

AMERICA'S UNDERWATER TREASURES



Flower Garden Banks National Marine Sanctuary

G.P. Schmahl
Superintendent

December 8, 2015





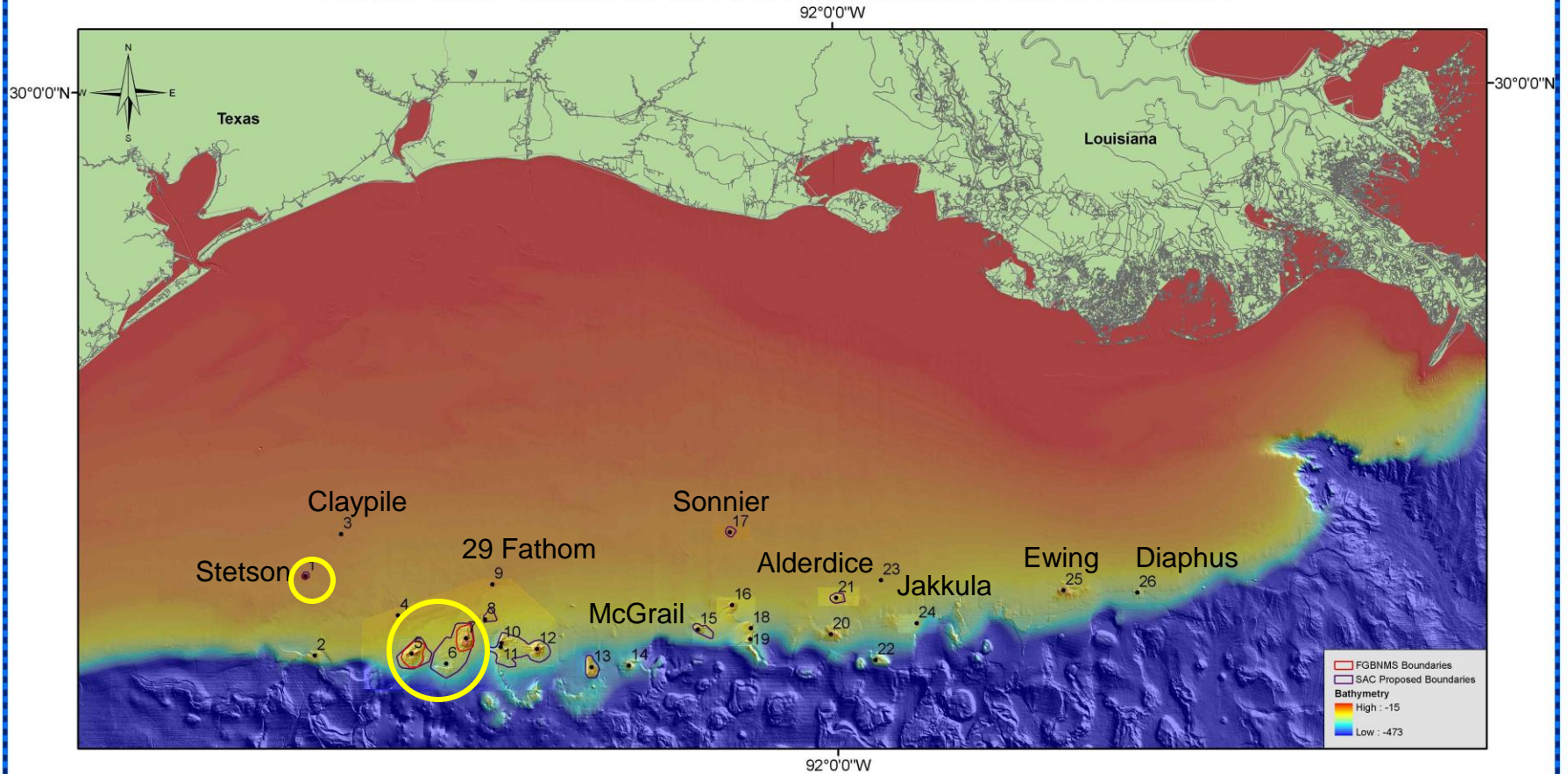
Our National Marine Sanctuaries



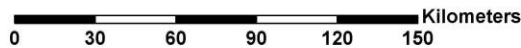
● National Marine Sanctuary

★ Marine National Monument

Reefs and Banks in the Northwestern Gulf Of Mexico



1. Stetson Bank, 2. Applebaum Bank, 3. Claypile Bank, 4. Coffee Lump Bank, 5. West Flower Garden Bank, 6. Horseshoe Bank, 7. East Flower Garden Bank, 8. MacNeil Bank,
9. 29 Fathom Bank, 10. Rankin Bank, 11. 28 Fathom Bank, 12. Bright Bank, 13. Geyer Bank, 14. Elvers Bank, 15. McGrail Bank, 16. Bouma Bank, 17. Sonnier Bank,
18. Rezak Bank, 19. Sidner Bank, 20. Parker Bank, 21. Alderdice Bank, 22. Sweet Bank, 23. Fishnet Bank, 24. Jakkula Bank, 25. Ewing Bank, 26. Diaphus Bank,

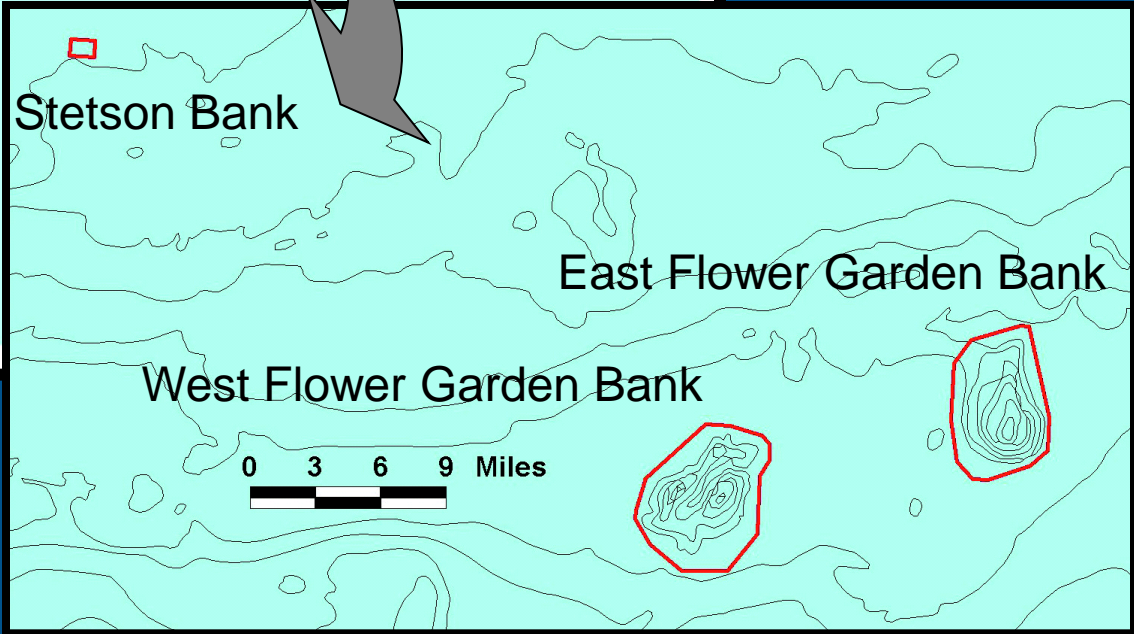
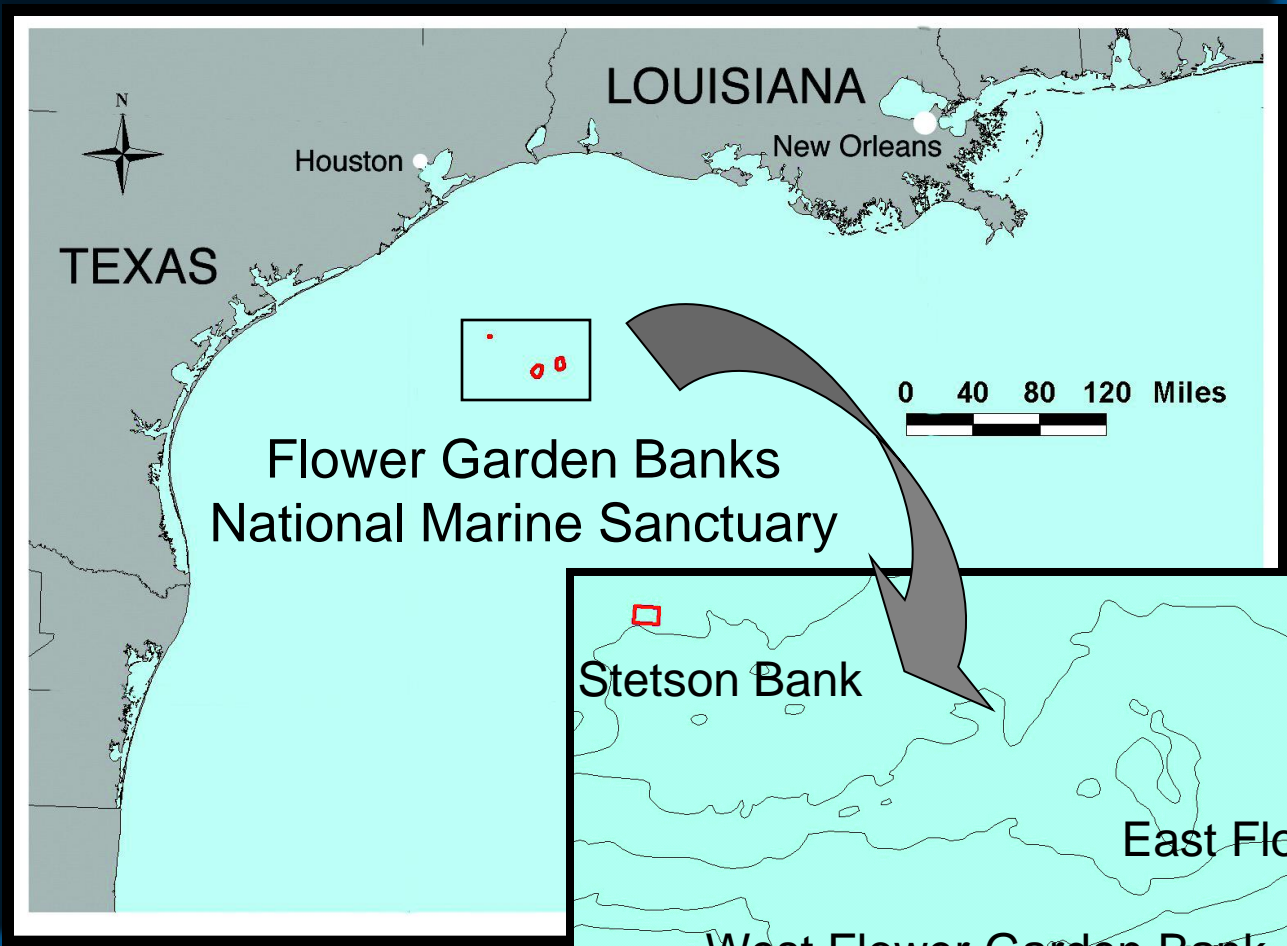


Bathymetry courtesy of USGS, UNH, Gardner and NOAA

M. Nuttall, FGBNMS, July 2010



Reefs and Banks of the Northwestern Gulf of Mexico



Remarkable Reefs of the Flower Garden Banks





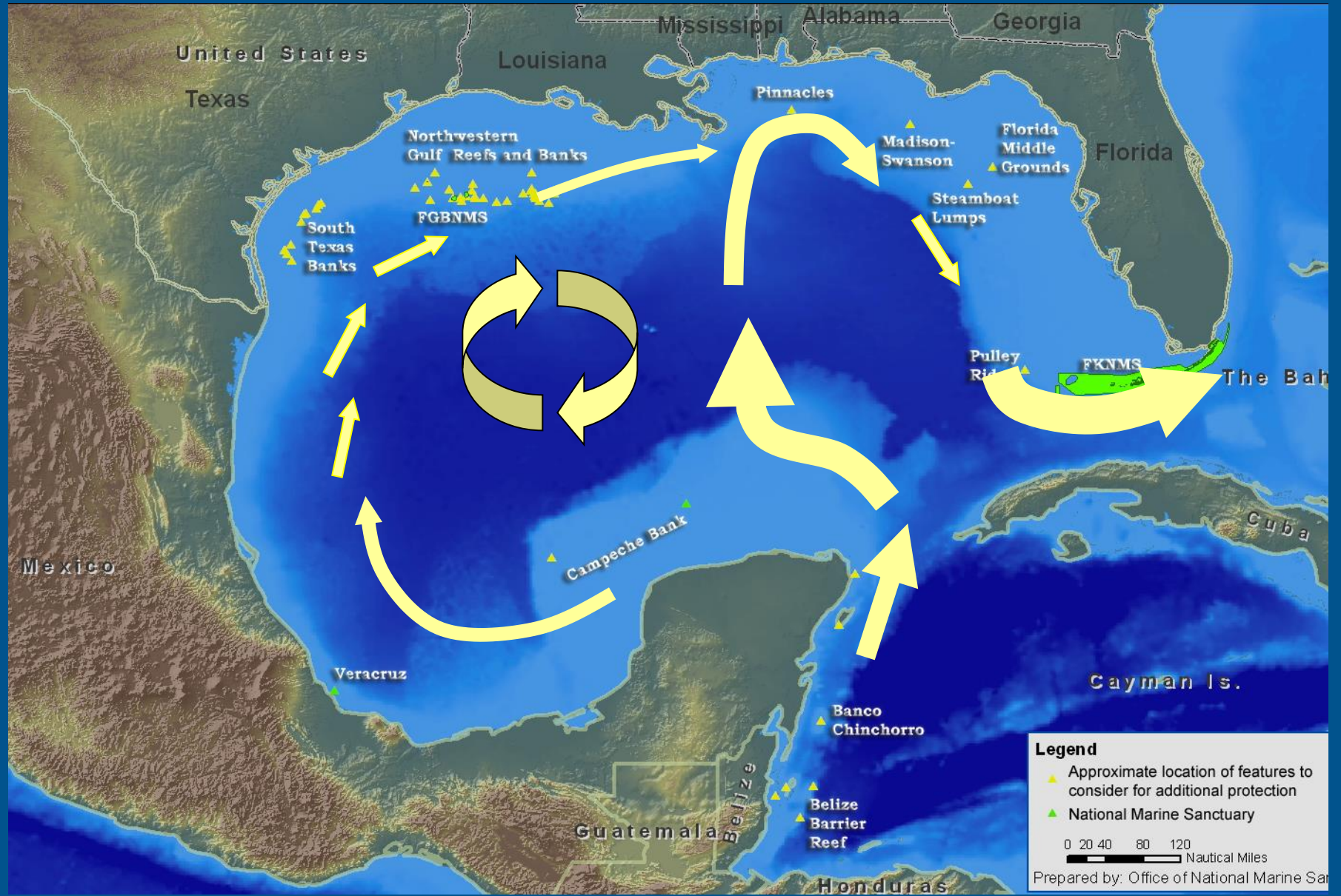
Flower Garden Banks National Marine Sanctuary

- Northernmost coral reef in the continental United States
- Includes: East and West Flower Garden and Stetson Banks
- Located 93 to 104 nautical miles offshore in the Gulf of Mexico
- Area: 145 square kilometers (56 square statute miles)
- Water Depth: 17 – 152 meters

