25 Sept 05



2 Nov 05

Hurricane Katrina & Rita Runoff Analysis, 27 September 2005

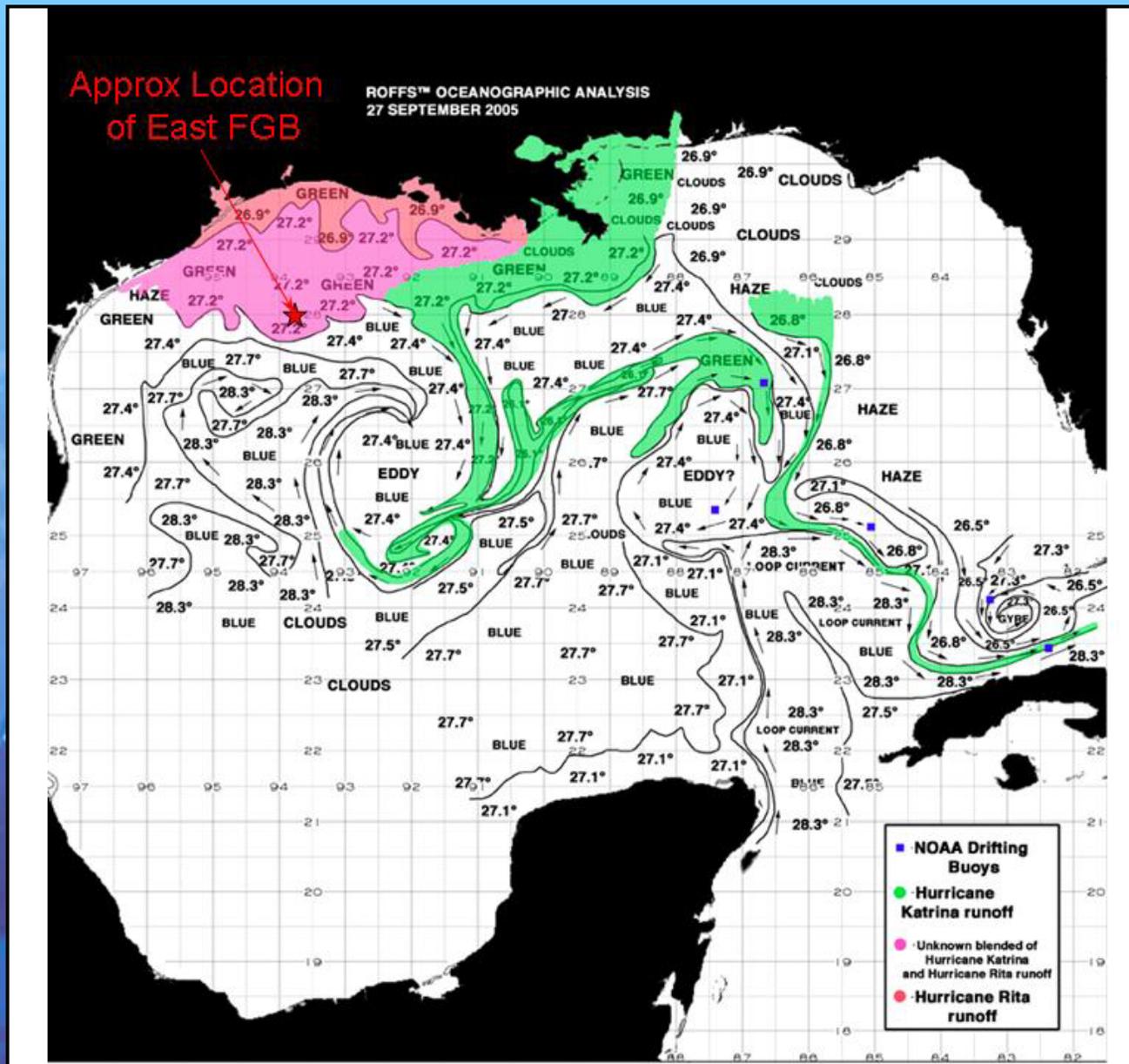
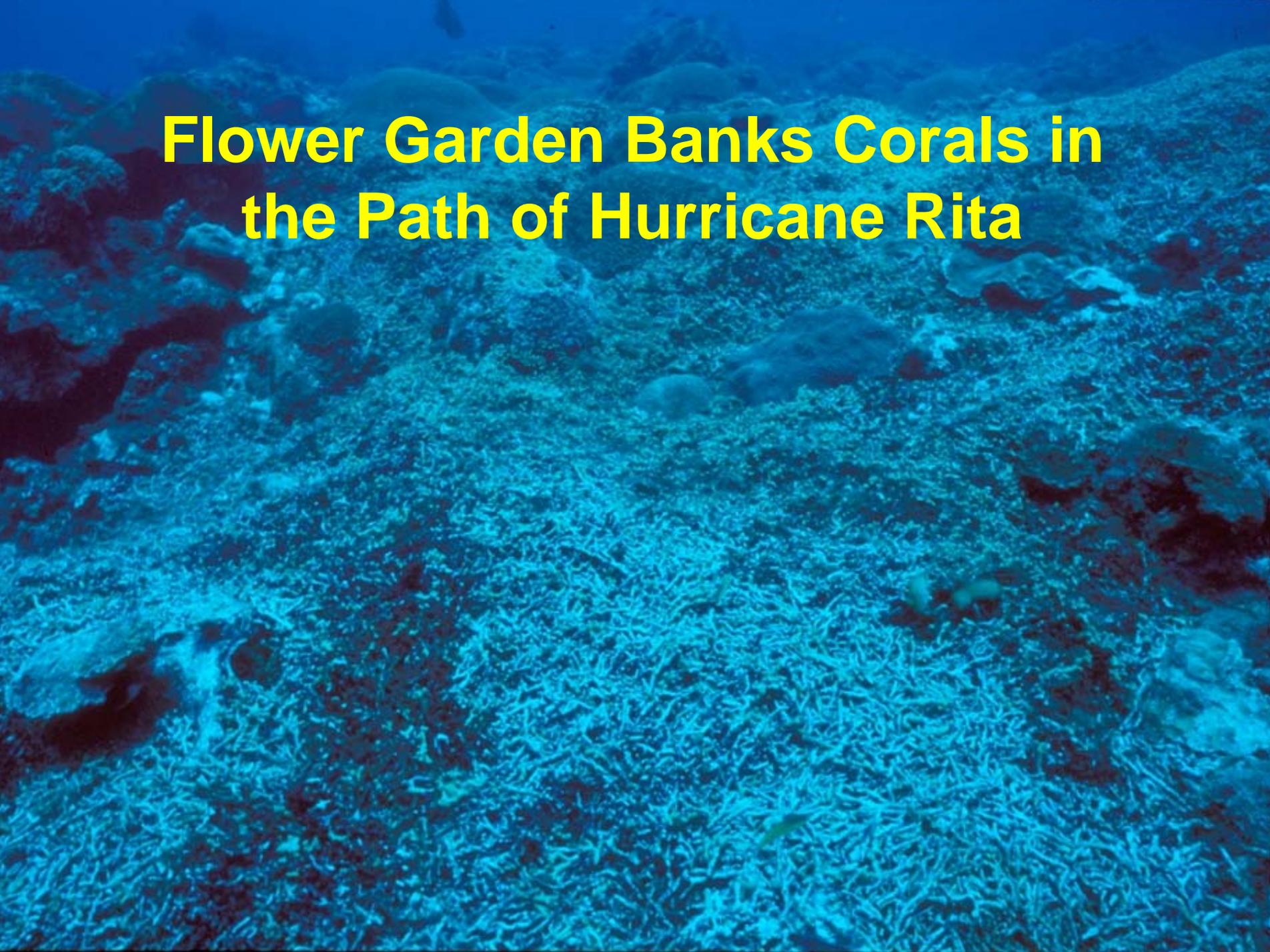