Flower Garden Banks National Marine Sanctuary



Gulf of Mexico "Loop Current" and Reef Features



United States of America

Flower Garden Banks
National Marine Sanctuary

Gulf of Mexico

Mexico

Florida Keys

Cuba

Yucatan

Northern
Veracruz Reefs

Campeche
Bank Reefs

Southern
Veracruz Reefs

- Arenas
- Triangulos
- Arcas

Alacrane

450 miles

610 miles

430 miles

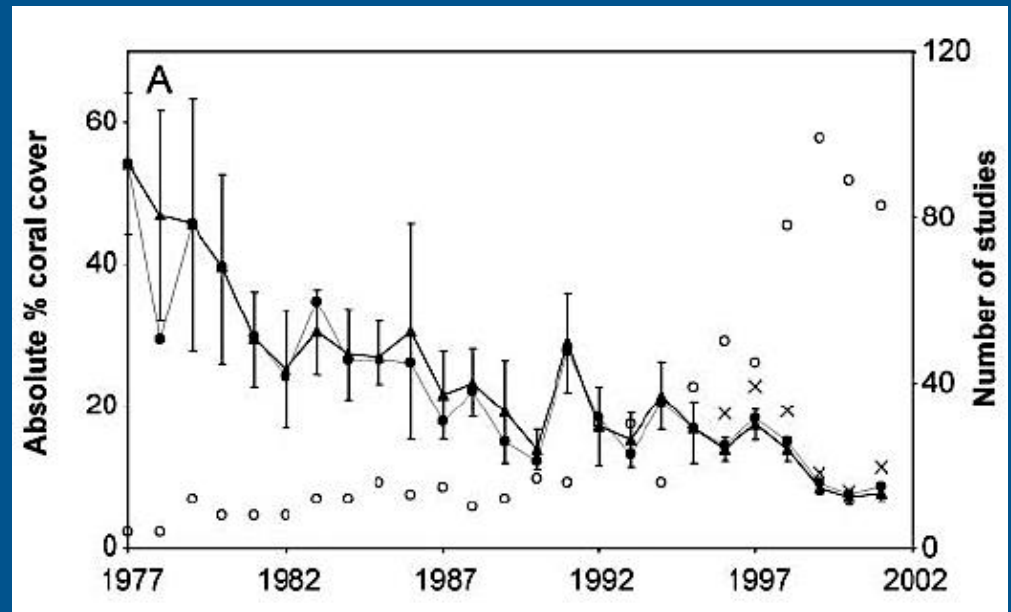
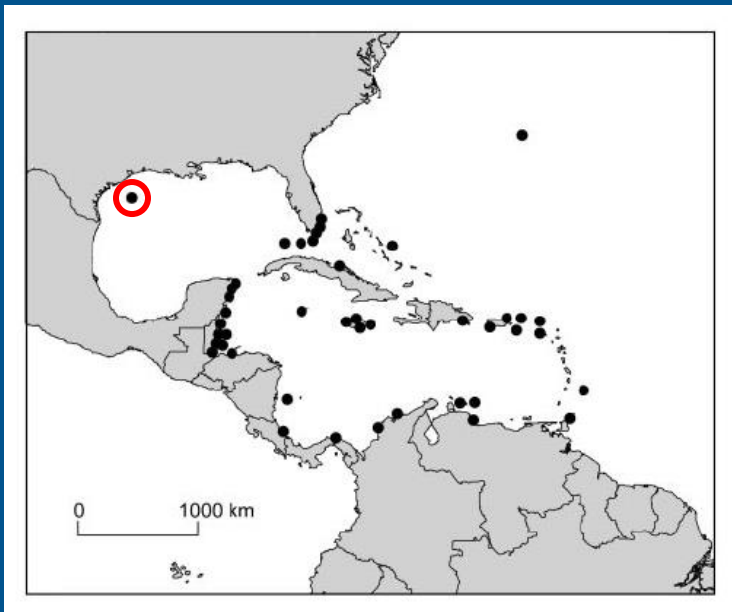
790 miles

Imagery Courtesy of Gulf of Mexico Coastal Ocean Observing System



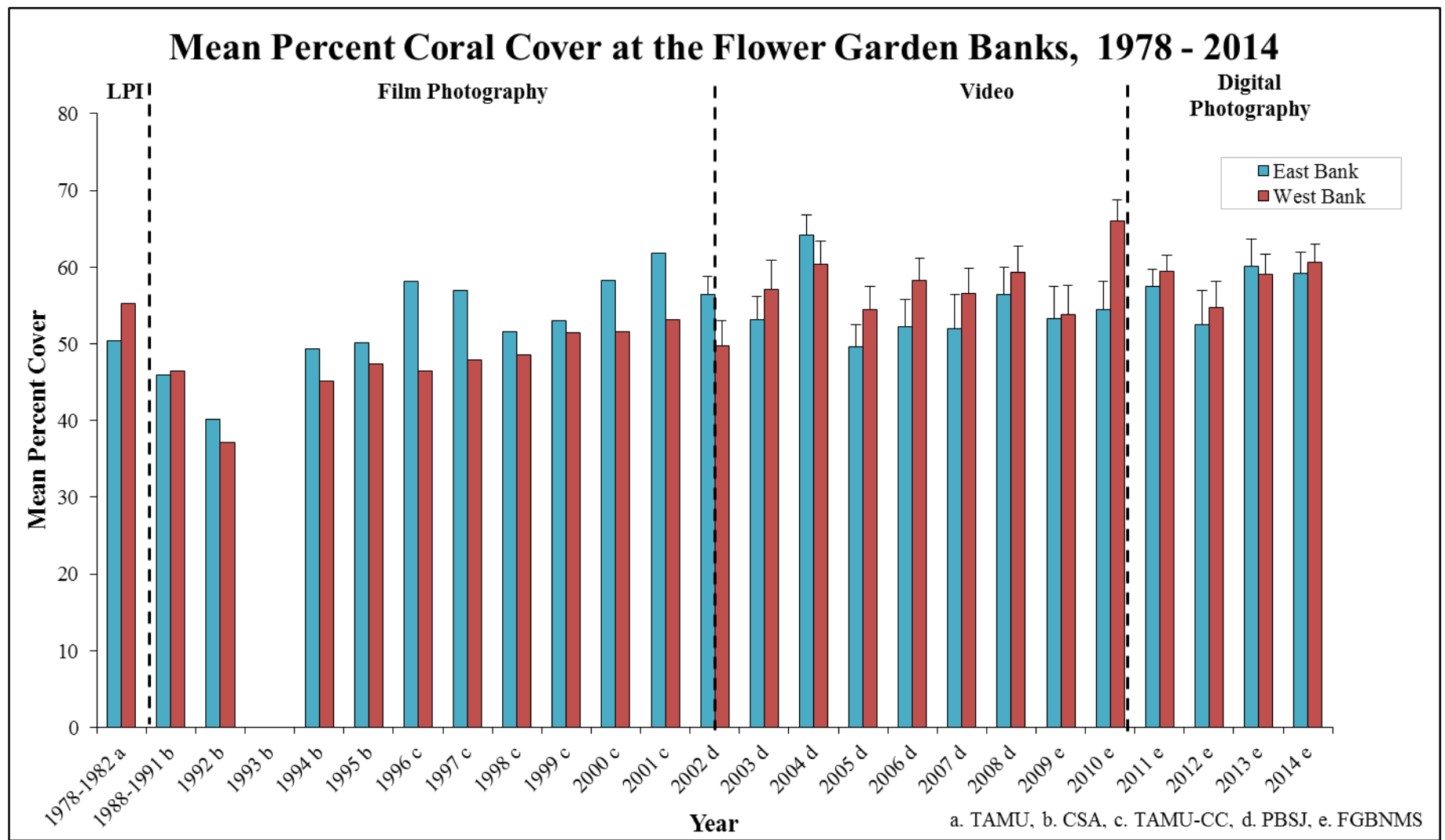
Long-term region-wide declines in Caribbean Corals

Gardner, T.A. et al., 2003. Science 301:958

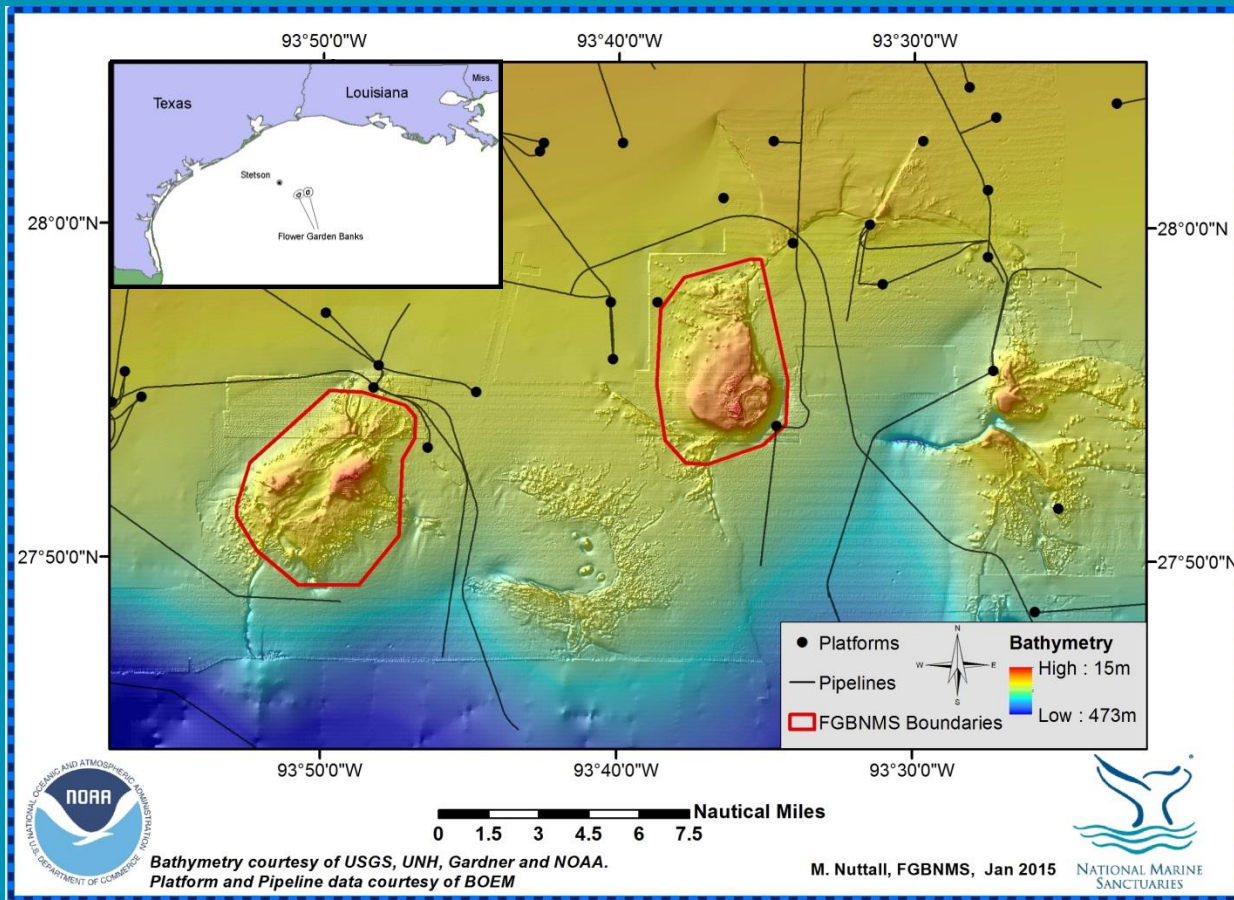


Average hard coral cover reduced by 80%
(from 50% to 10%) in 30 years

Historical Coral Cover Dataset



Monitoring at East and West Flower Garden Banks

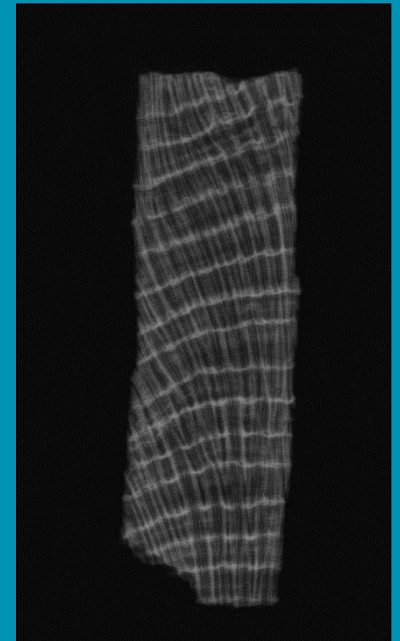
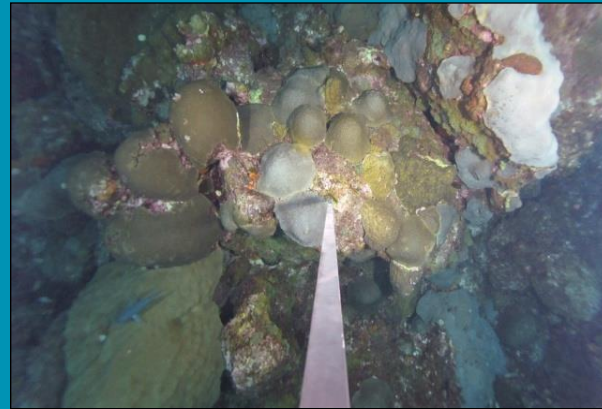


- Monitoring since 1975
- BOEM instituted monitoring beginning in 1989
- Designated as a Sanctuary in 1992
- Joint monitoring effort began in 1995
- 26 year dataset

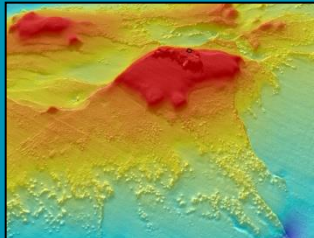
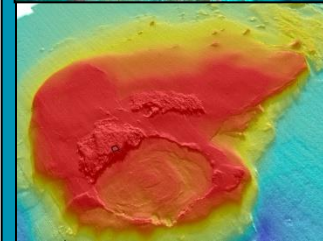
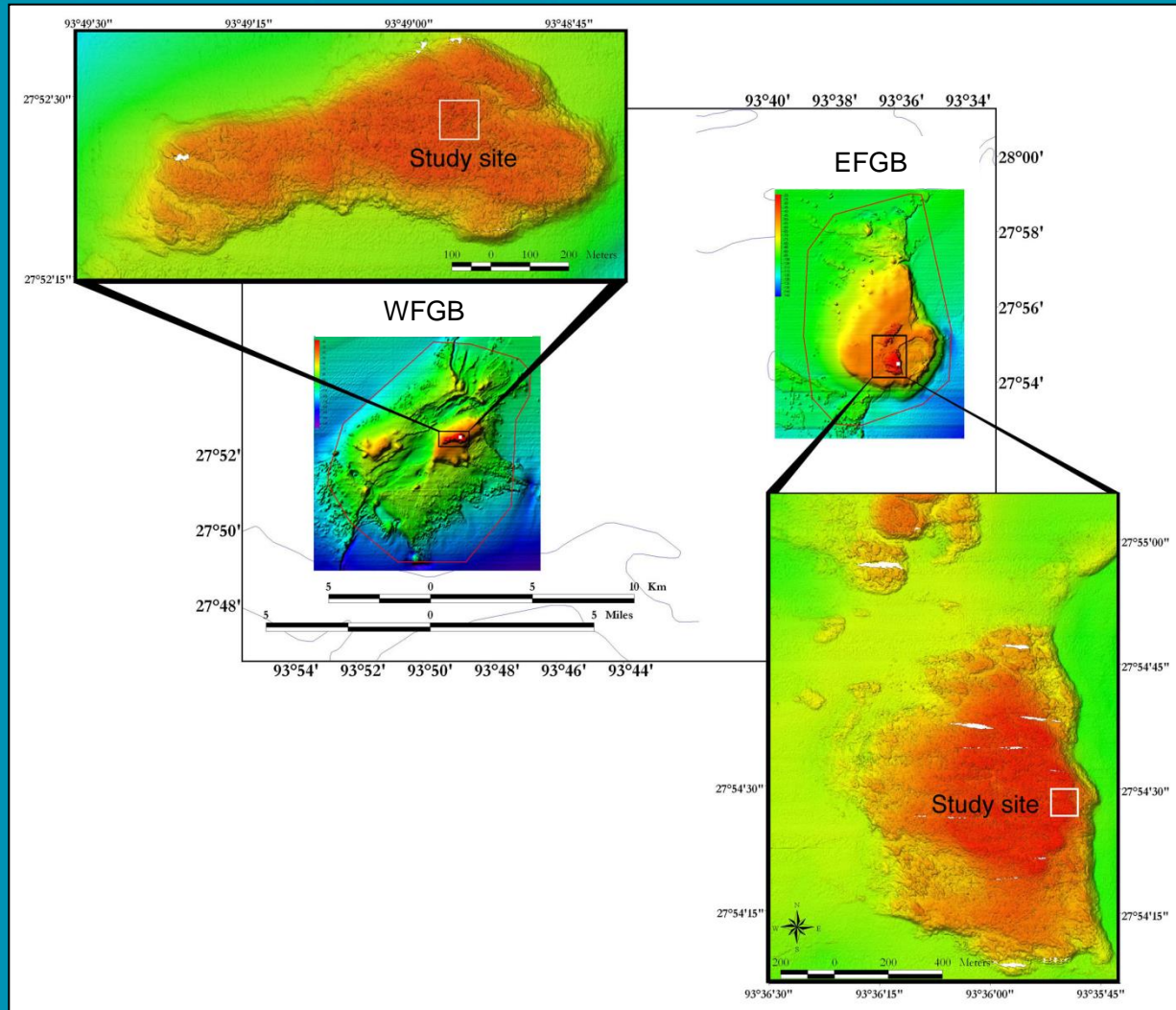
Major Reefs Living Coral Cover

Location	Percent Coral Cover	Source
Flower Garden Banks	60	Johnston et al. 2015
Bonaire	10-38	Steneck et al. 2011
Bermuda	35	Jackson et al. 2014
Puerto Rico	7-36	Waddell and Clark 2008
Navassa Island	10-25	Waddell and Clark 2008
Florida Keys NMS	3-20	ONMS 2011
Jardin de la Reina, Cuba	7-19	Pina Amargós et al. 2008
Pedro Bank, Jamaica	5-19	Bruckner 2013
Cay Sal Bank, Bahamas	7-9	Bruckner 2011