Image: Roffer's Ocean Fishing Forecasting Service, Inc. – <http://www.roffs.com>

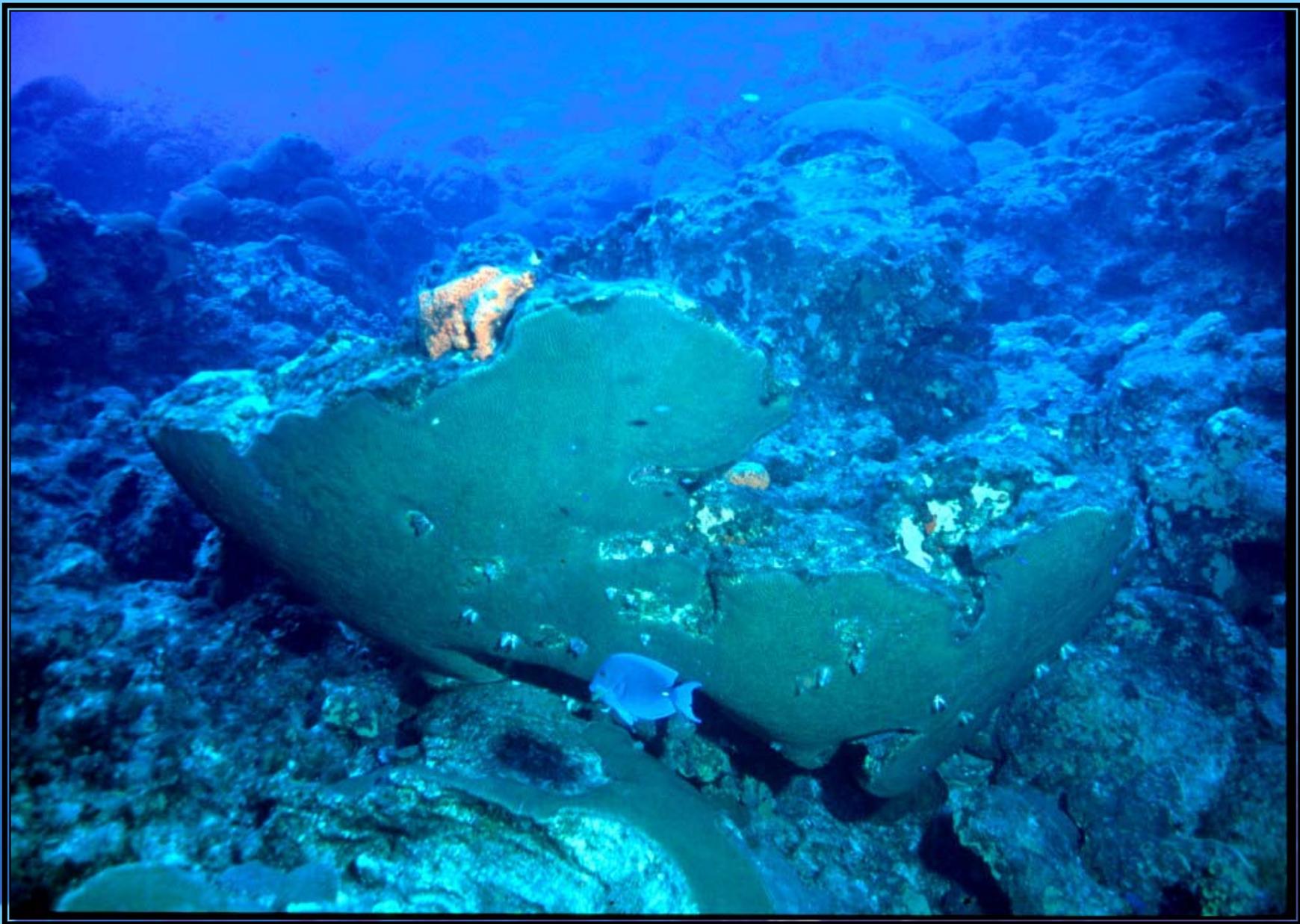
OCTOBER 2005 CRUISE – FGBNMS



Flower Garden Banks Corals in the Path of Hurricane Rita









Damage from Hurricane Rita – October 2005 Assessment

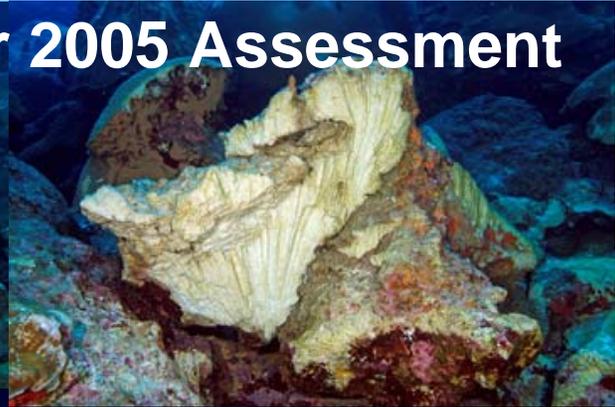
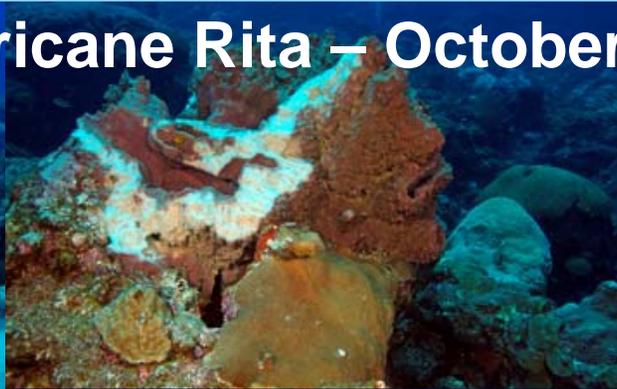


Image credit: G. J. and Frank Bur

2005 Bleaching Event



Image credit (all): Joyce and Frank Burek

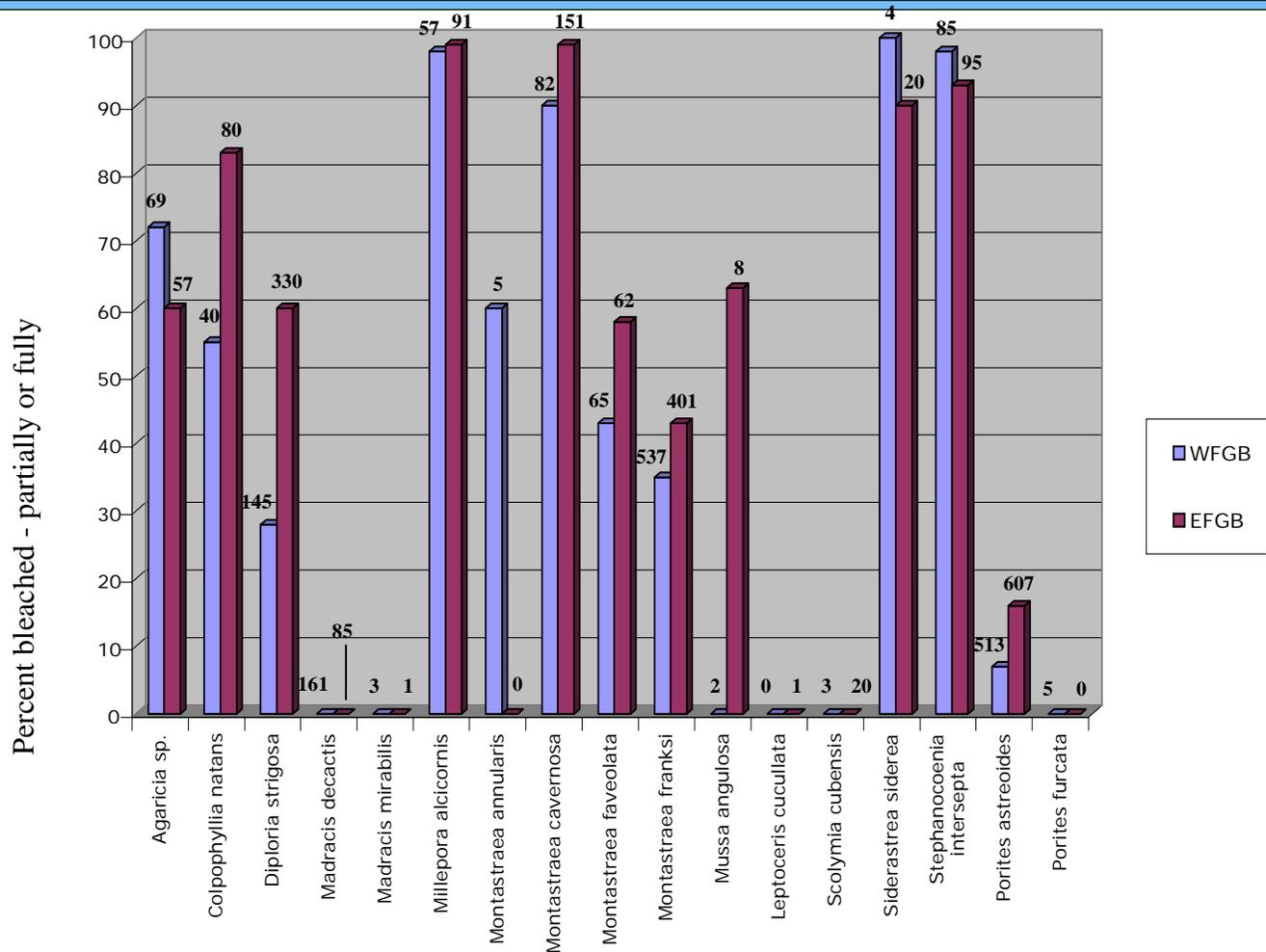


Flower Garden Banks Coral Bleaching Survey Summary October 2005

WFGB
14 transects
1200 feet total
transect distance

EFGB
18 transects
1400 feet total
transect distance

Surveys conducted
by FGBNMS (Doug
Weaver)



Bleaching Summary

East Flower Garden Bank

Total colonies surveyed: 2040

Number of colonies exhibiting some degree of bleaching (partially to fully bleached): 981

Percentage exhibiting bleaching: 48%

West Flower Garden Bank

Total colonies surveyed: 1783

Number of colonies exhibiting some degree of bleaching (partially to fully bleached): 623

Percentage exhibiting bleaching: 35%

Note: The level of bleaching ranged from slight paling, splotching, mottling, to 100% bleached colonies. There is no differentiation of this in the data.

The bleaching appeared to decrease in intensity at 95 feet depth.