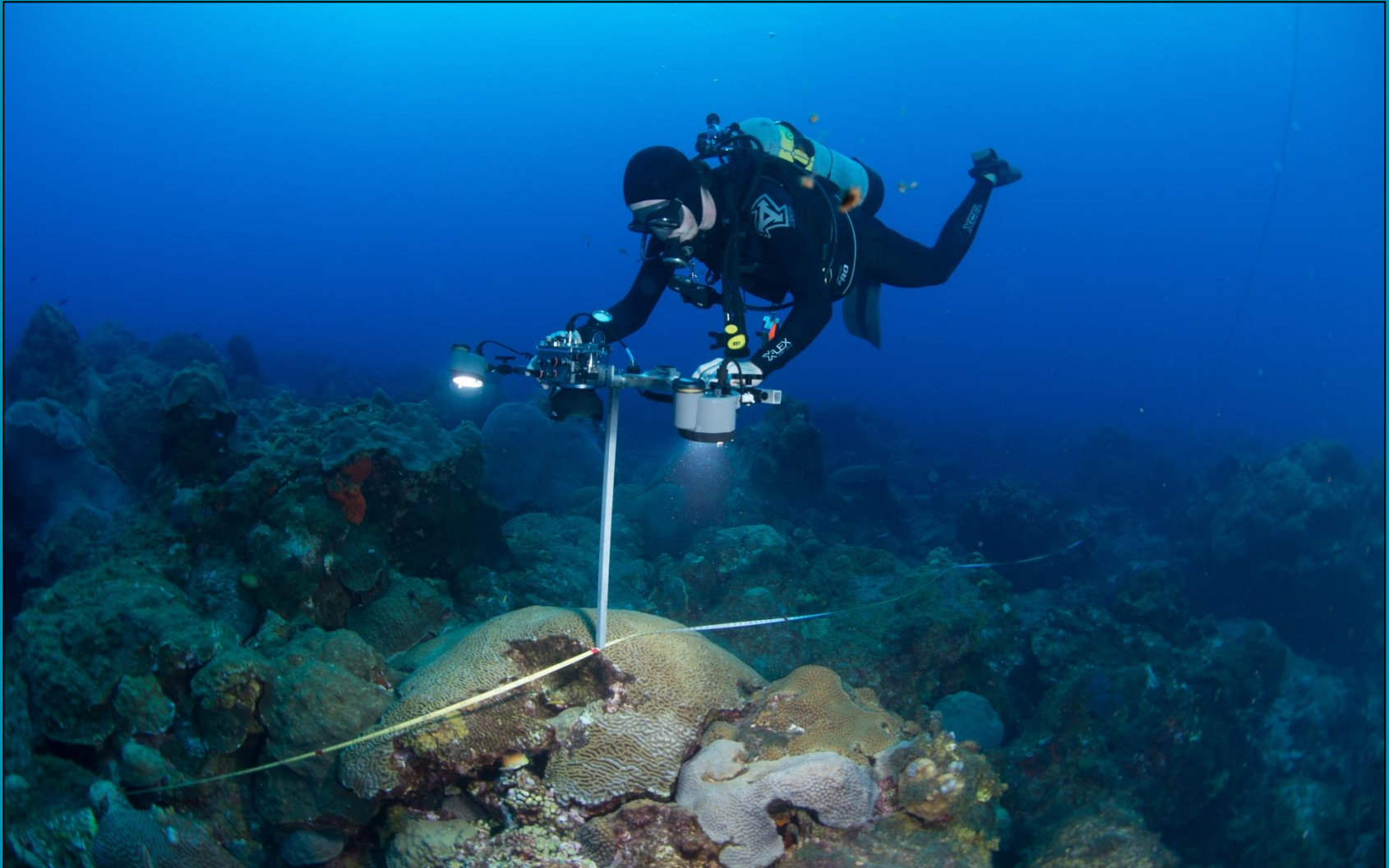
Long-Term Monitoring Methods



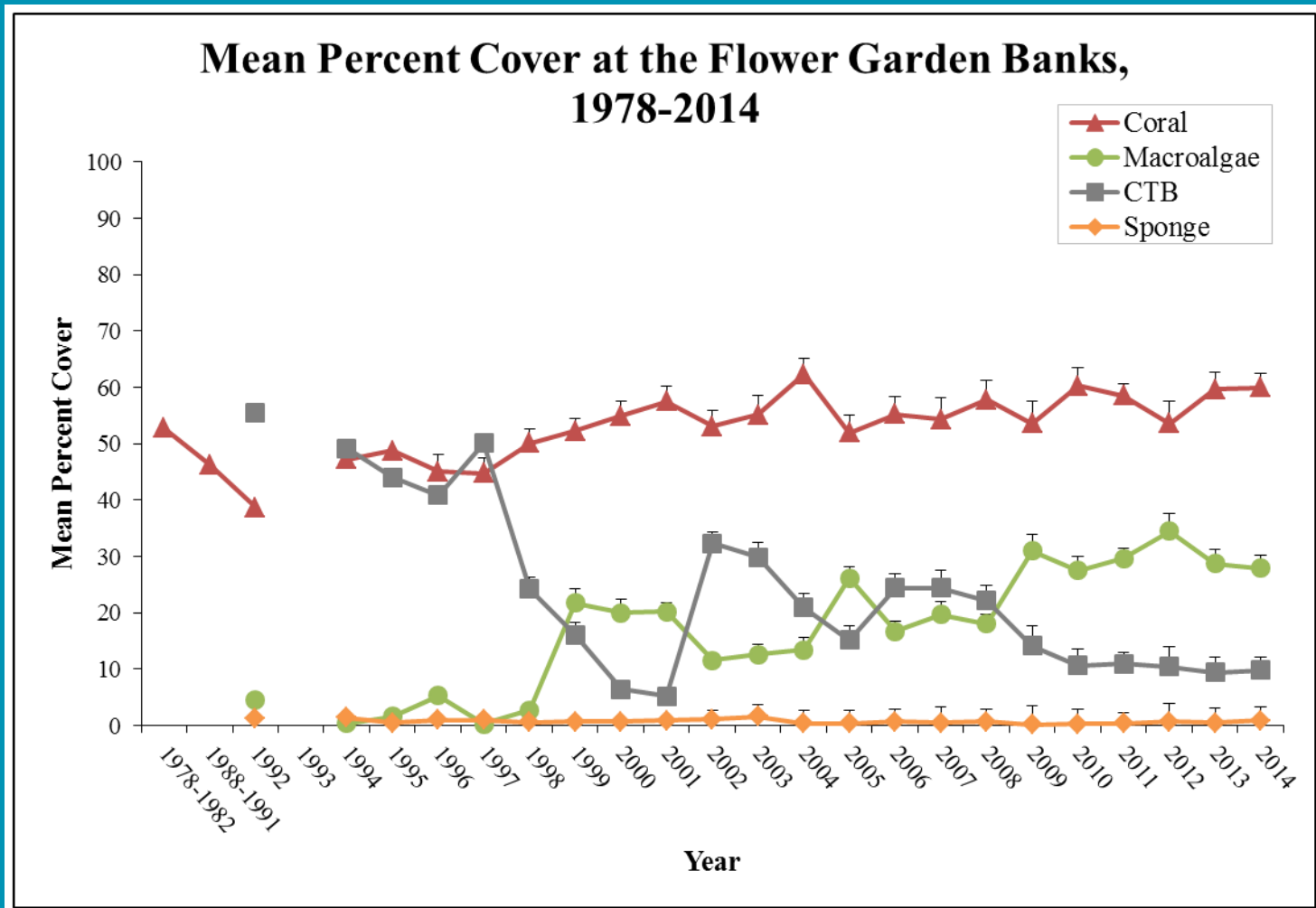
Flower Garden Banks Study Sites



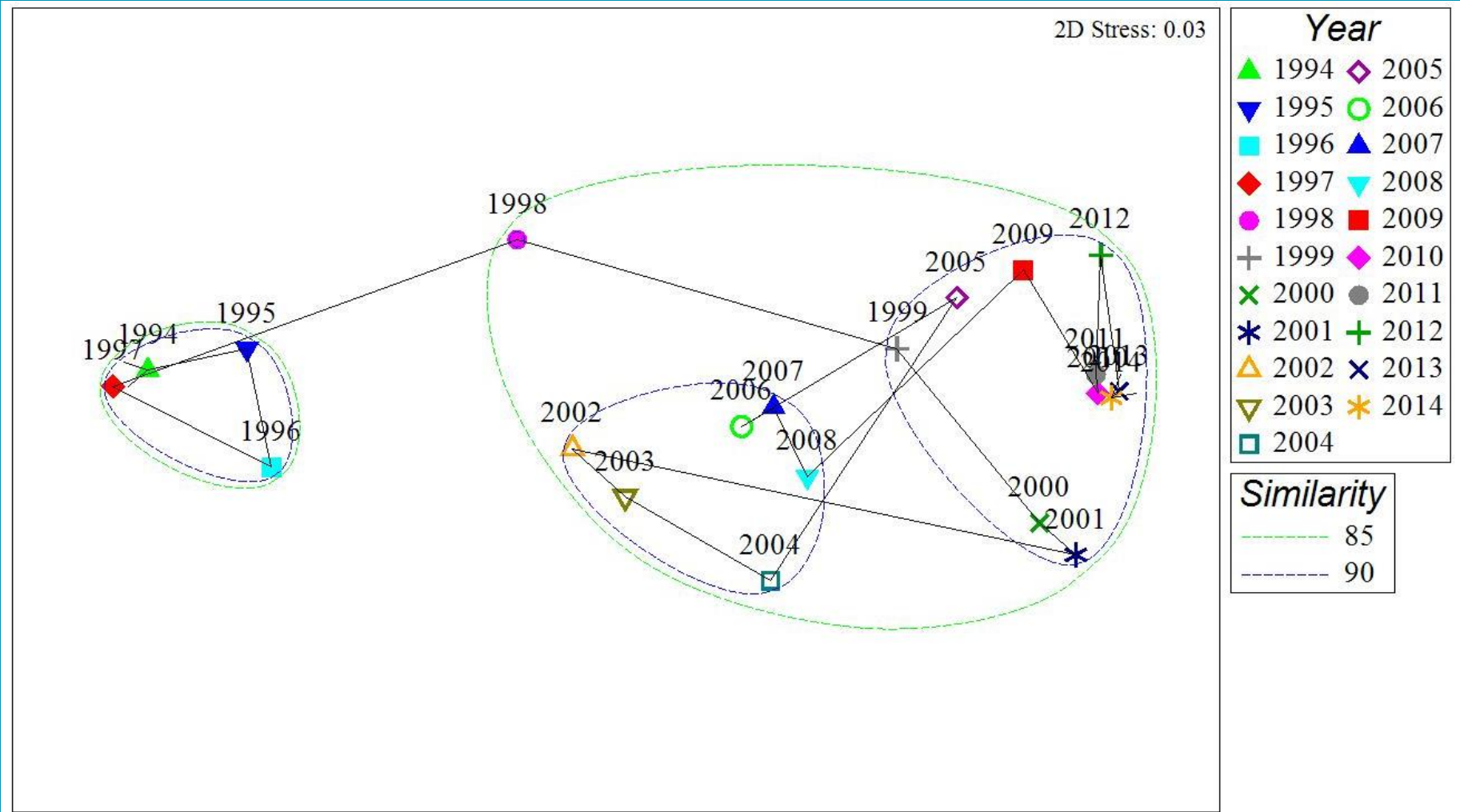
Random Transects – Coral Cover



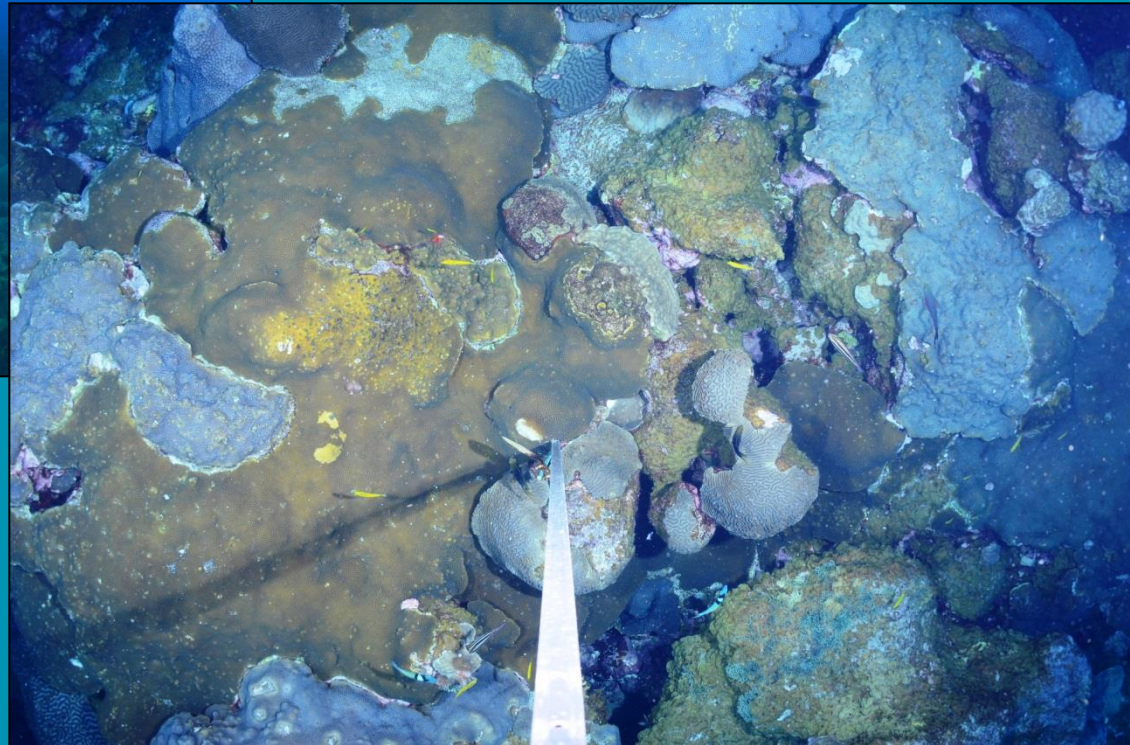
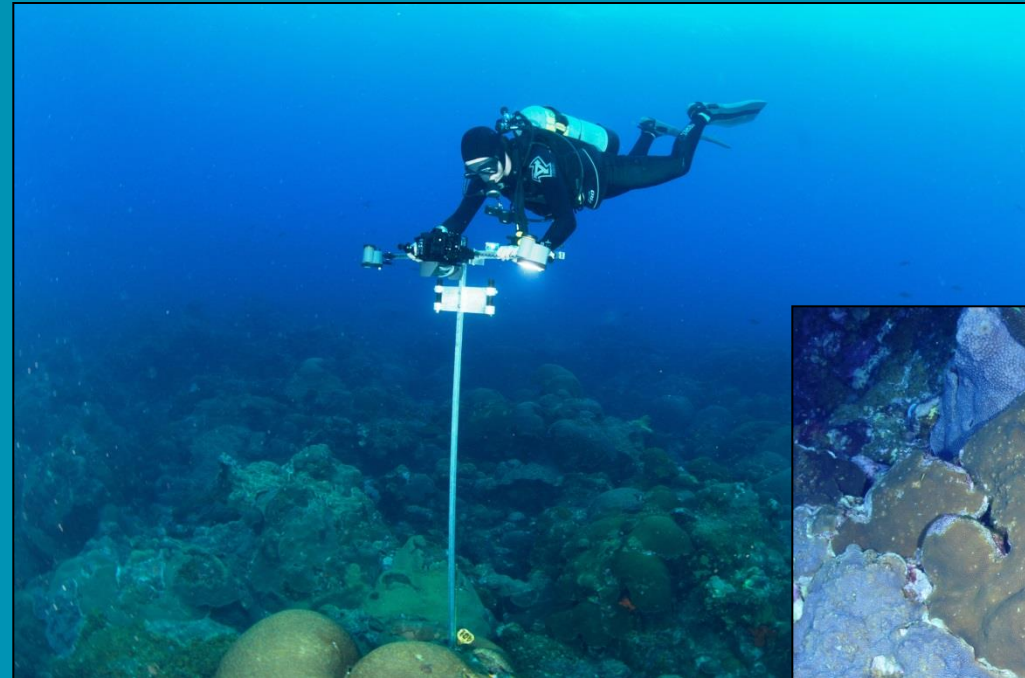
Historical Coral Cover Dataset