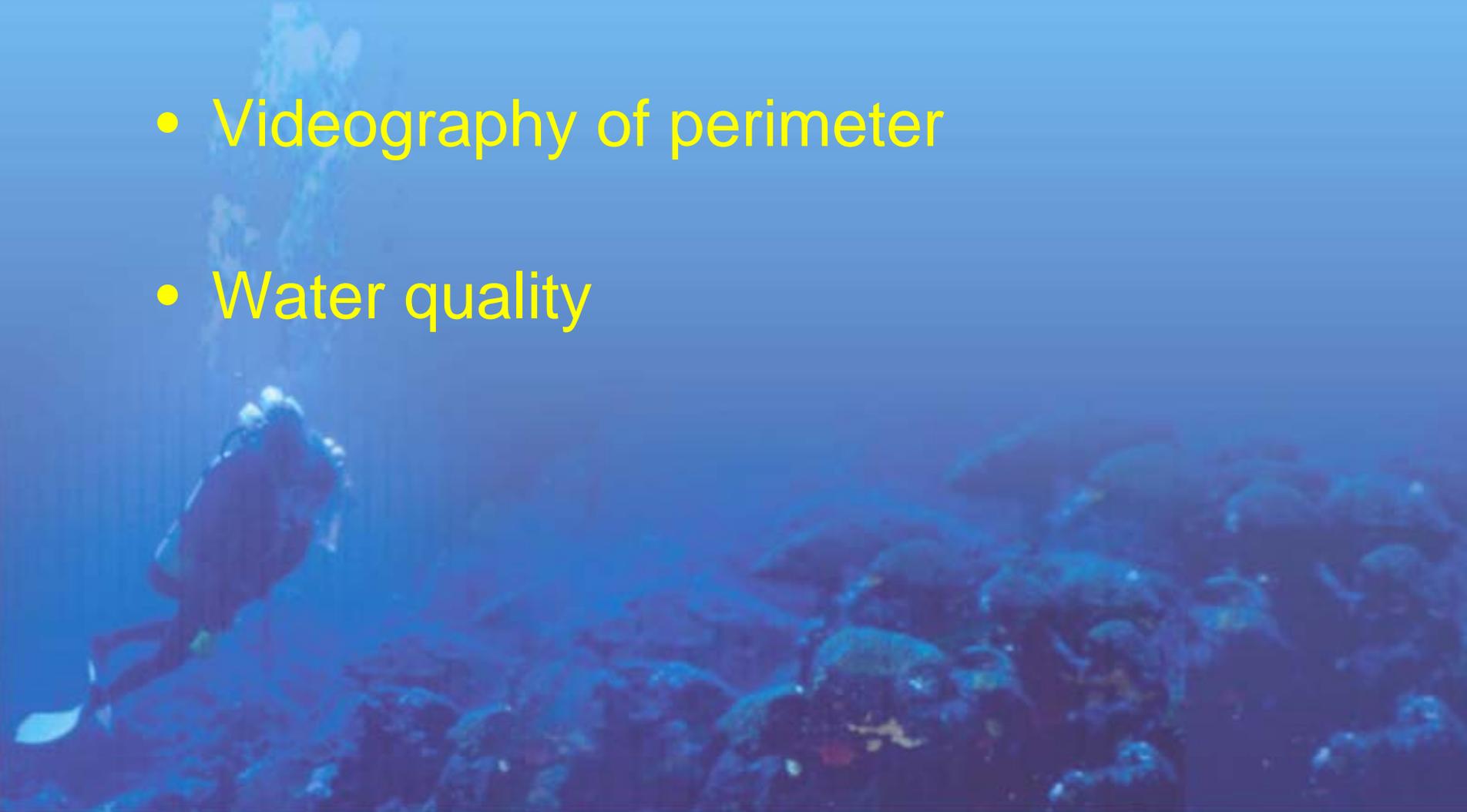
It was noted that 100% of the fire coral was bleached at Stetson Bank, although no surveys were conducted.



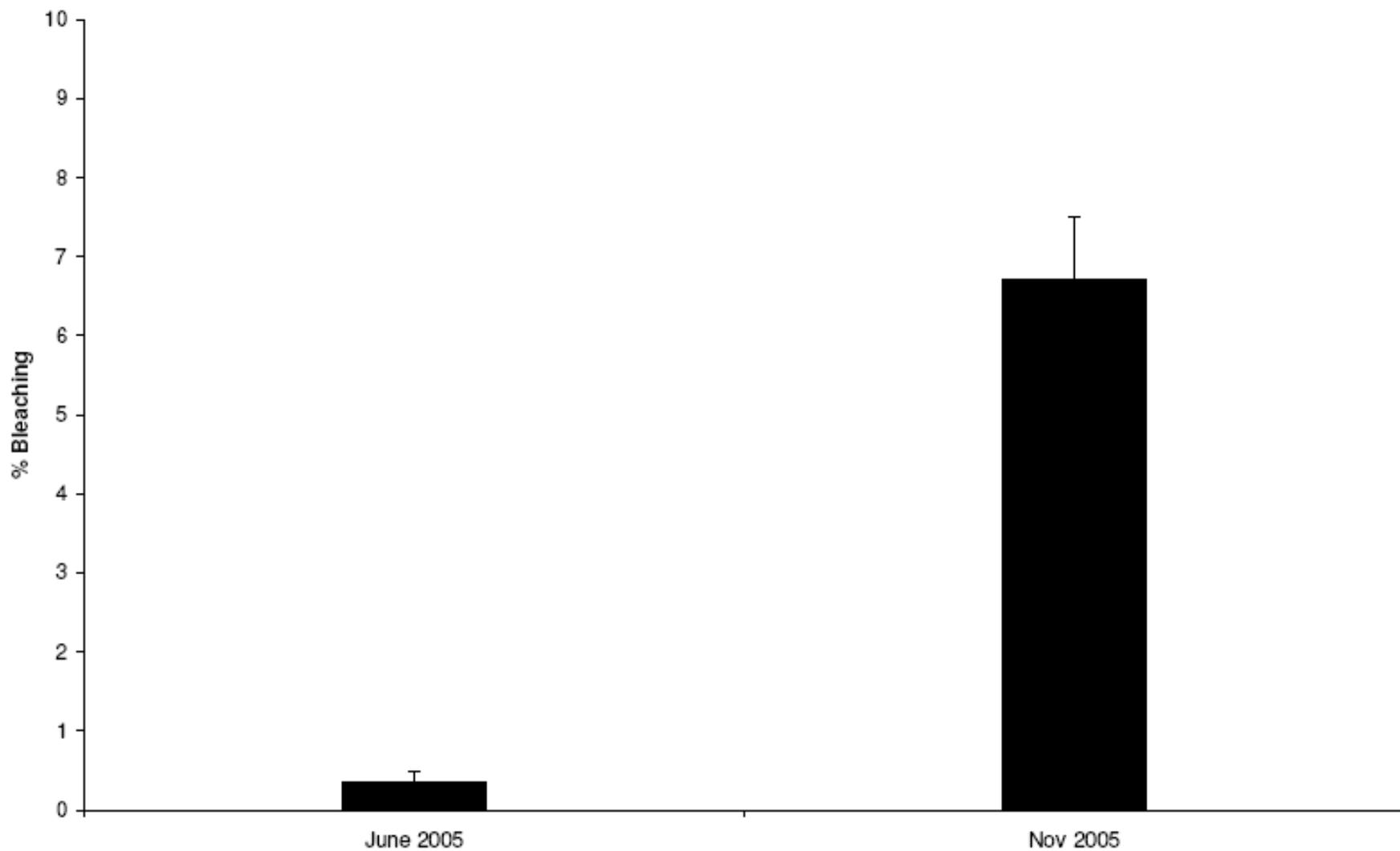
Image credit: FGBNMS/Emma Hickerson

NOVEMBER POST-HURRICANE CRUISE

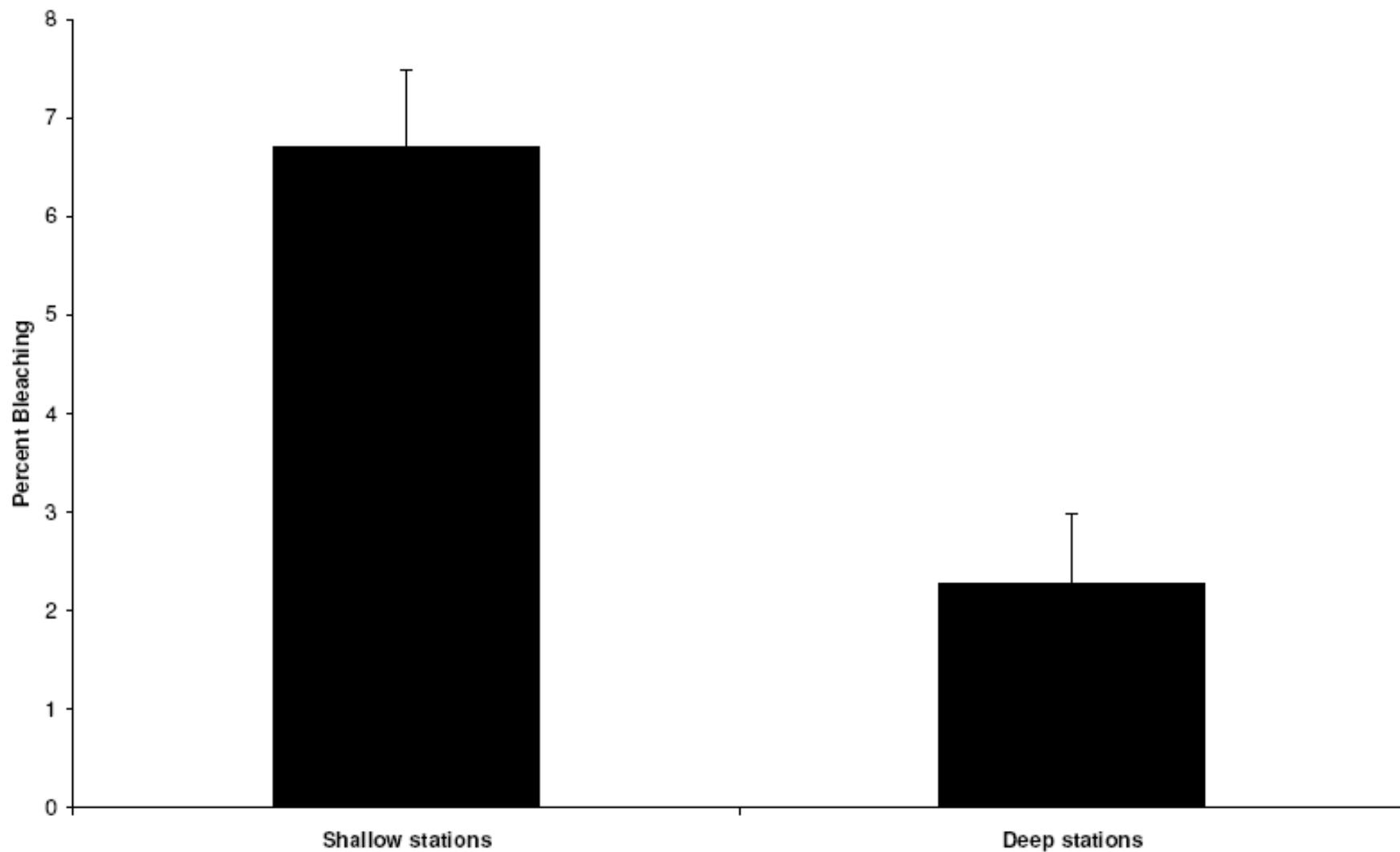
- Repetitive Quadrats
- Videography of perimeter
- Water quality