Random Transect Time Series

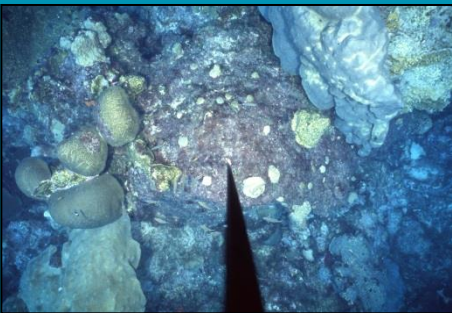


Repetitive Photostations

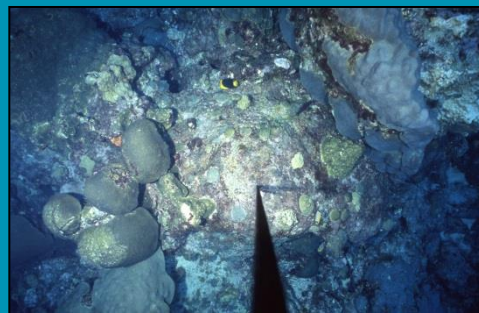


Repetitive Photostation Time Series

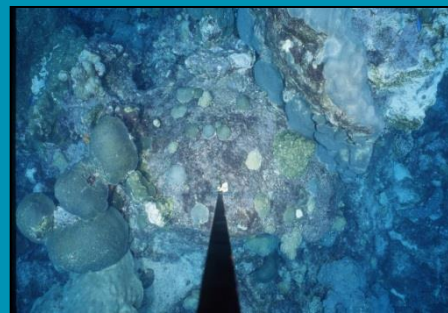
1989



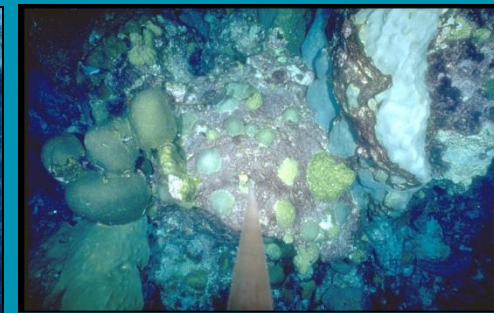
1992



1995



1998



2002



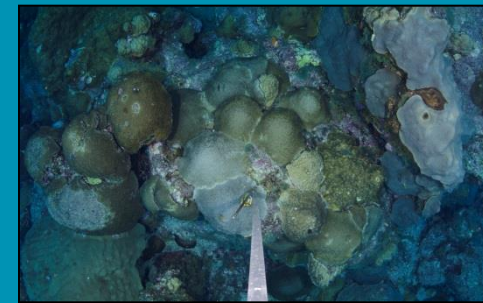
2006



2010



2014

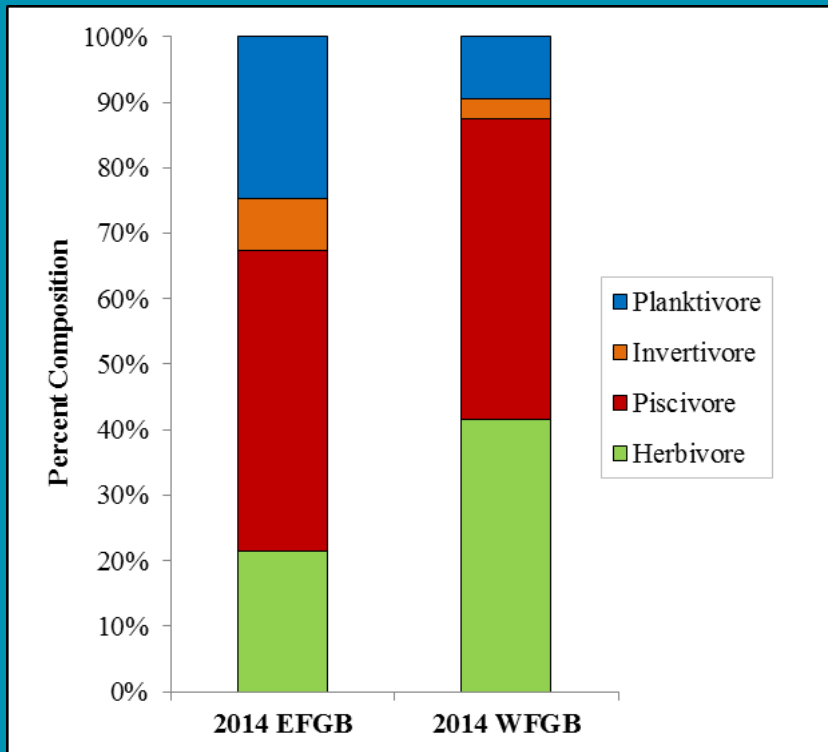




Fish Survey Data



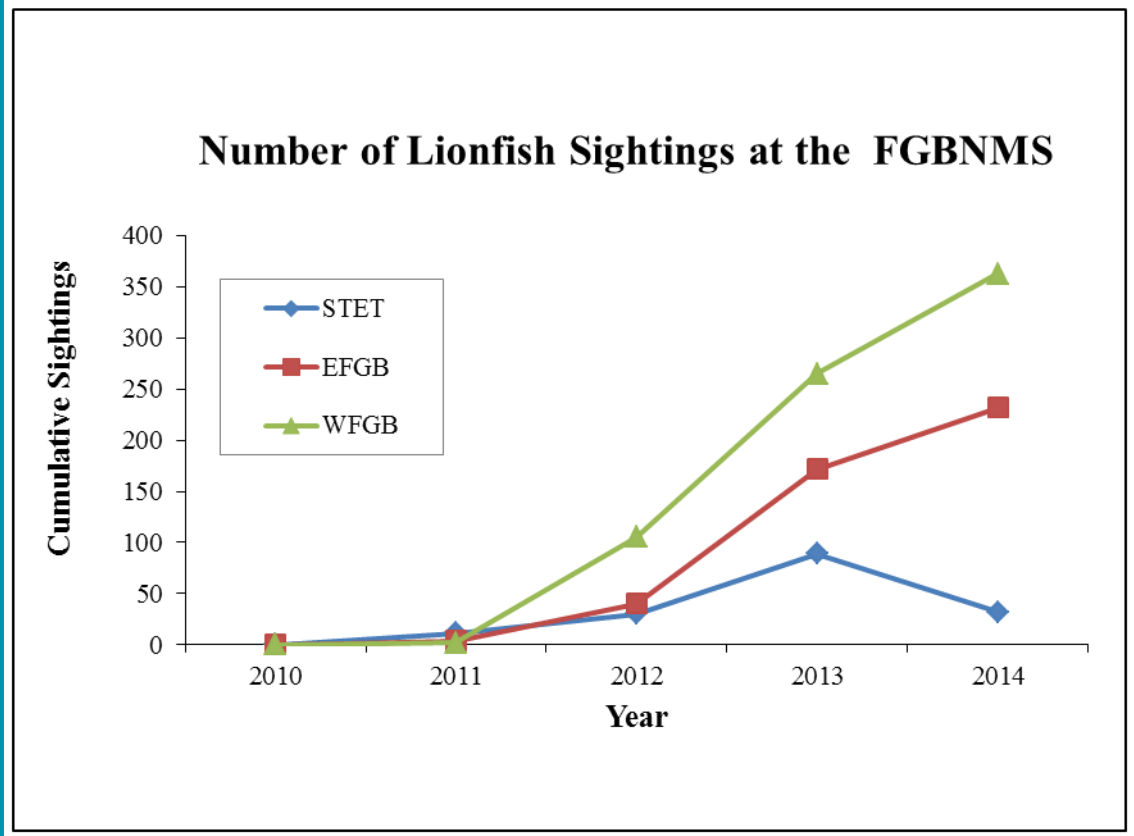
Fish Survey Data



Trophic Group	2014 Biomass (g/100 m ²)		All Surveys
	EFGB	WFGB	
Herbivore	2752.45 ± 356.56	11321.96 ± 3075.44	7037.21 ± 1633.07
Invertivore	1023.09 ± 158.05	877.01 ± 127.49	950.05 ± 101.12
Planktivore	60395.23 ± 32185.49	2555.41 ± 462.18	31475.32 ± 16395.58
Piscivore	5932.58 ± 1087.08	12471.35 ± 3015.55	9201.96 ± 1645.13

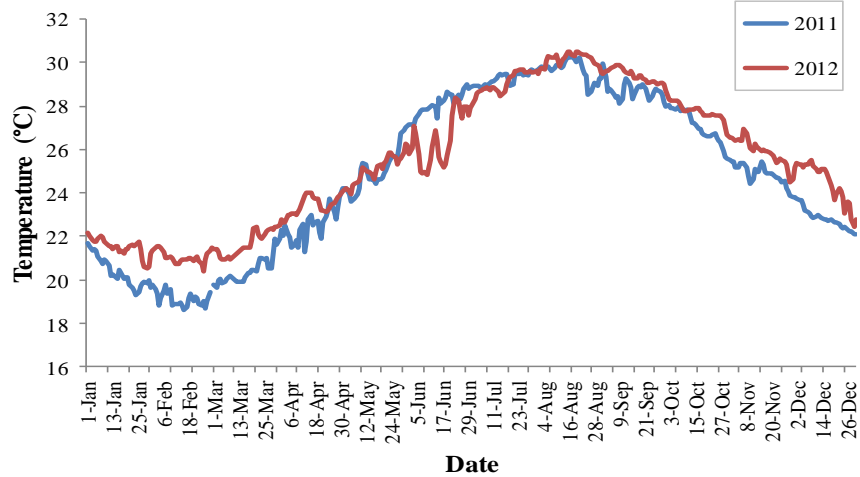
Region	Average Biomass (g/100 m ²)	Average Richness (Richness/100 m ²)
Puerto Rico (Caldow et al. 2015; Bauer et al. 2015a; Bauer et al. 2015b)	3830.25 ± 188.51	18.19 ± 0.19
US Virgin Islands (Roberson et al. 2015; Pittman et al. 2015; Clark et al. 2015b; Bauer et al. 2015c)	6355.38 ± 172.60	20.70 ± 0.12
FGB (Clark et al. 2015a)	34570.87 ± 3517.95	24.60 ± 0.36

Fish Survey Data

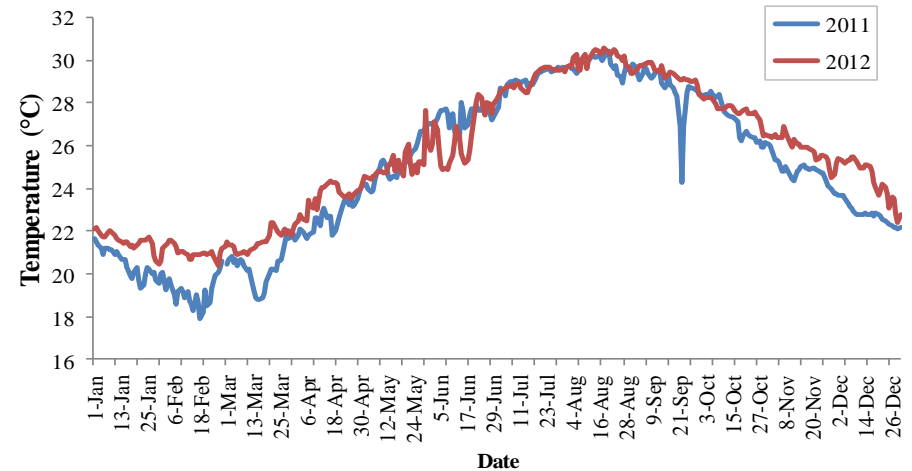


Water Quality Analysis

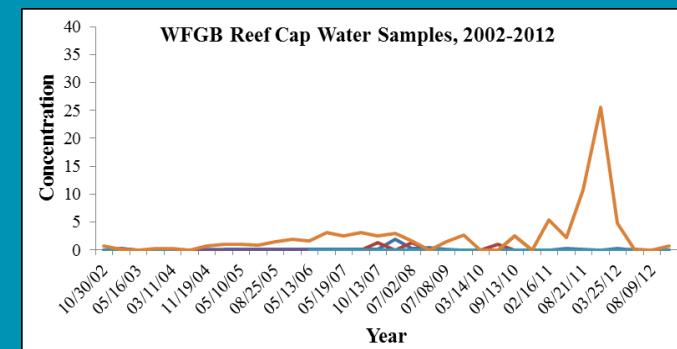
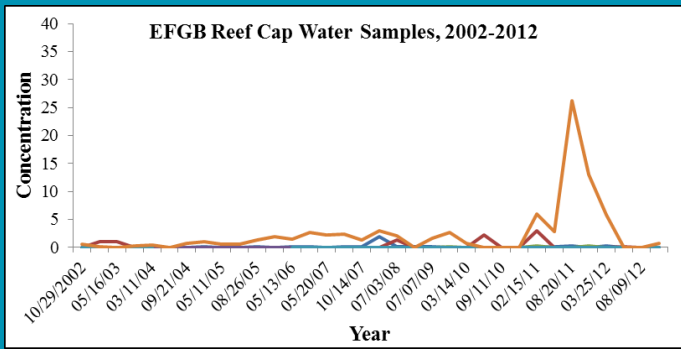
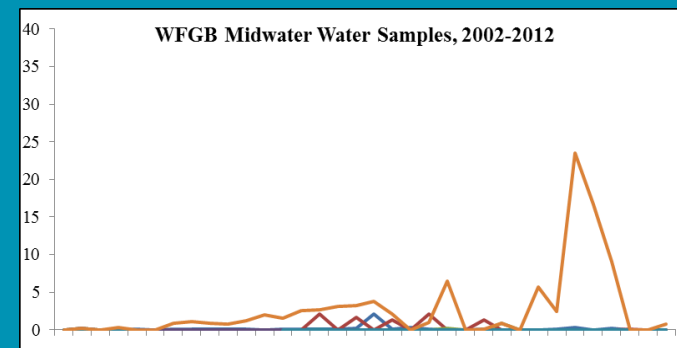
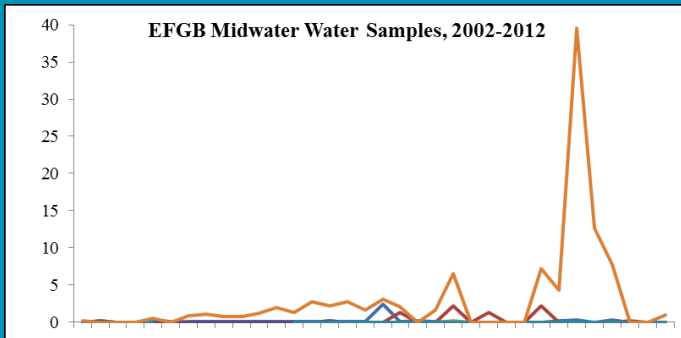
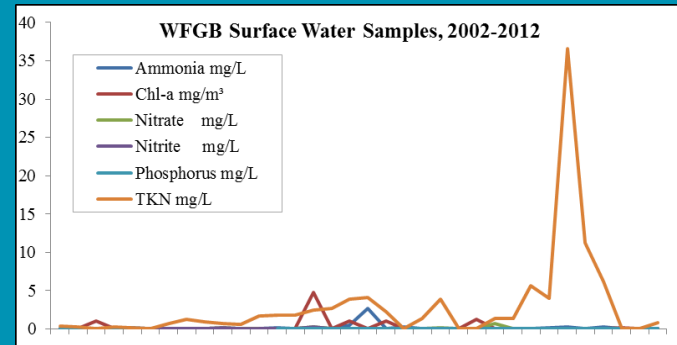
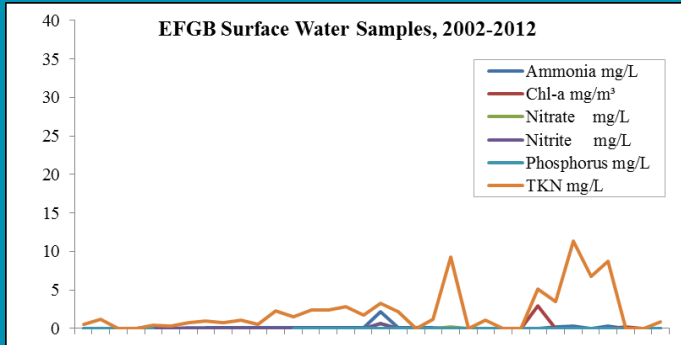
Sea-Bird Annual Temperature Variation at East Flower Garden Bank, 2011-2012