Coral Bleaching within Study Site Repetitive Quadrats

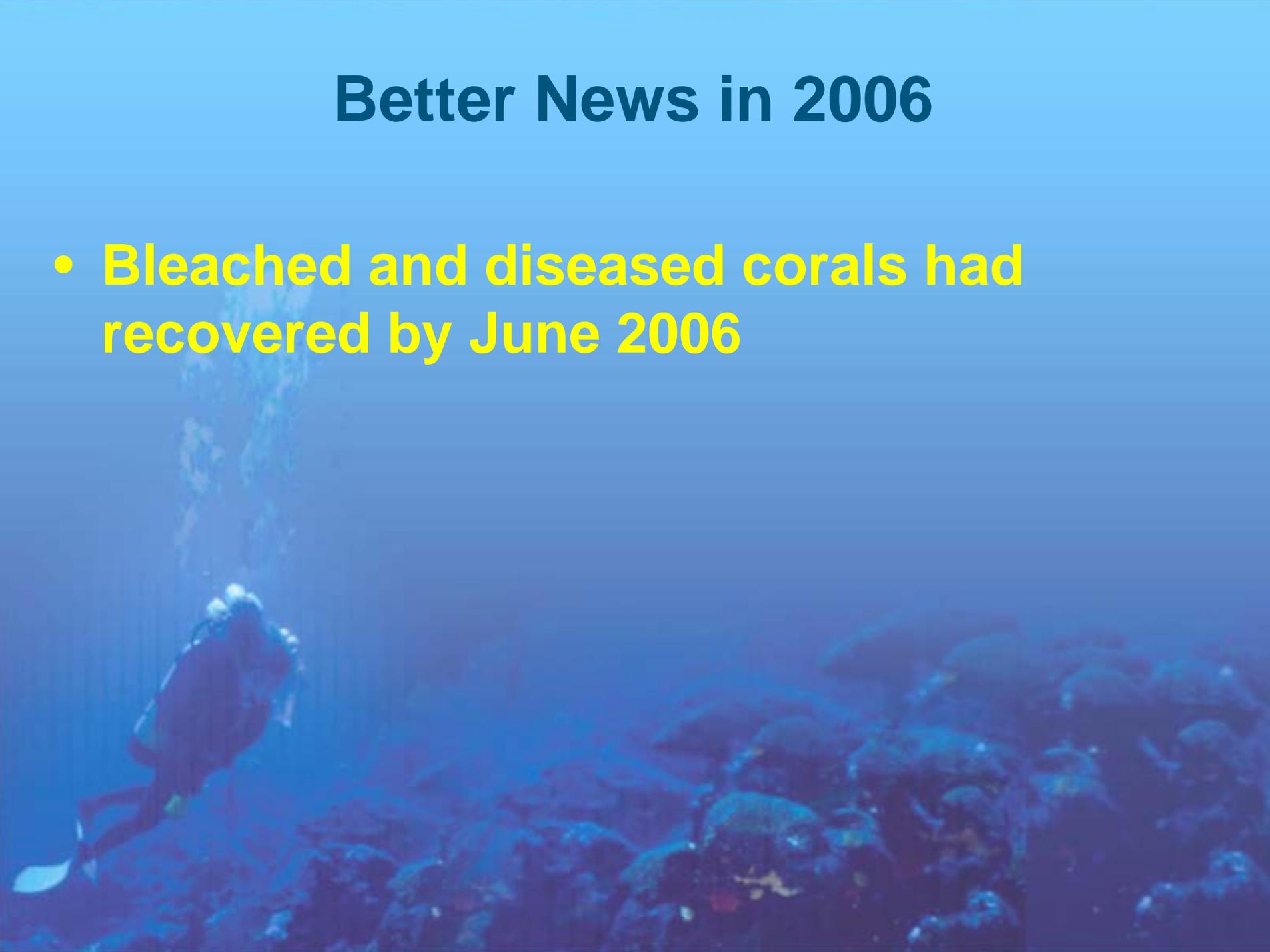


Percent Bleaching at the East Bank in November 2005



Better News in 2006

- Bleached and diseased corals had recovered by June 2006



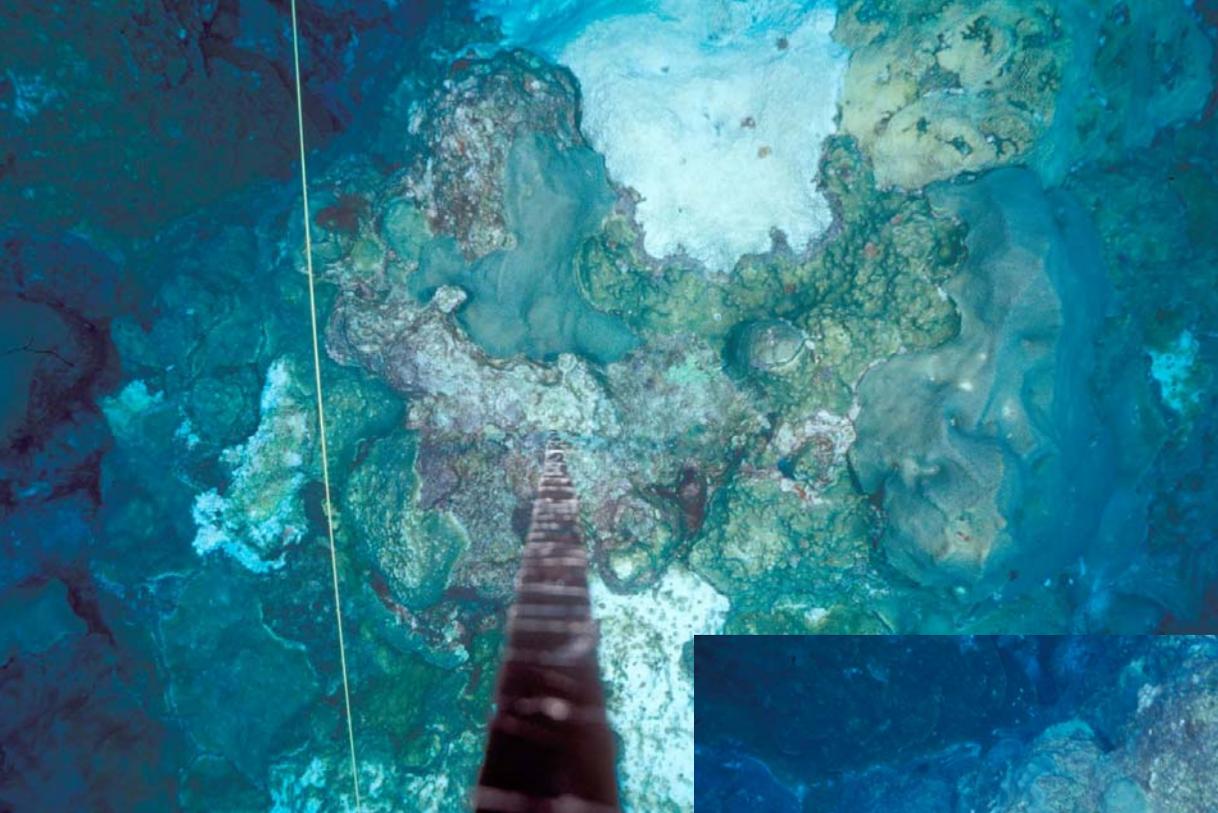


June 2006

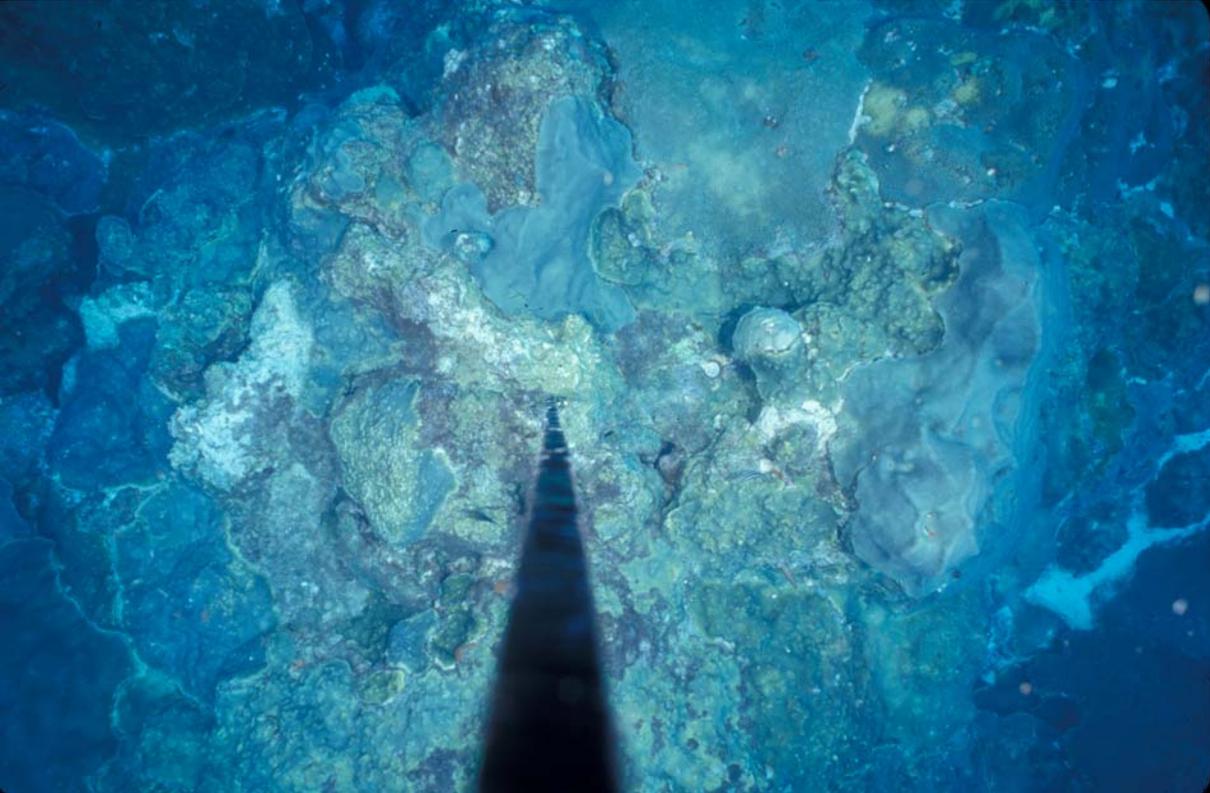


November 2005





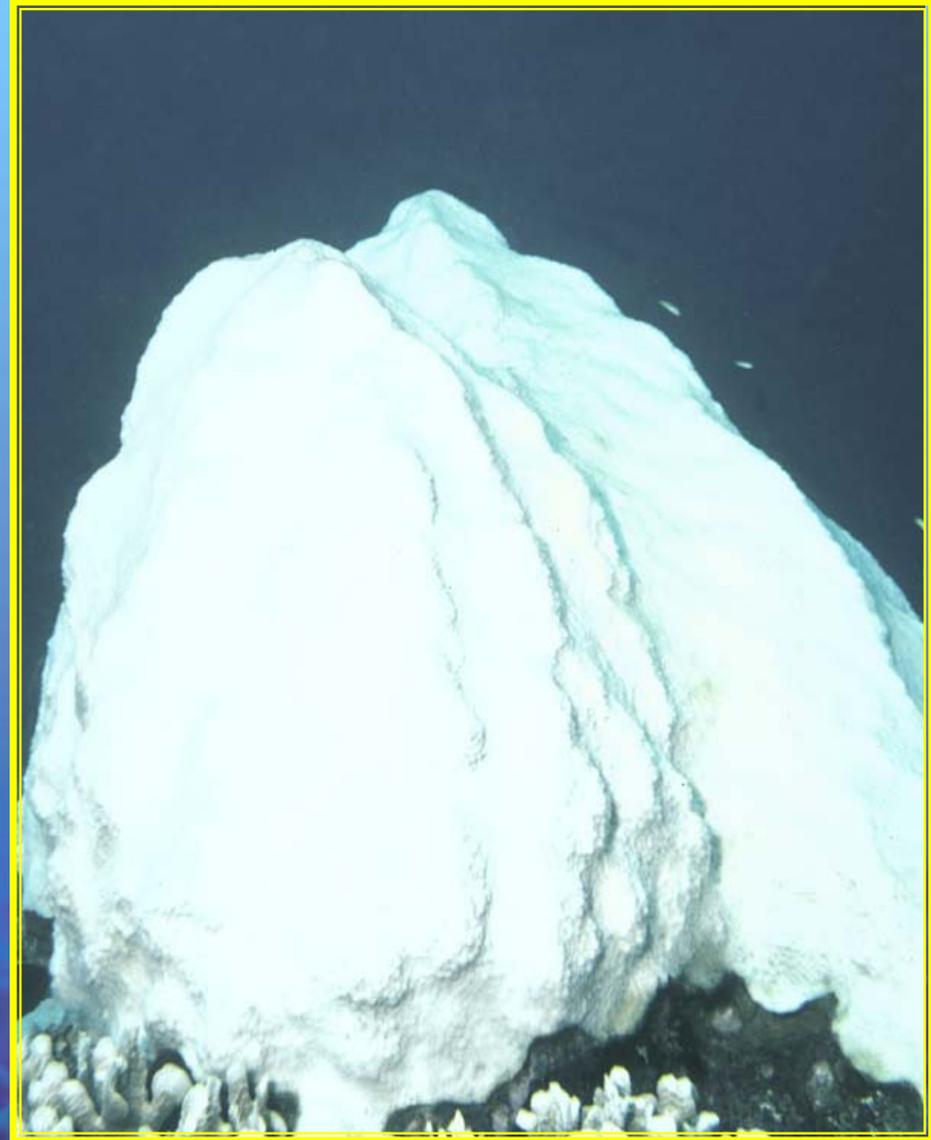
June 2006



November 2005

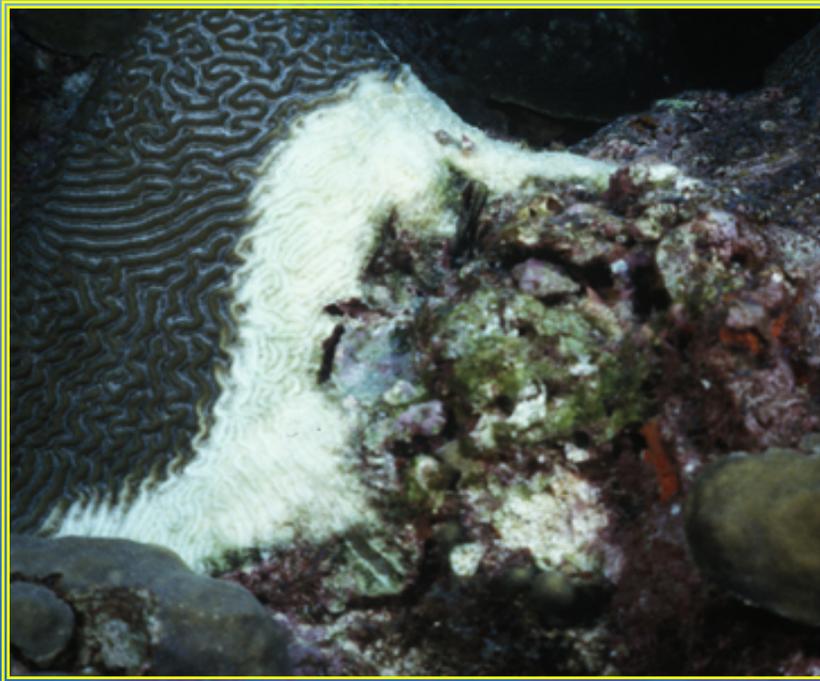
Coral Bleaching

- Common since late 1980s
- Generally temperature induced
- Can lead to partial or complete tissue mortality
- Generally global or regional in nature
- Most colonies have subsequently recovered



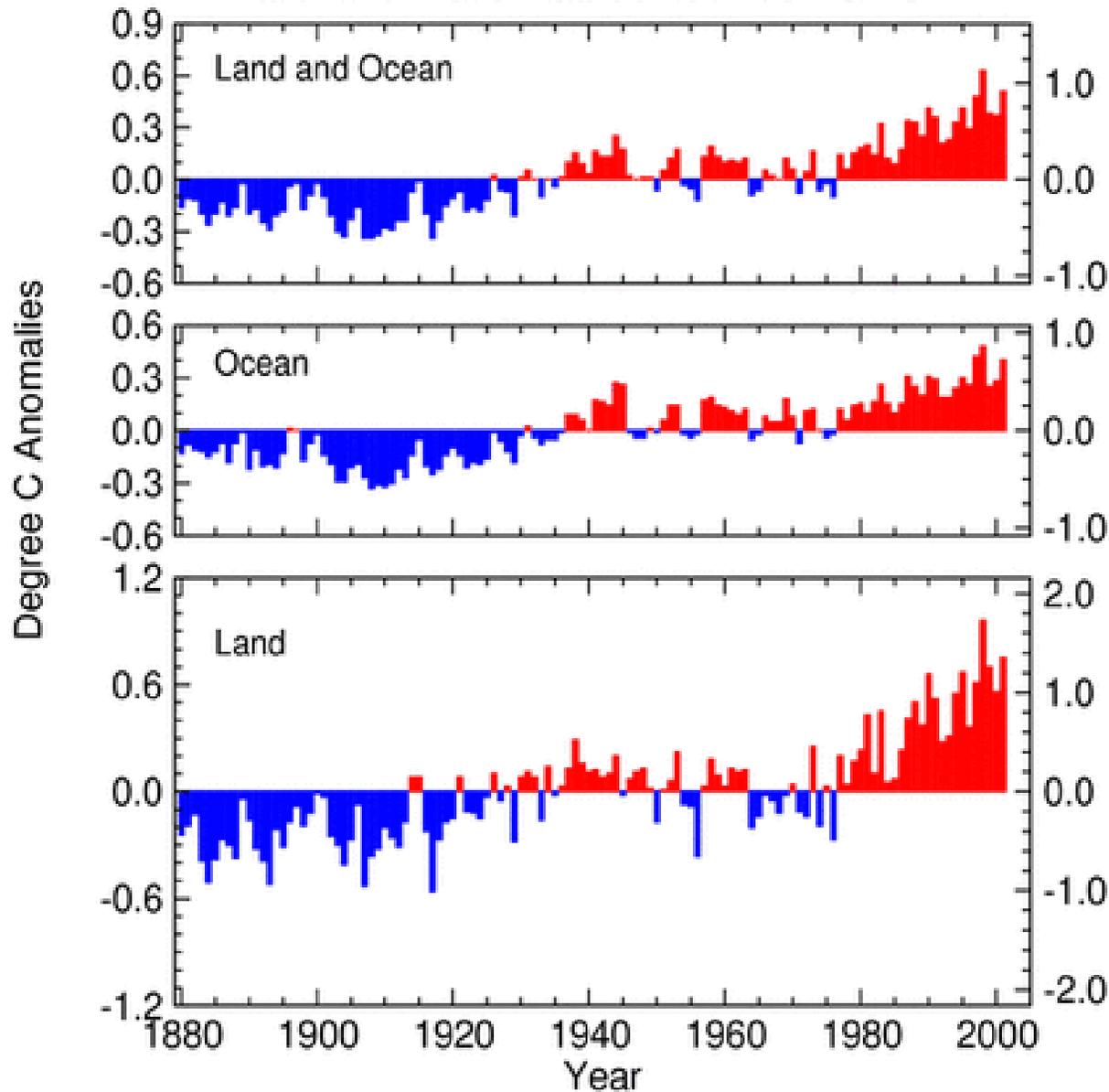
Coral Mortality

- White-Band Disease (plague syndromes)
- Etiology and virulence poorly understood