Sea-Bird Annual Temperature Variation at West Flower Garden Bank, 2011-2012



Water Quality Analysis

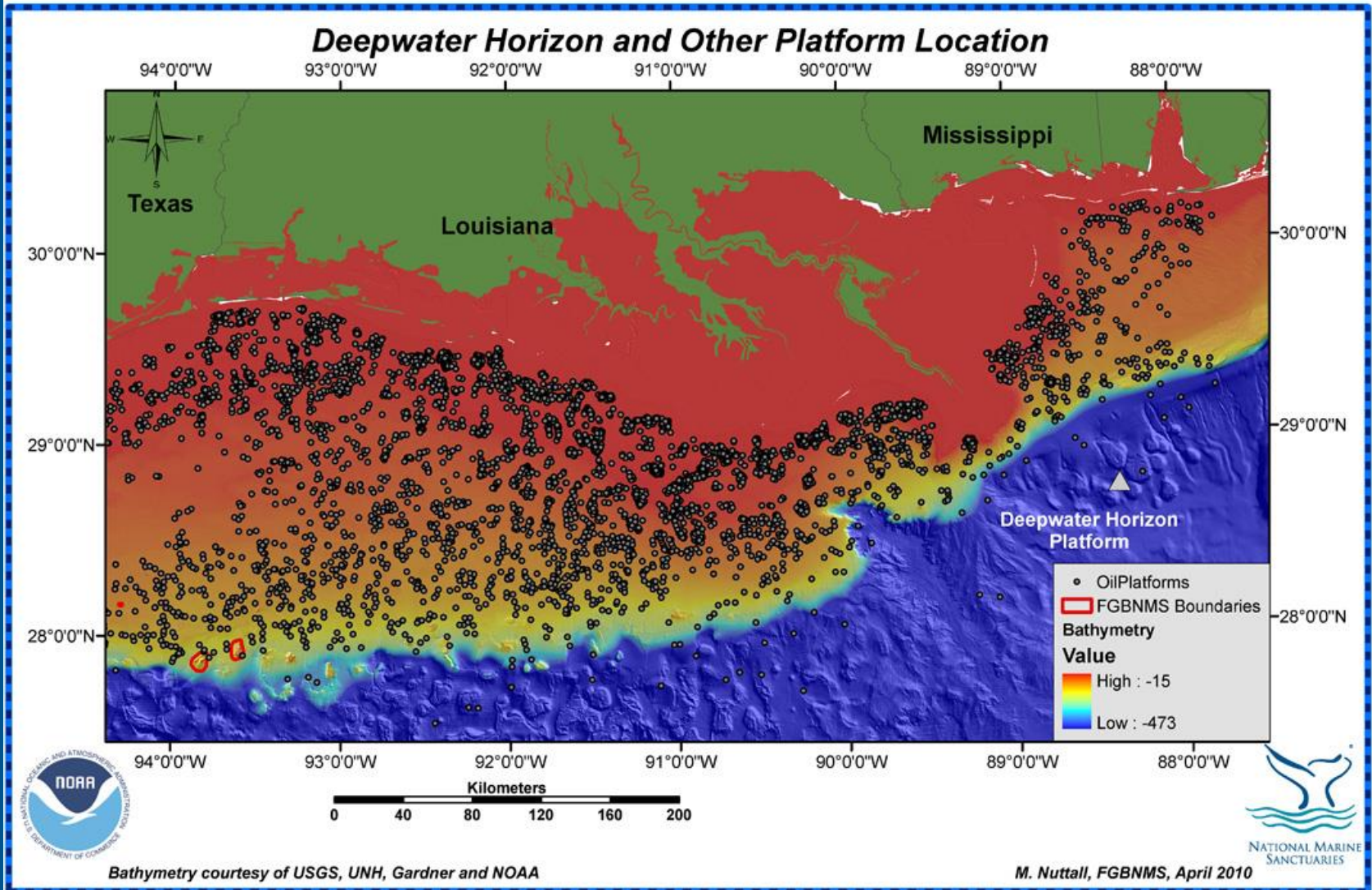


Summary

- FGBNMS represents a relatively stable coral reef environment
 - Consistent High Coral Cover ~50%
 - Consistent Fish Species and Family Abundance
- Lengthy Historical Dataset
- Continued monitoring is needed to monitor the environment for changes that may threaten the health of the reef



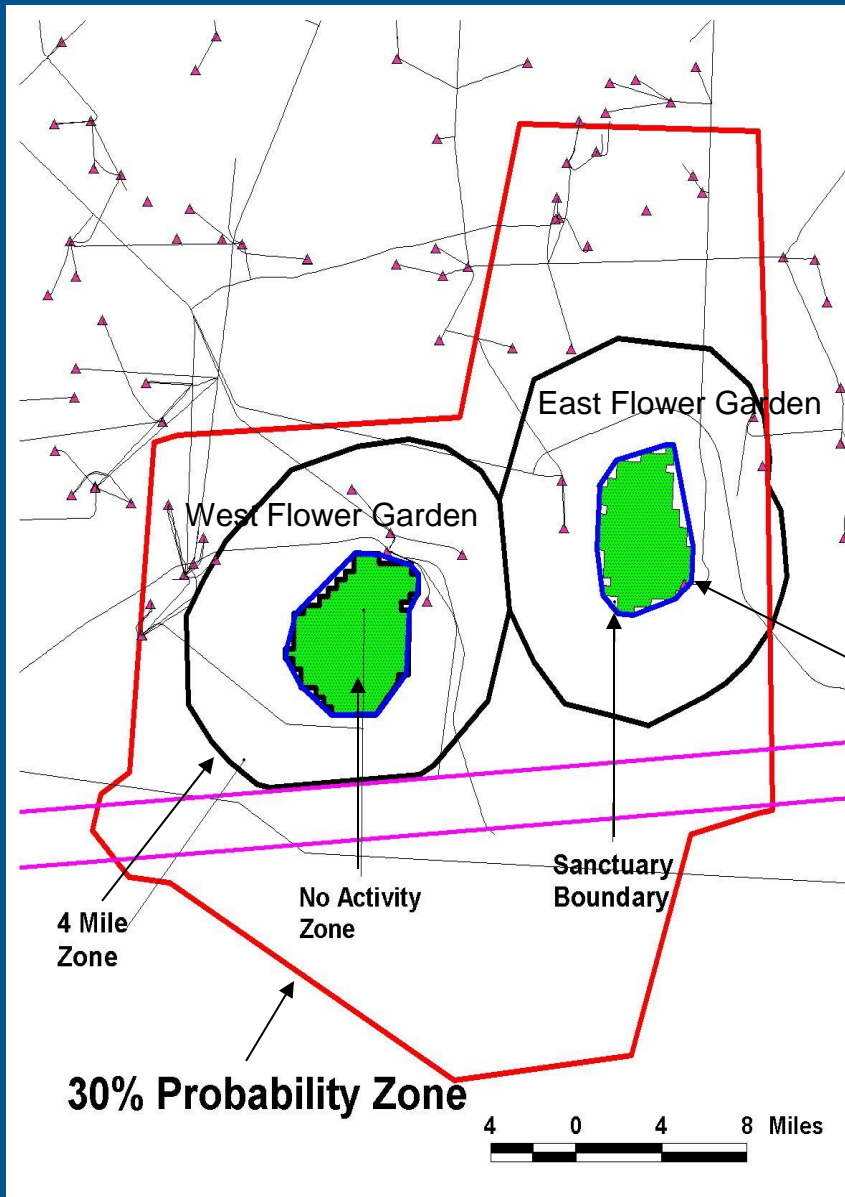
Oil and Gas Infrastructure



Flower Garden Banks

Regulatory Zones and Oil and Gas Infrastructure

Oil & gas development is allowed within the Sanctuary outside the No-Activity Zone (NAZ)

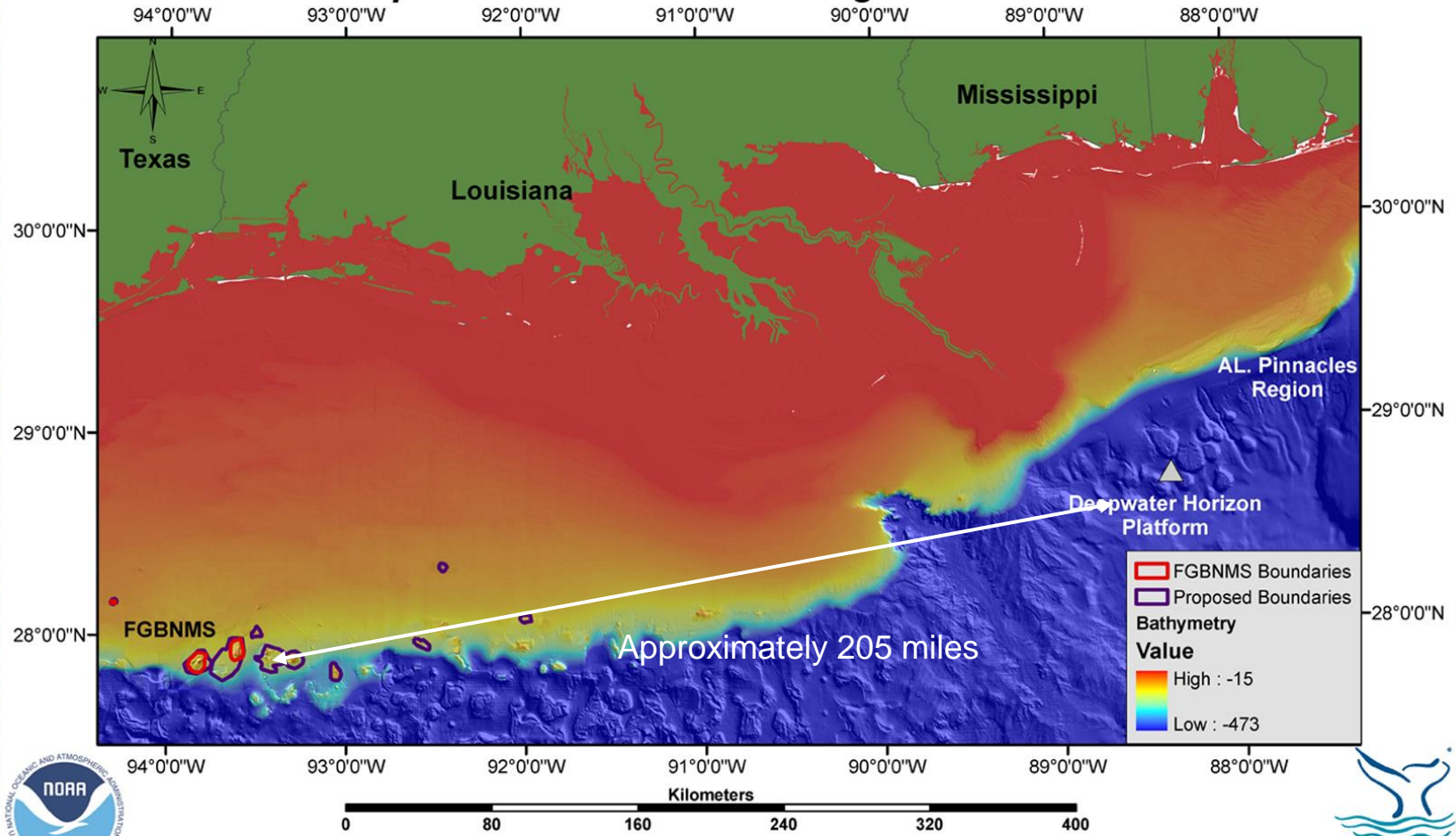


Platform High Island A389 located inside East Flower Garden Bank boundary



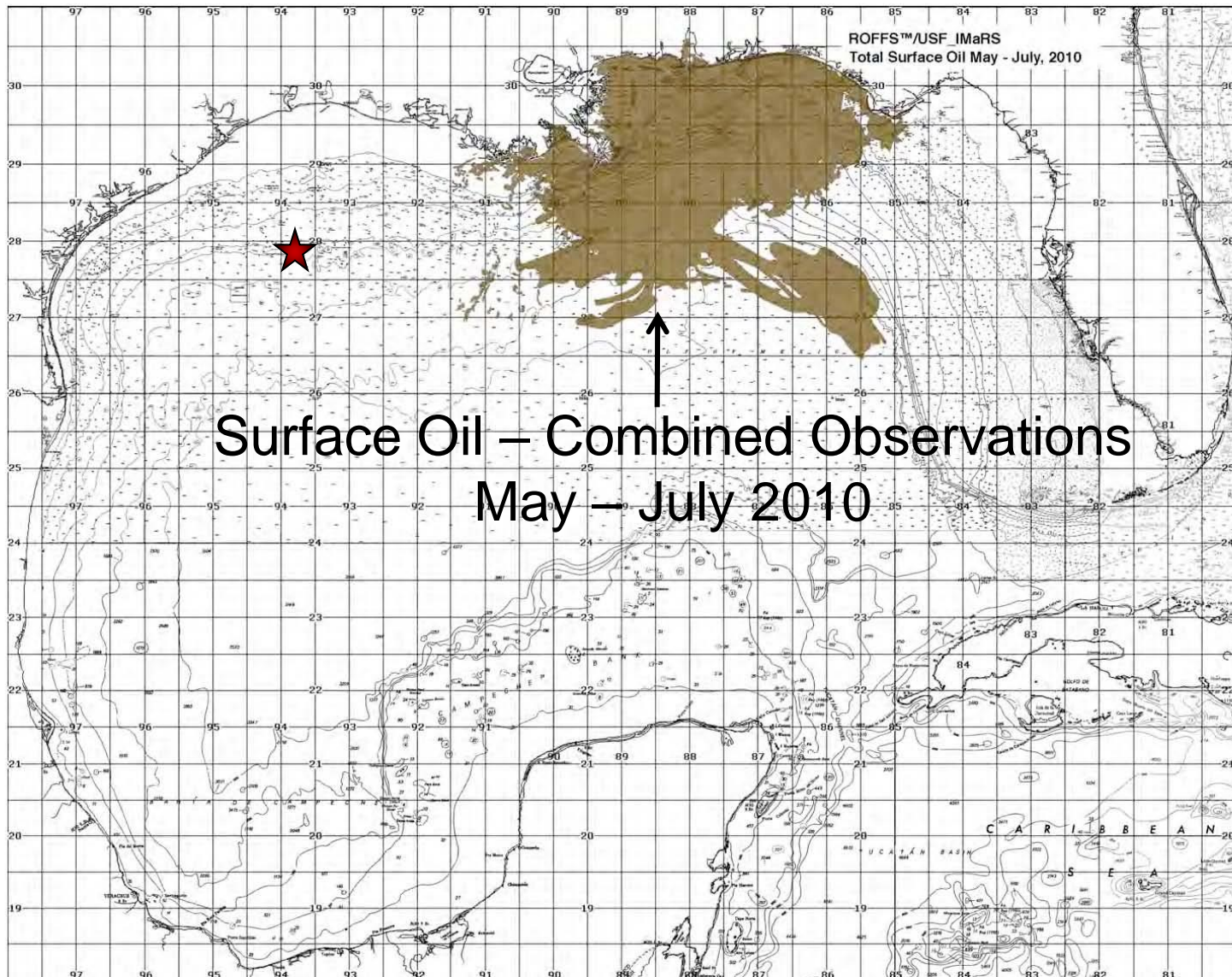
Deepwater Horizon 4/23/10

Deepwater Horizon Platform Regional Location



Bathymetry courtesy of USGS, UNH, Gardner and NOAA

M. Nuttall, FGBNMS, April 2010



Data courtesy of: ROFFER'S OCEAN FISHING FORECASTING SERVICE, INC.