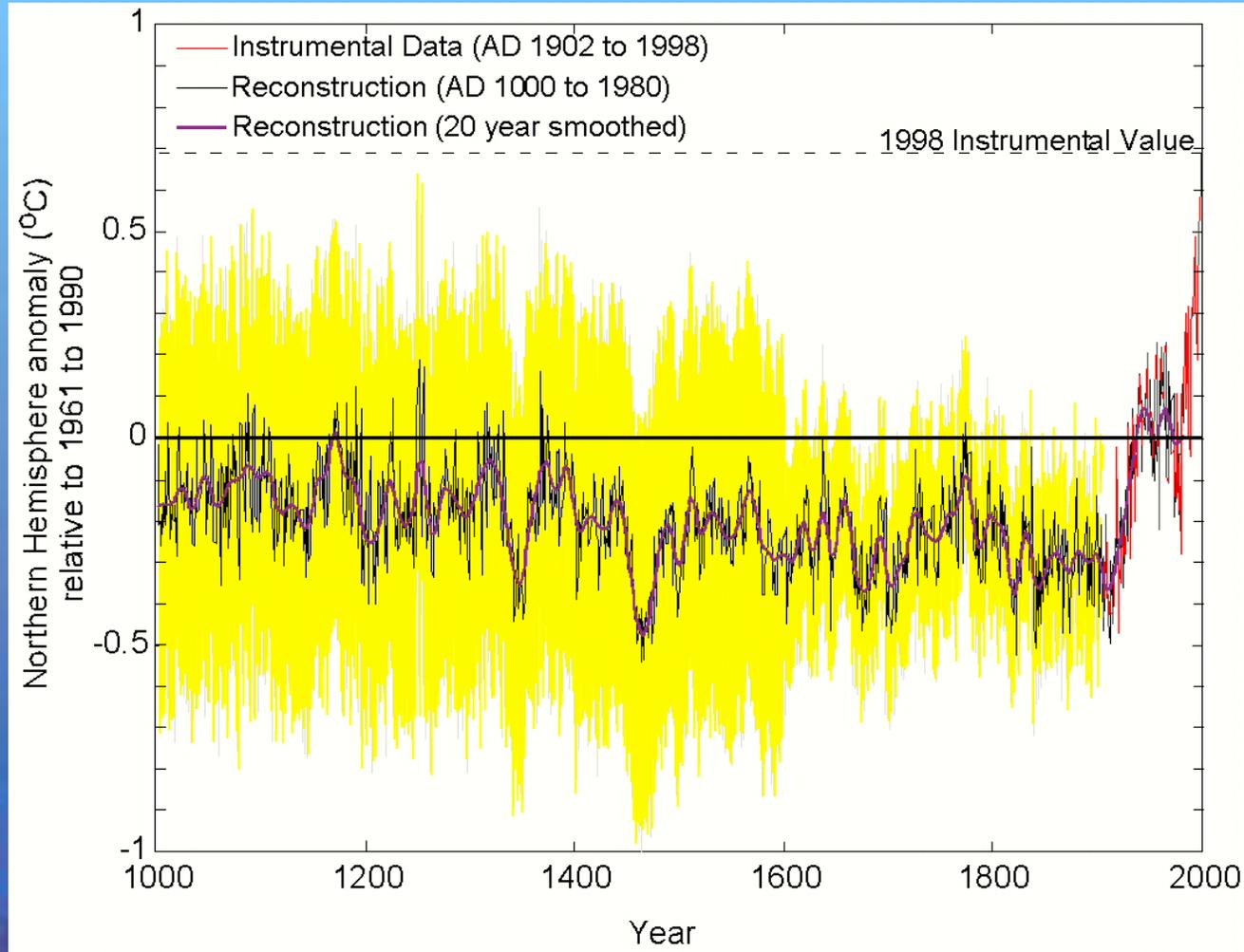
Jan - Dec Global Surface Mean Temp Anomalies

National Climatic Data Center/NESDIS/NOAA



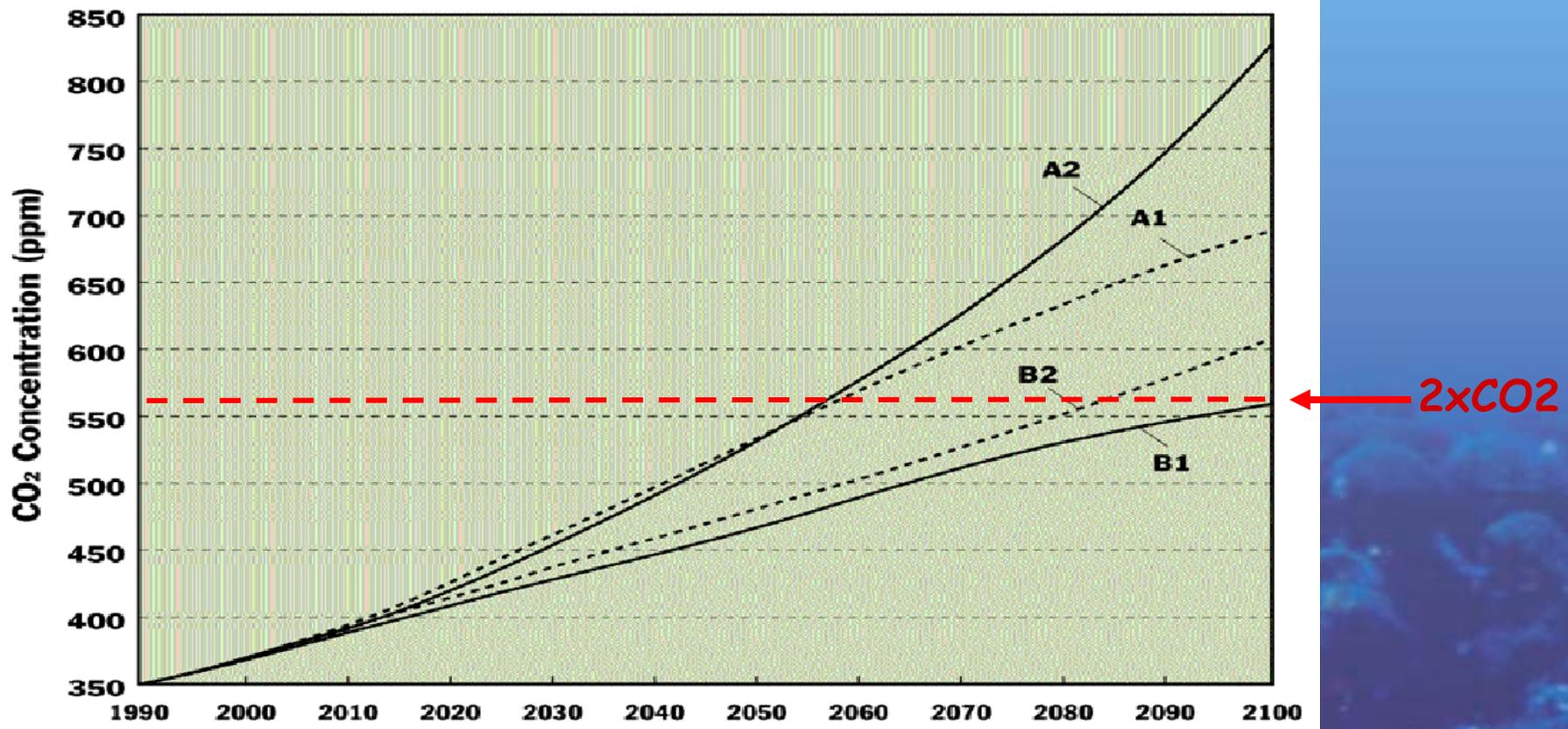
Is Recent Warming Unusual?