Nearshore Surface Oil Forecast Deepwater Horizon MC252

NOAA/NOS/OR&R

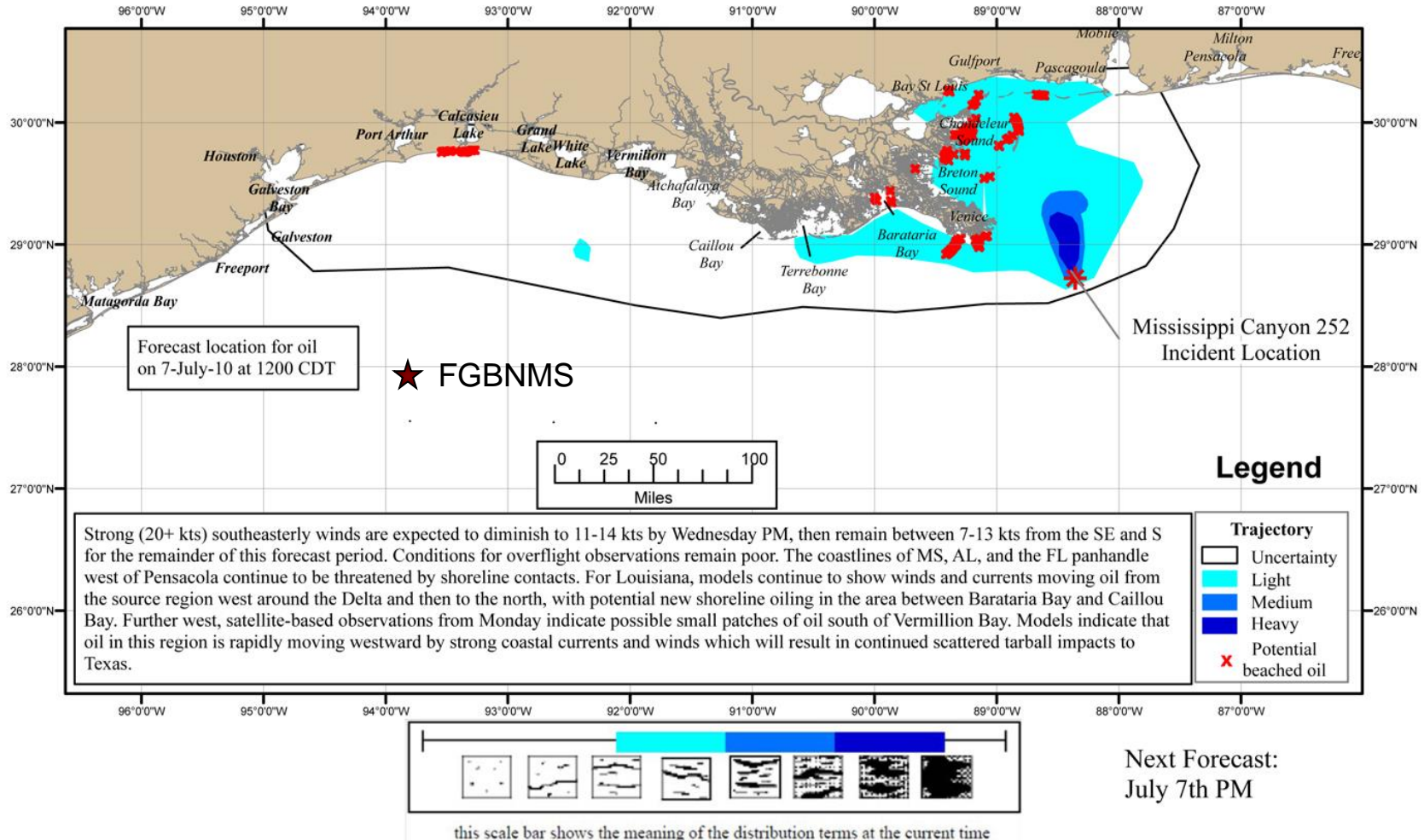
Nearshore



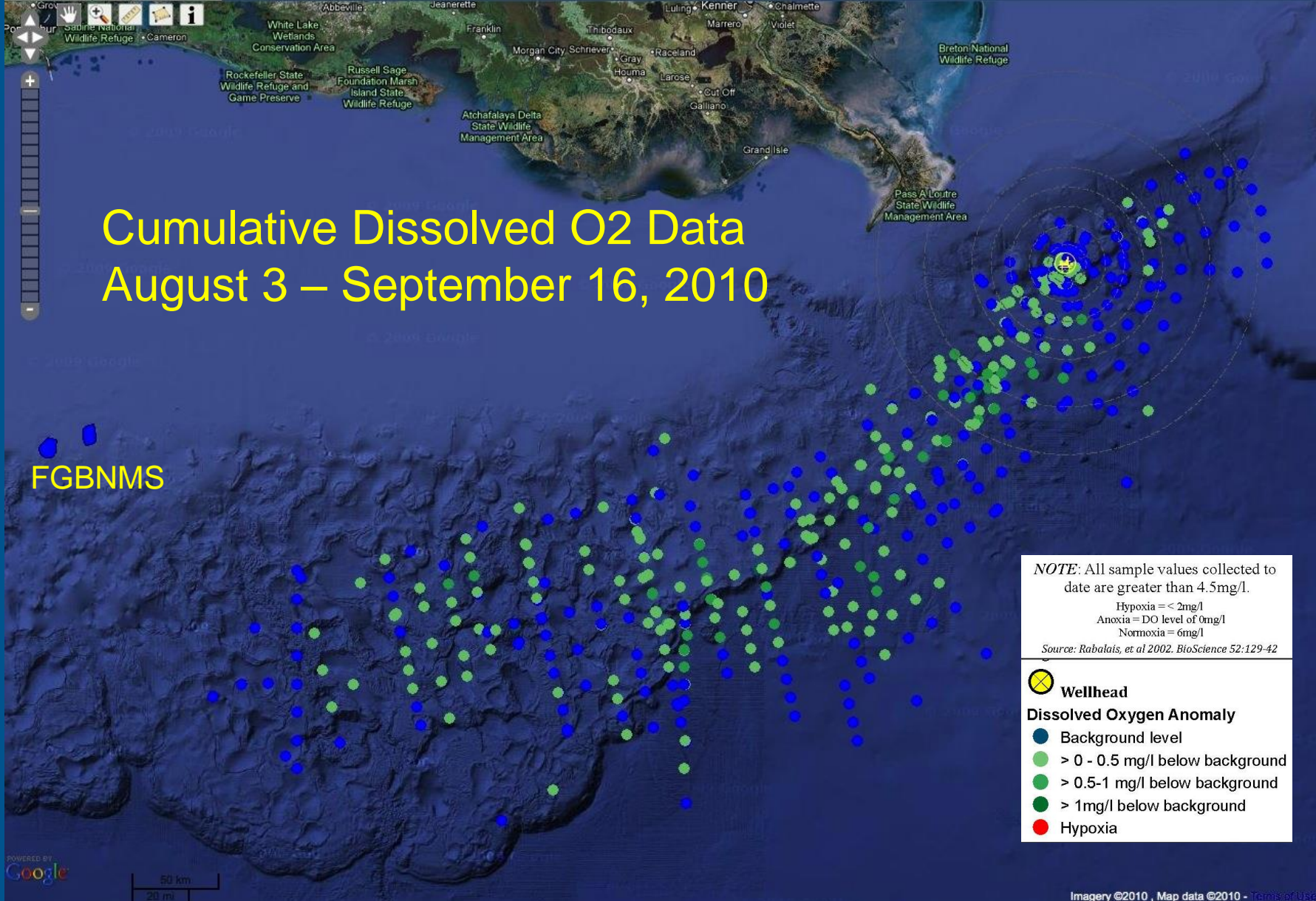
Estimate for: 1200 CDT, Wednesday, 7/07/10

Date Prepared: 2100 CDT, Tuesday, 7/06/10

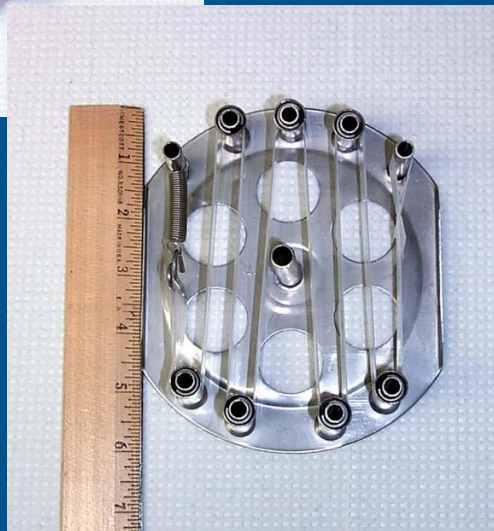
This forecast is based on the NWS spot forecast from Tuesday, July 6 PM. Currents were obtained from several models (NOAA Gulf of Mexico, West Florida Shelf/USF, TGLO/TAMU, NAVO/NRL) and HFR measurements. The model was initialized from Sunday-Tuesday satellite imagery analysis (NOAA/NESDIS) and Tuesday overflights. The leading edge may contain tarballs that are not readily observable from the imagery (hence not included in the model initialization). Oil near bay inlets could be brought into that bay by local tidal currents.



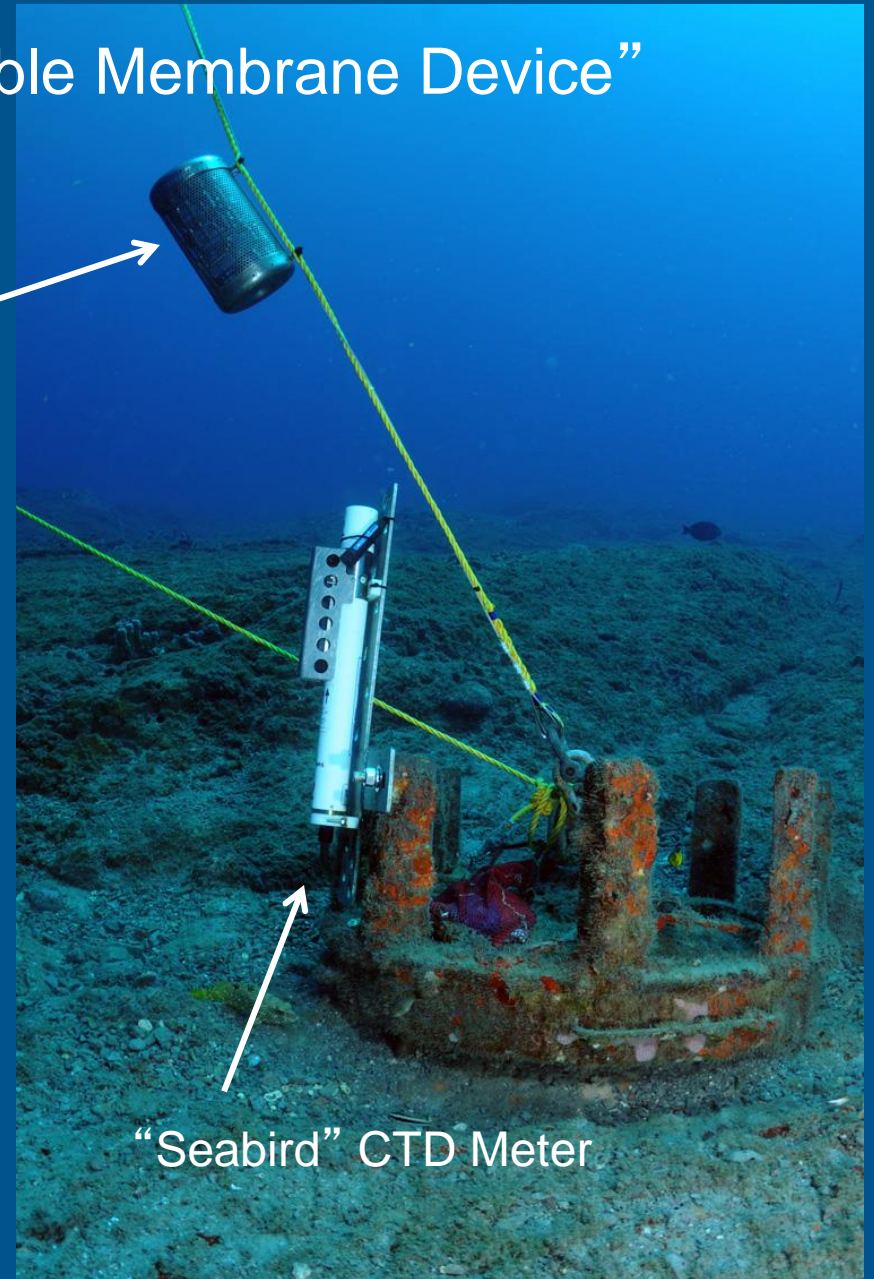
Next Forecast:
July 7th PM



SPMD – “Semi Permeable Membrane Device”



SPMD

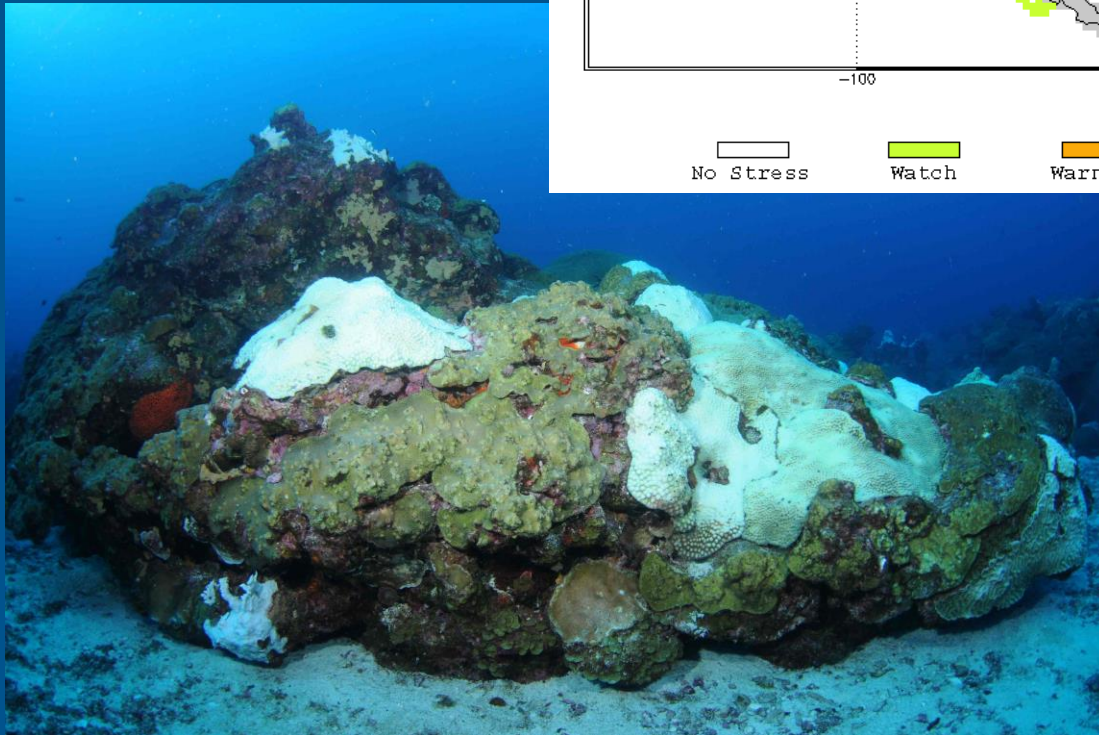
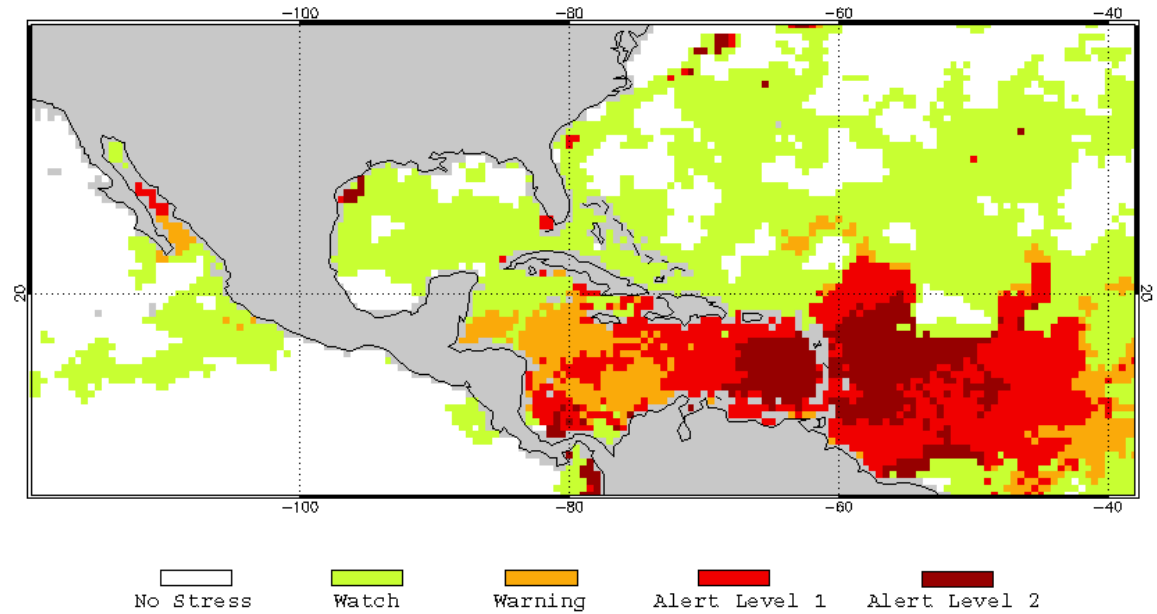


“Seabird” CTD Meter



SPMD Maintenance – Flower Garden Banks - 2010

NOAA Coral Reef Watch Satellite Coral Bleaching Alert Area
20 Sep 2010

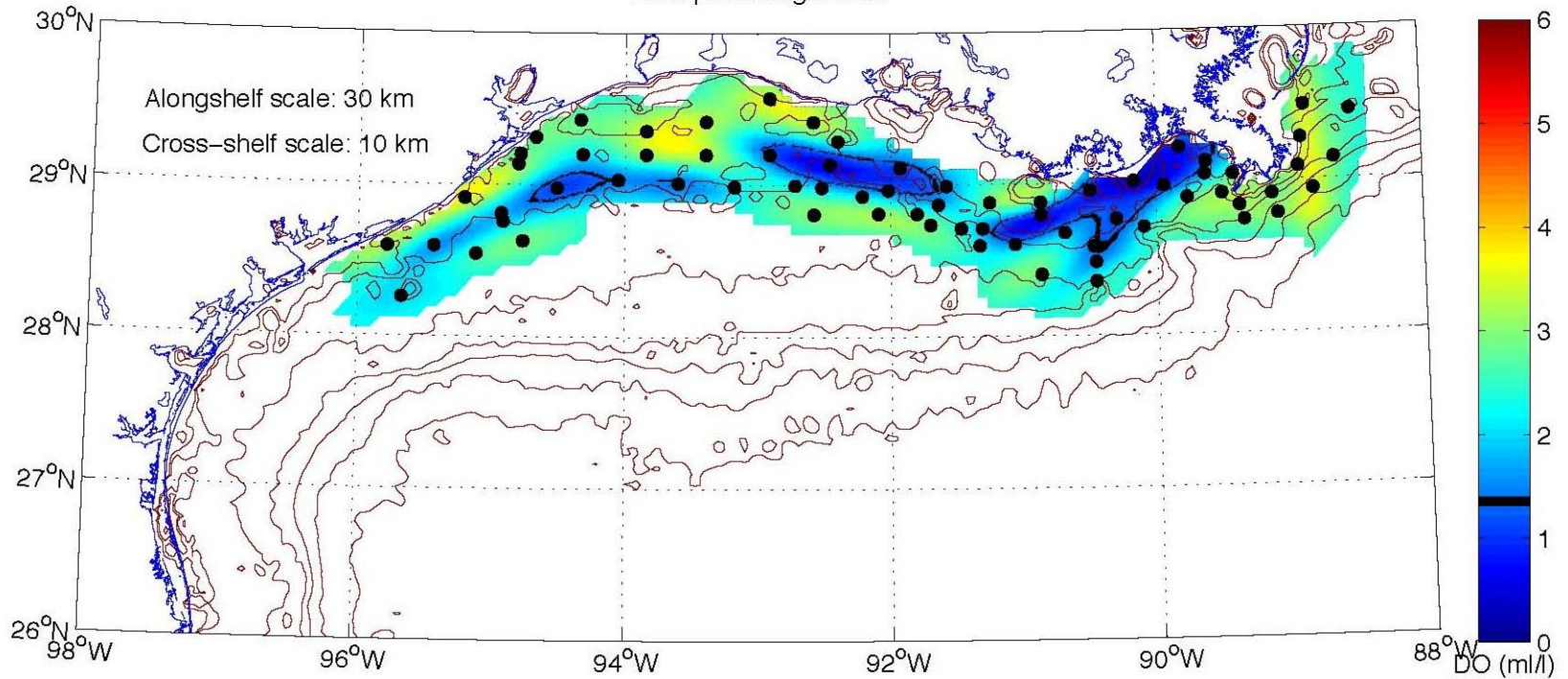


Coral Bleaching

West Flower Garden Bank – October 2010



ms3 cruise 2011: Hypoxic area = 8445 km²
range: 3650 to 16018 km²
Area percentage: 12%



Dr. Steve DiMarco (TAMU) – Hypoxia off Texas & Louisiana



Texas / Louisiana Shelf – 3/14/2009

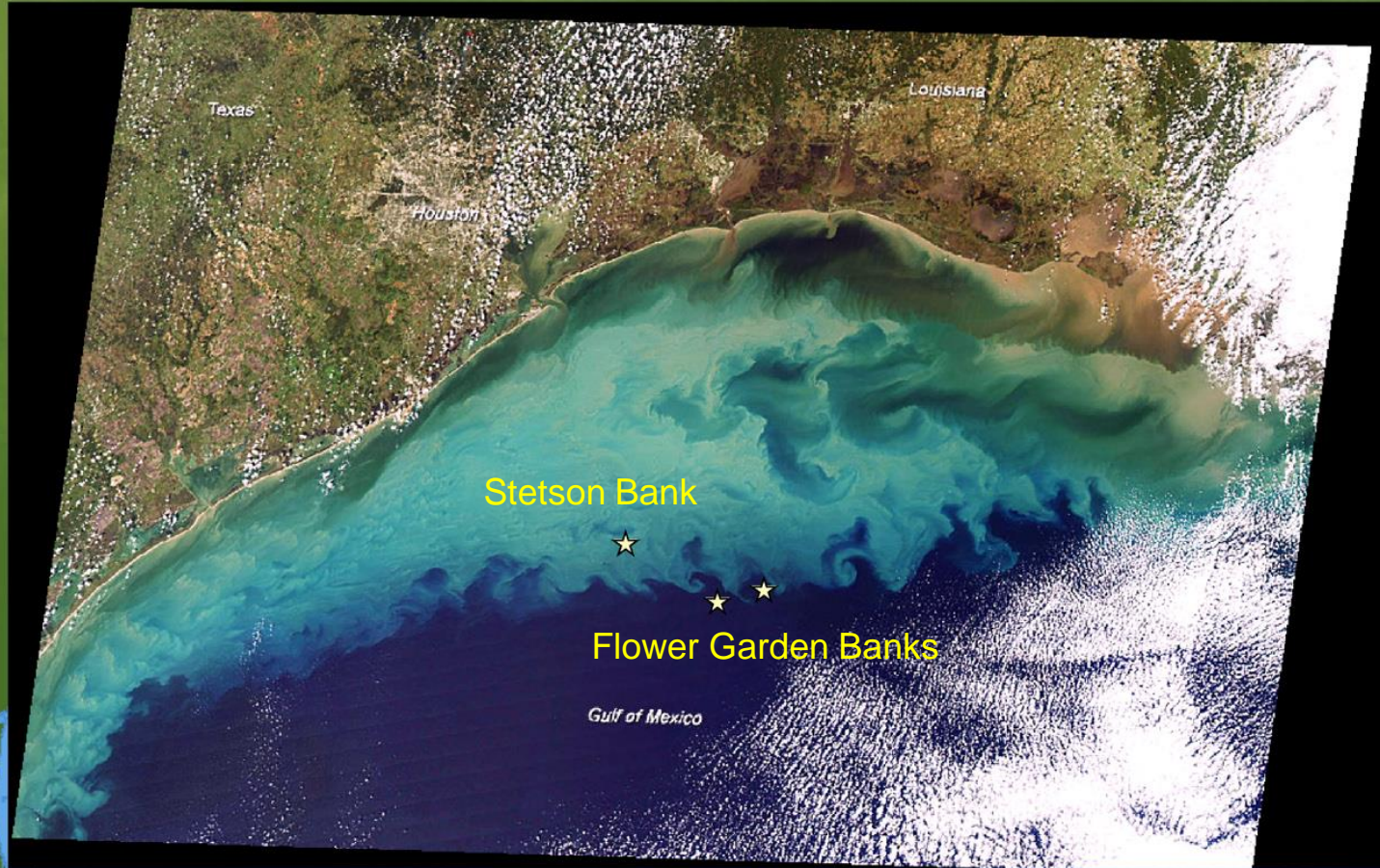


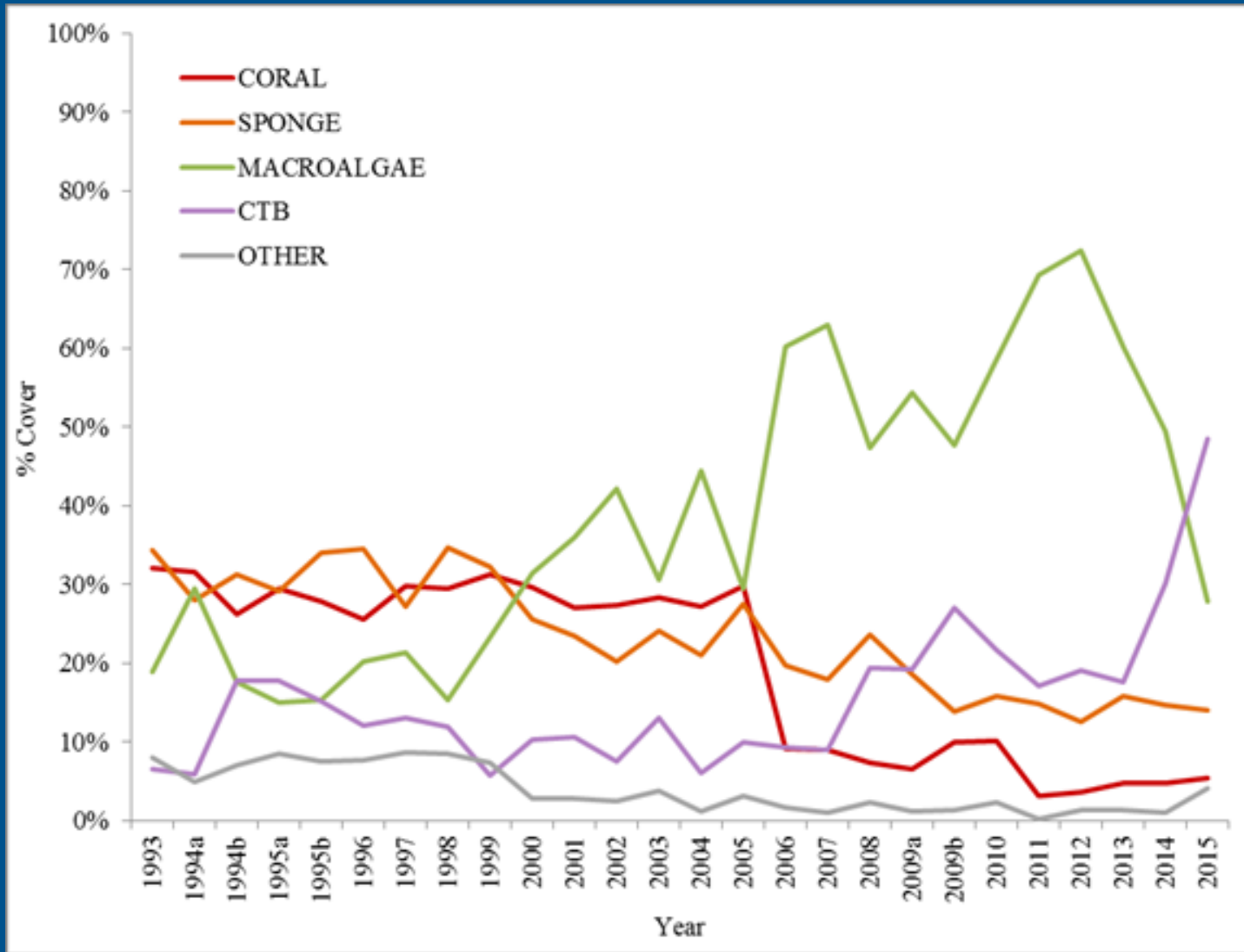
Image courtesy of NASA

Stetson Bank – September 2011



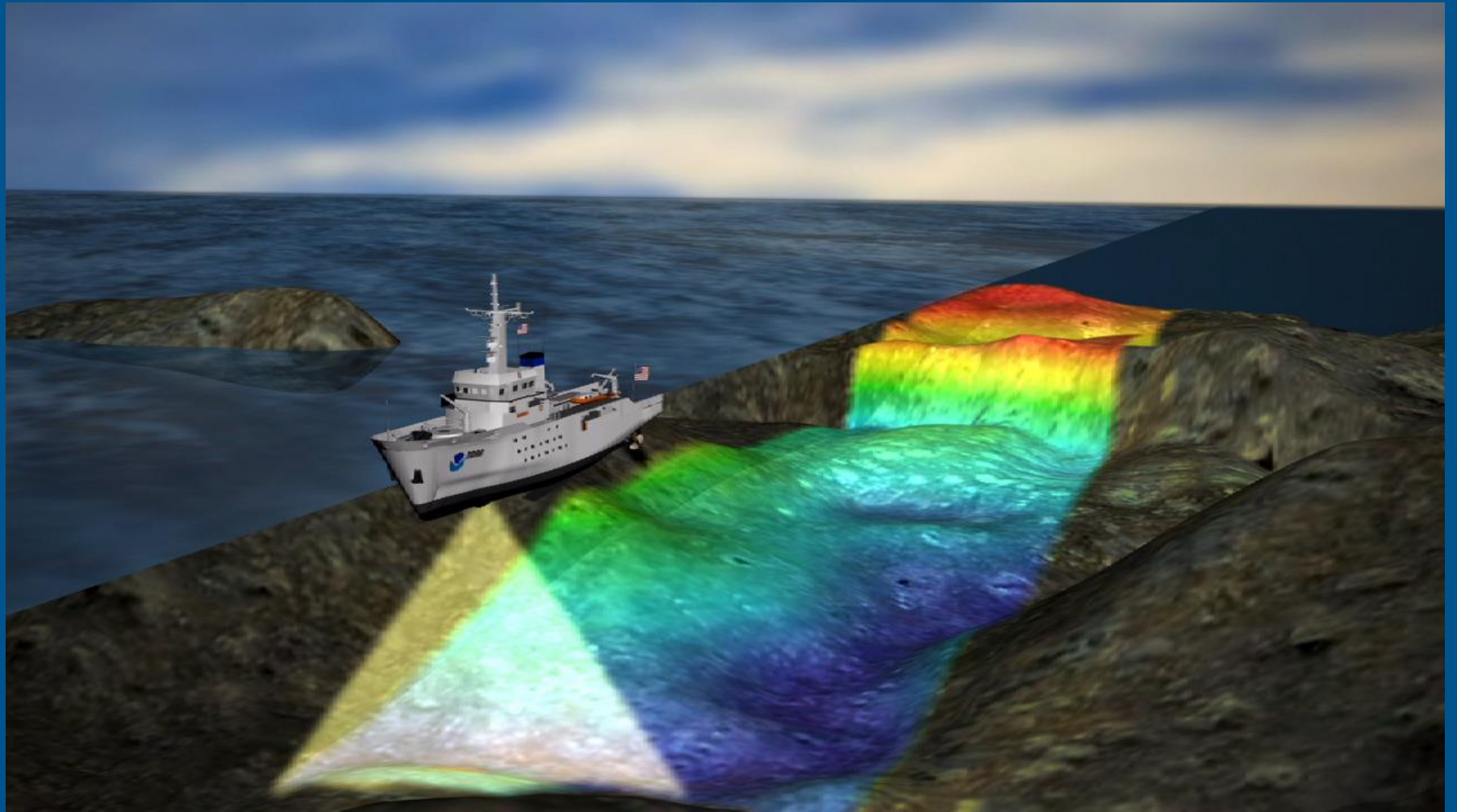
Algal Mats

Stetson Bank Mean Percent Cover, 1993-2015

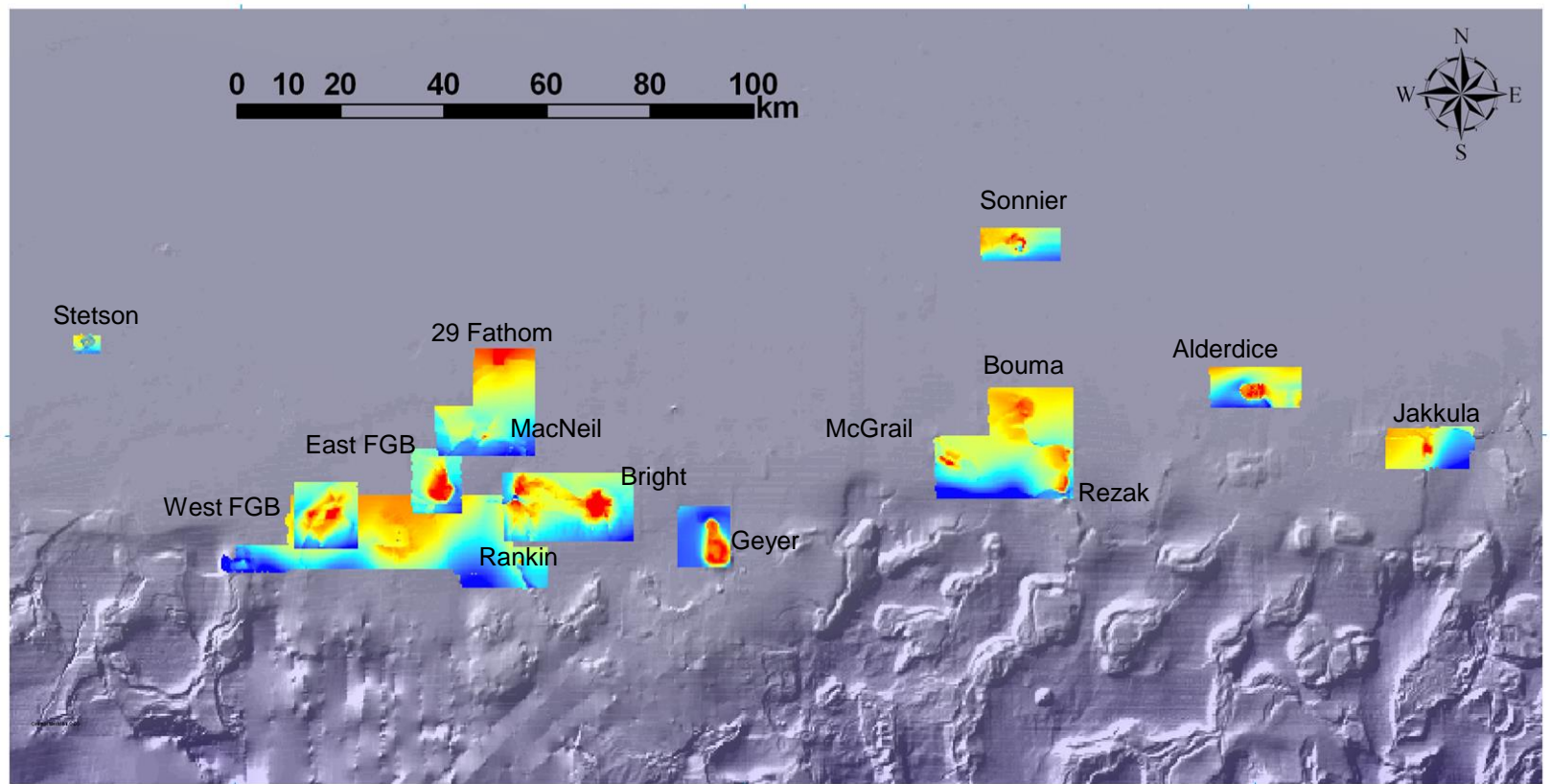






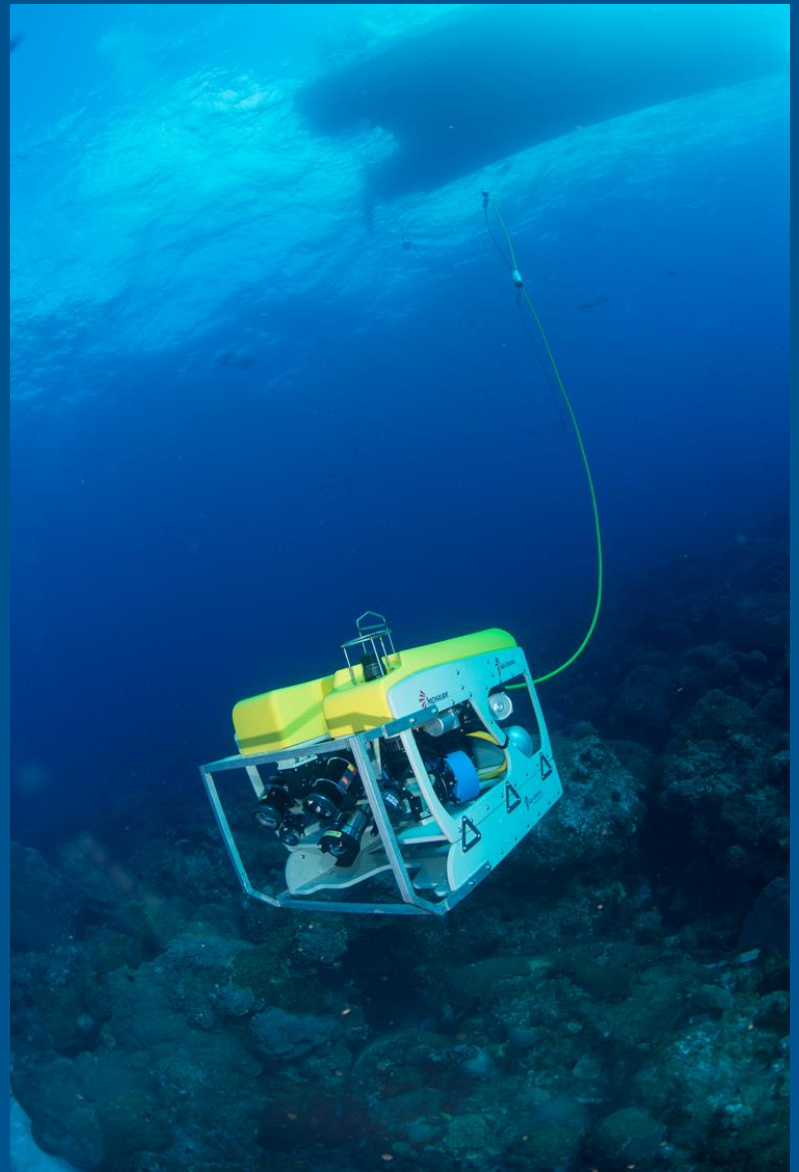
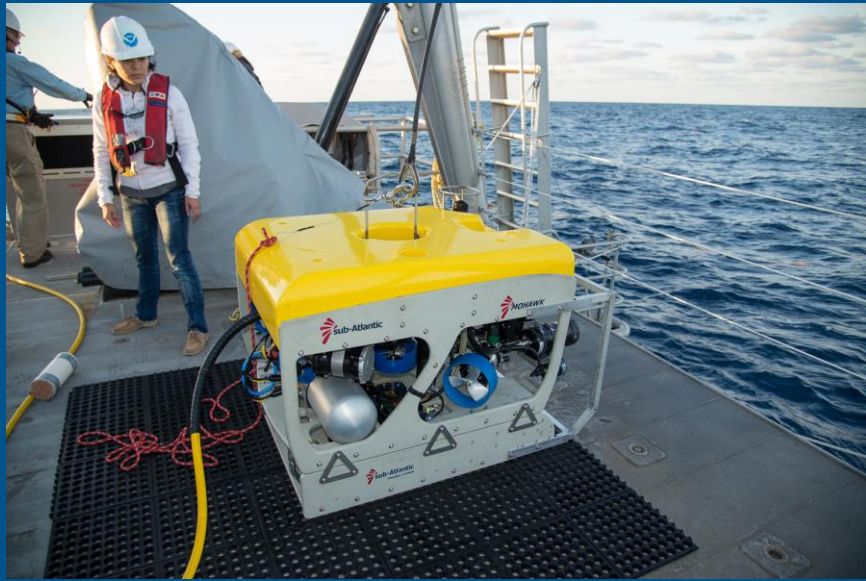


Seafloor Mapping – “Multibeam Bathymetry”



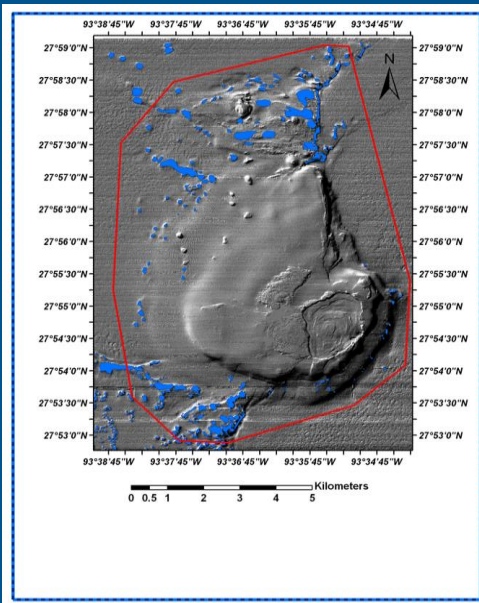
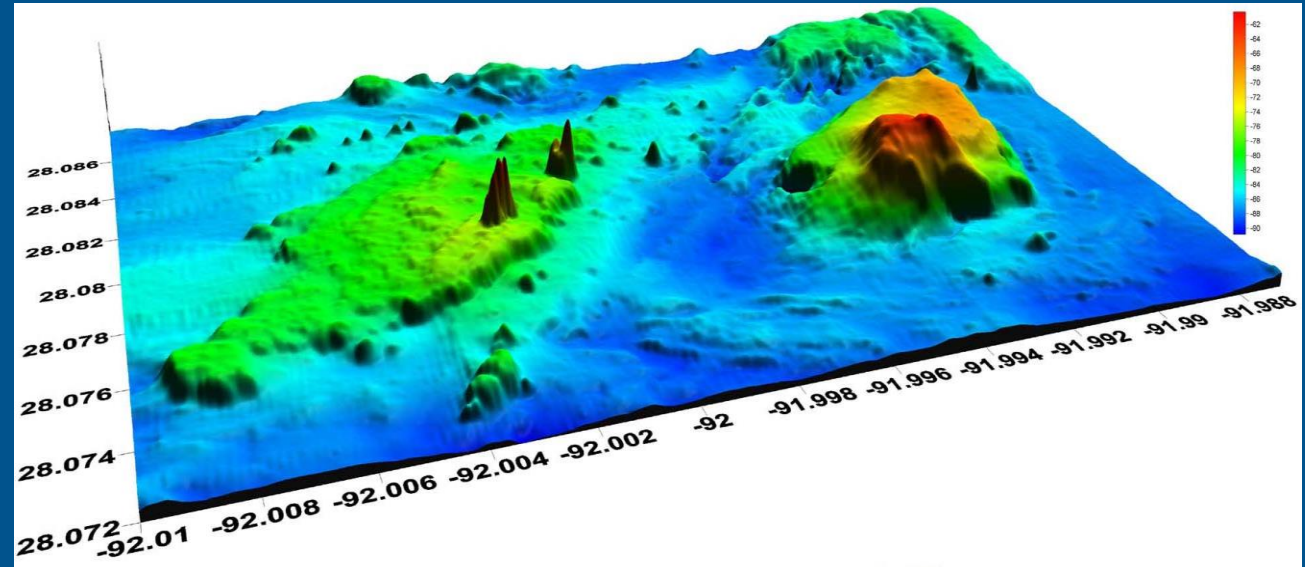
Reefs and Banks of the Northwestern Gulf of Mexico

High-resolution multibeam mapping, 2001-2007

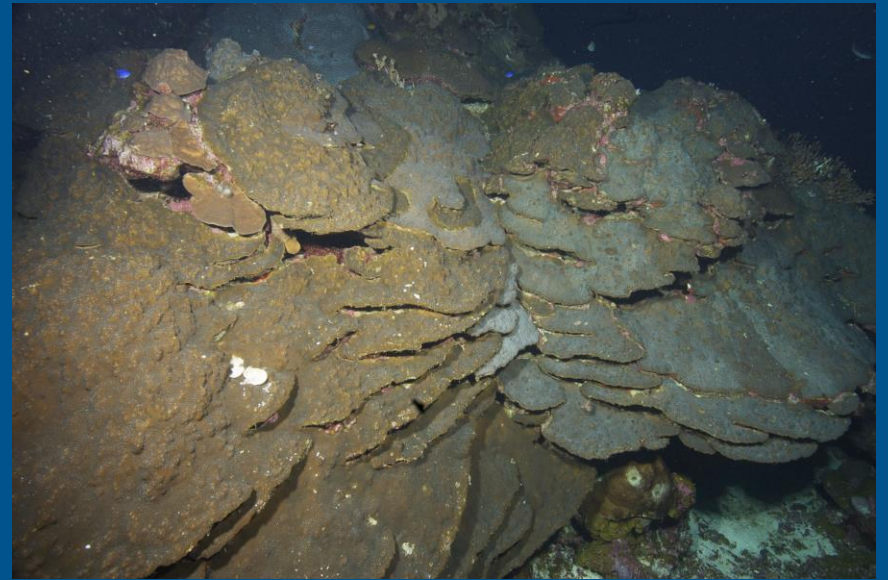