- Recent warm decades unprecedented in last 1000 years

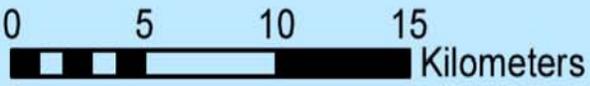
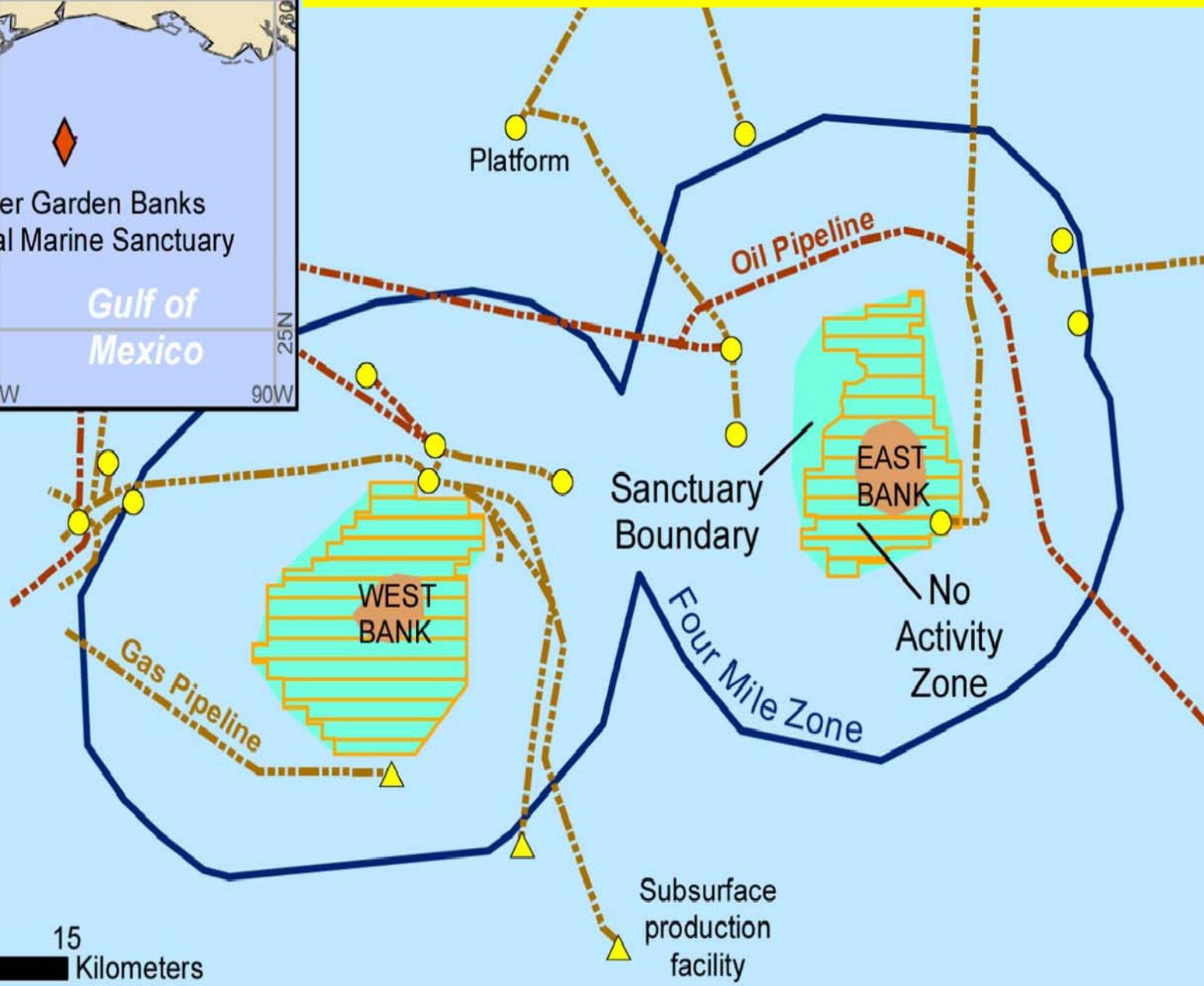


Carbon Dioxide Is Increasing

The question is not if atmospheric CO₂ will reach double preindustrial levels (to 560 ppm), but when—most probably within 50–100 years.



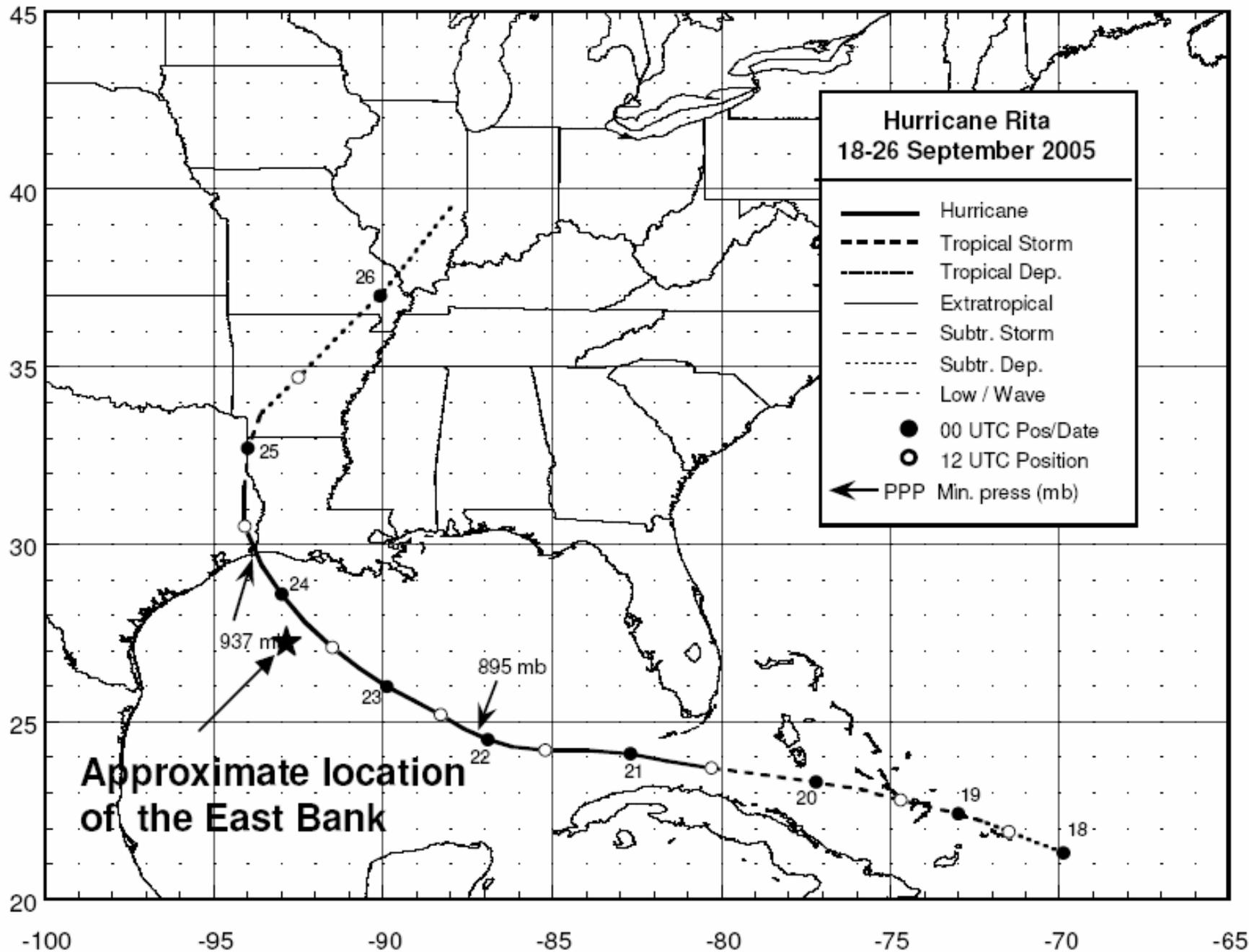
The FGB is much like a walled city.





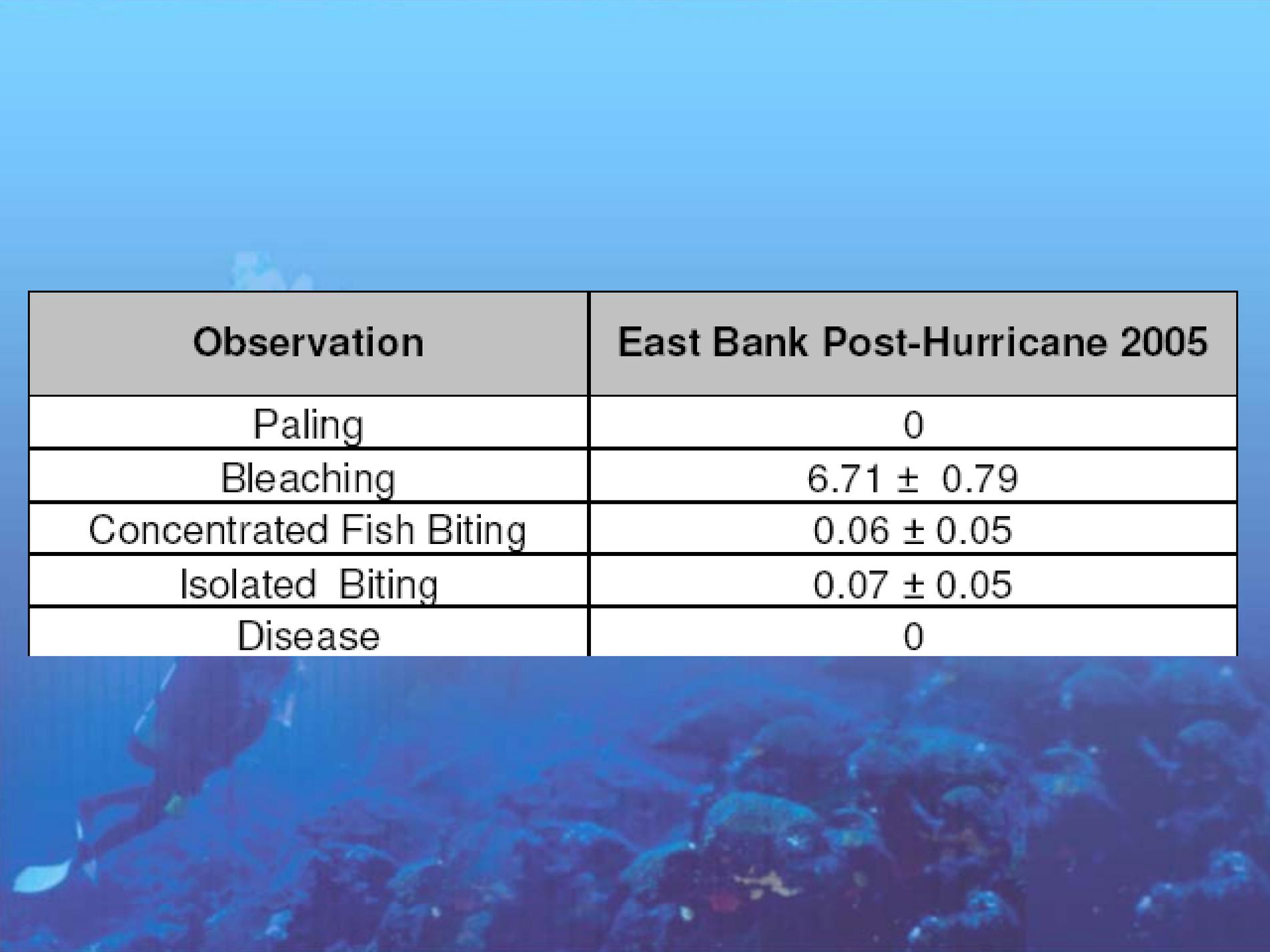
Just as walls do not protect humans from disease or environmental stressors, protective measures at the FGB cannot protect the benthic communities from stressors, such as disease or bleaching, related to global changes. These are the challenges of scientists and resource managers around the world.