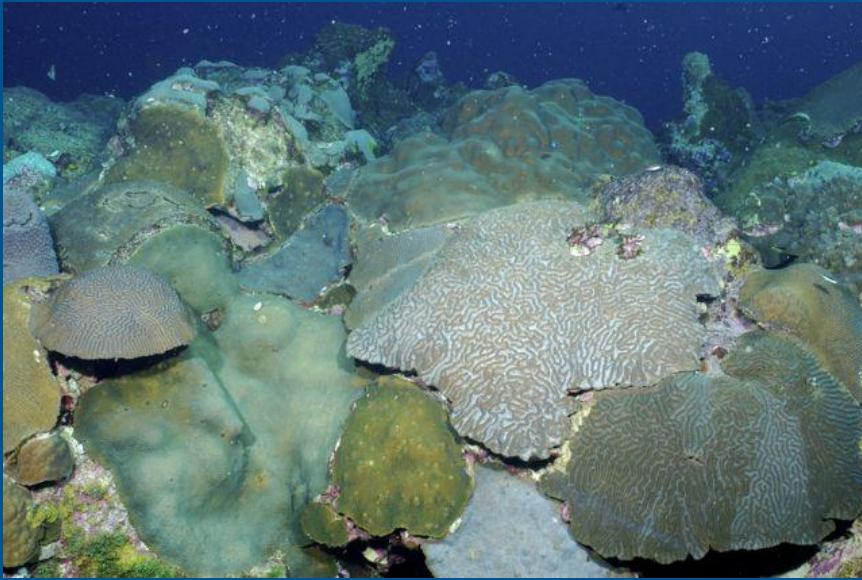


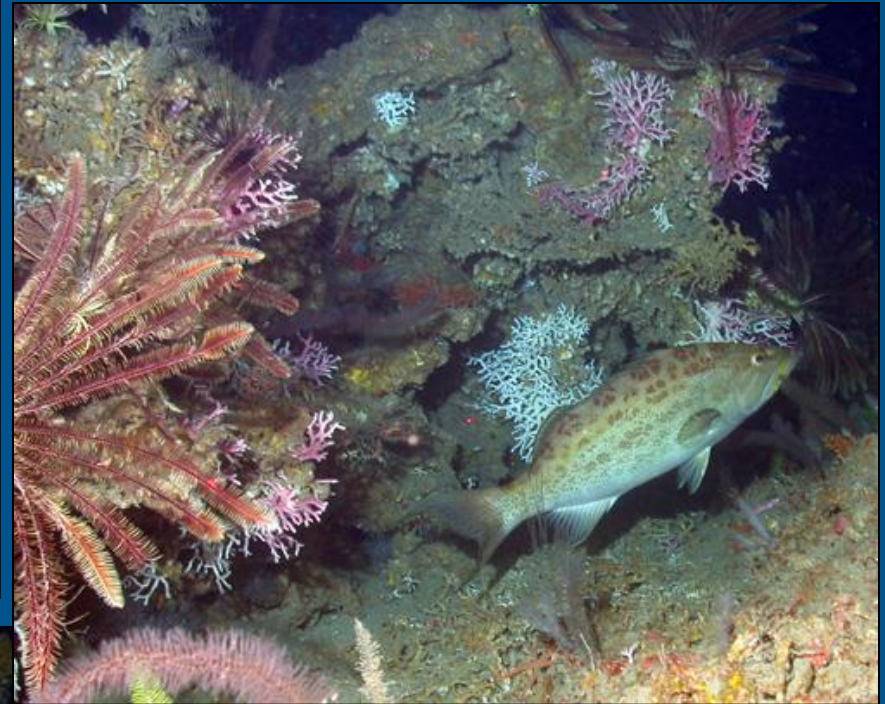
Mohawk ROV at East Flower Garden Bank, November 2013

Mapping



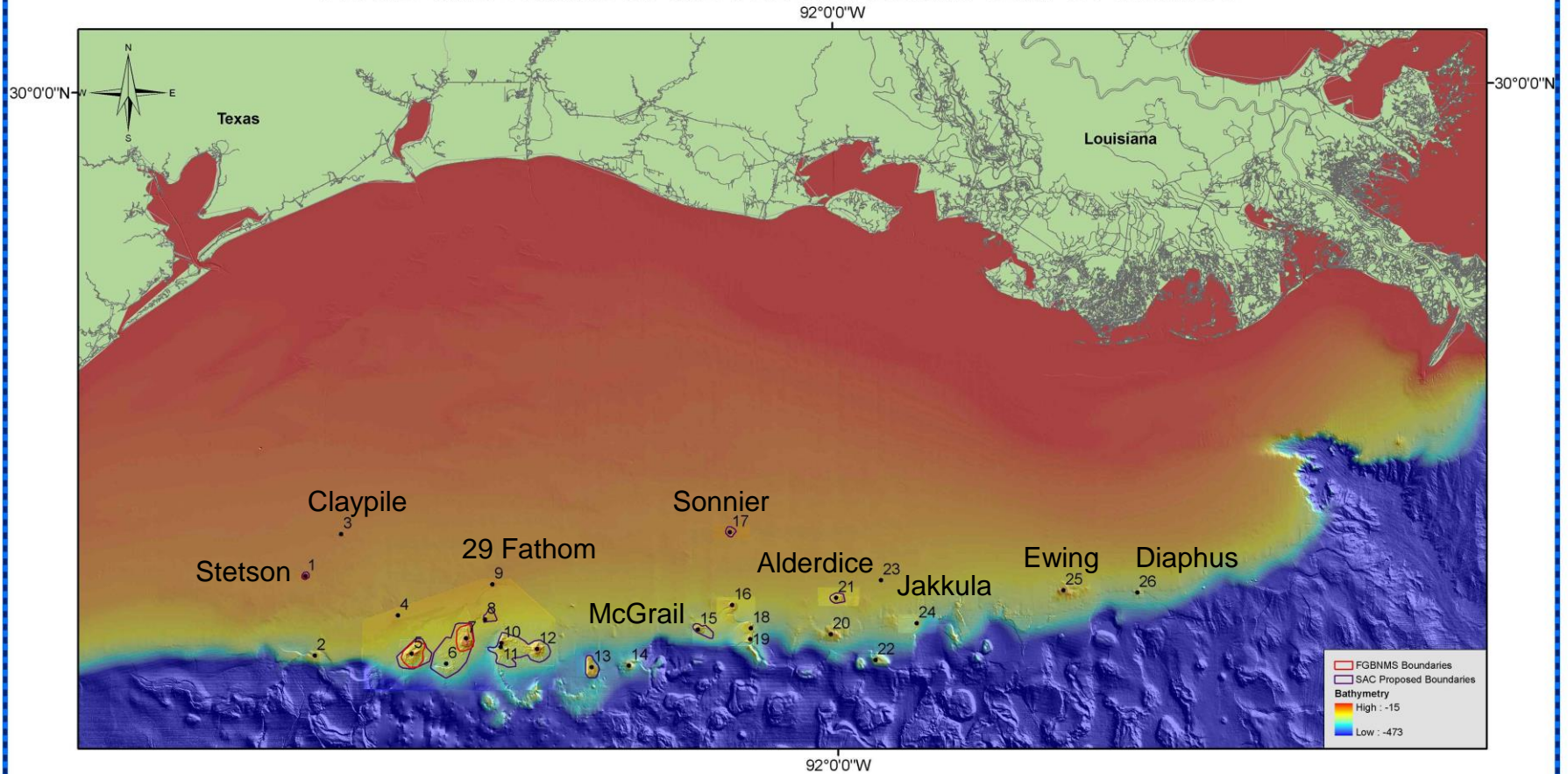
Habitat Characterization



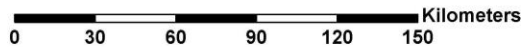


Deep Coral
Communities of the
northwestern Gulf of
Mexico

Reefs and Banks in the Northwestern Gulf Of Mexico



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Bathymetry courtesy of USGS, UNH, Gardner and NOAA

M. Nuttall, FGBNMS, July 2010



Reefs and Banks of the Northwestern Gulf of Mexico

National Marine Sanctuaries
National Oceanic and Atmospheric Administration



NATIONAL MARINE
SANCTUARIES

FLOWER
GARDEN BANKS

<http://flowergarden.noaa.gov>