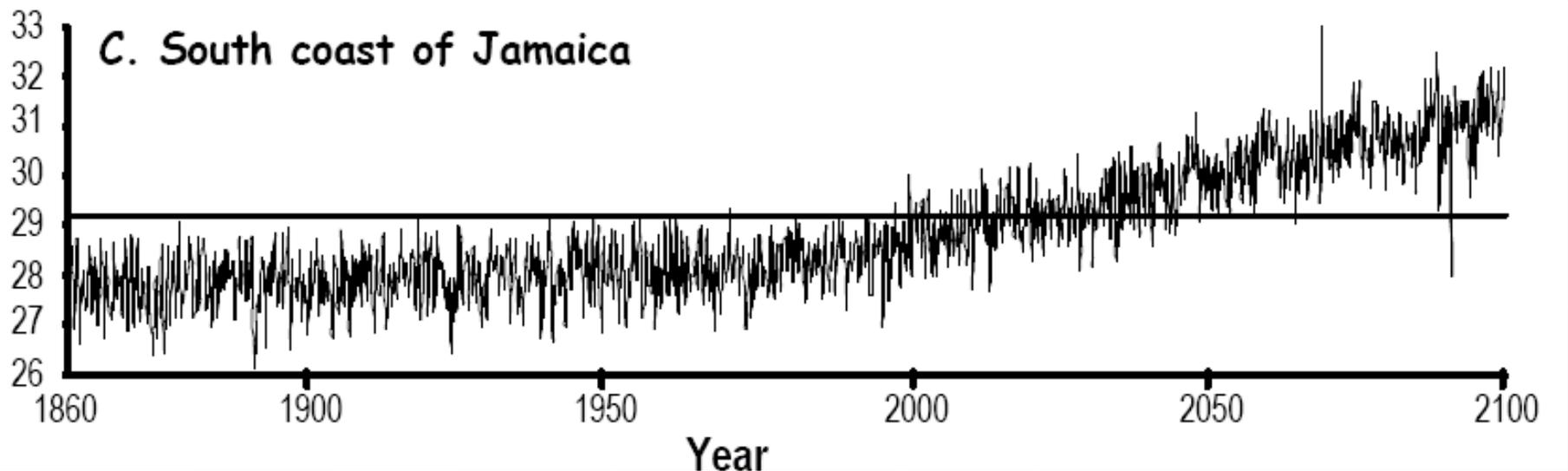


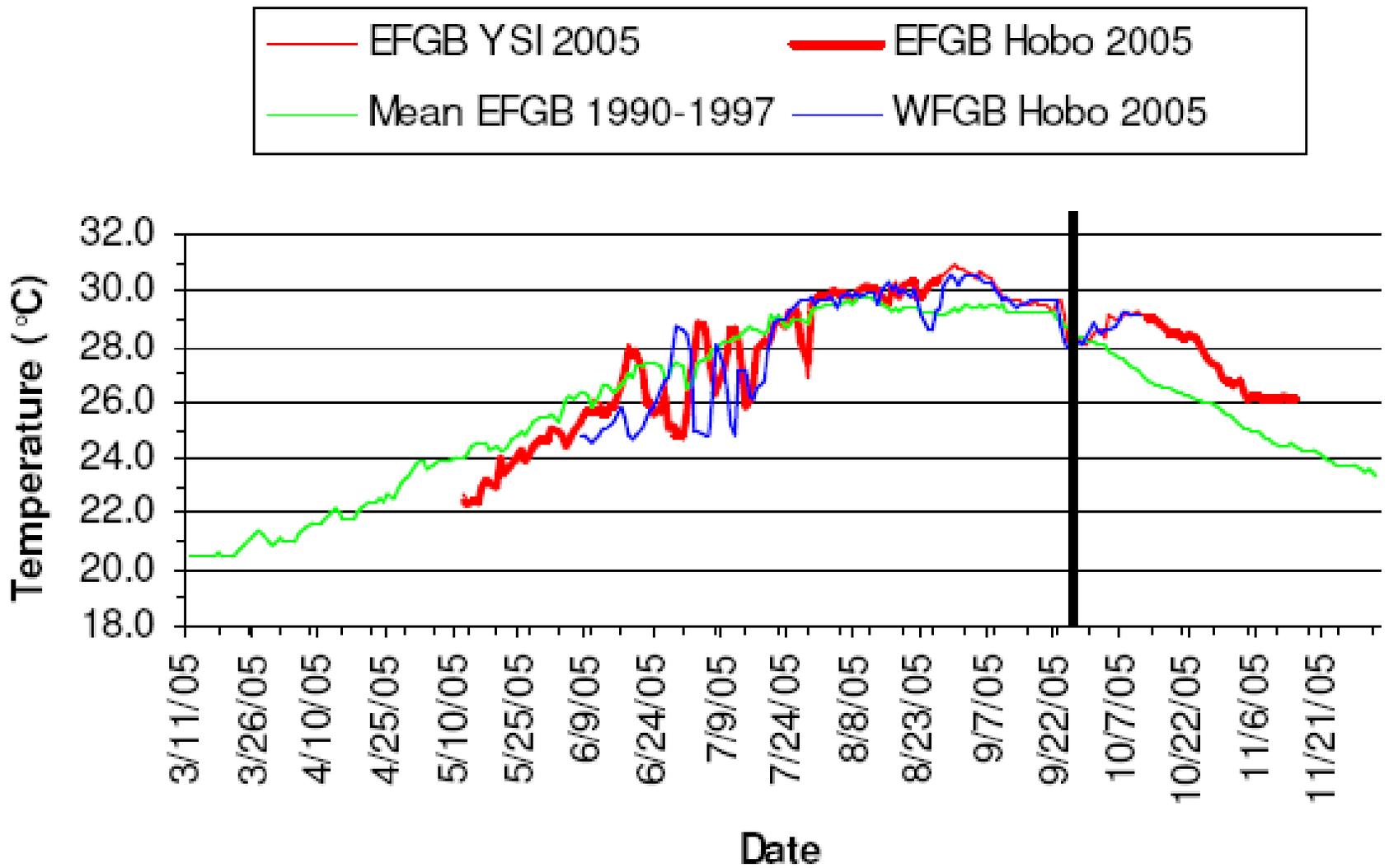
Name/Category	Date	Wind Speed (mph)	Trajectory
Tropical Storm Bonnie	8/10/04	50	Central GOM, ~600 km east of the Flower Garden Banks
Hurricane Charley	8/13/04	Cat 4	Passed over the Florida Straits, southwest Florida
Tropical Storm Frances	9/4/04	65	Northeast GOM, ~1000+ km east of the Flower Garden Banks
Hurricane Ivan	9/15/04	Cat 4	Passed ~550 km east of the Flower Garden Banks
Tropical Storm Matthew	10/09/04	40	Passed ~320 km east of the Flower Garden Banks
Tropical Storm Arlene	6/11/05	70	Central GOM, ~600 km east of the Flower Garden Banks
Tropical Storm Bret	6/25/05	40	Southwest GOM, ~800+ km south of the Flower Garden Banks
Tropical Storm Cindy	7/5/05	70	Central GOM, ~500 km east of the Flower Garden Banks
Hurricane Dennis	7/10/05	Cat 4	Central GOM, ~800 km east of the Flower Garden Banks
Hurricane Emily	7/19/05	Cat 1	Southwest GOM, ~600 km south of the Flower Garden Banks
Tropical Storm Gert	7/25/05	45	Southwest GOM, ~750 km south of the Flower Garden Banks
Tropical Storm Jose	8/23/05	50	Southwest GOM, ~800 km south of the Flower Garden Banks
Hurricane Katrina	8/28/05	Cat 5	Central GOM, ~500 km east of the Flower Garden Banks
Hurricane Rita	9/23/05	Cat 3	Central GOM, over the Flower Garden Banks
Tropical Storm Stan	10/3/05	40	Southwest GOM, ~850 km south of the Flower Garden Banks
Hurricane Wilma	10/24/05	Cat 3	Southeast GOM, ~900 km SE of the Flower Garden Banks



The background of the slide is a photograph of a coral reef. In the foreground, there are large, dark coral structures. In the mid-ground, several divers are visible, swimming and observing the reef. The water is clear and blue. The overall scene is a healthy coral reef environment.

Observation	East Bank Post-Hurricane 2005
Paling	0
Bleaching	6.71 ± 0.79
Concentrated Fish Biting	0.06 ± 0.05
Isolated Biting	0.07 ± 0.05
Disease	0





References

Mann, M.E., R.S. Bradley, and M.K. Hughes. 1994. Northern hemisphere temperatures during the past millennium: Inferences, uncertainties, and limitations. *Geophysical Research Letters* 26(6): 759–762.

Wigley, T.M.L. 2000. Updated version of and results from the simple climate model MAGICC. Boulder, CO: National Center for Atmospheric Research.