## Port Miami Deep Dredge Project: Diving Beneath the Murky Headlines

### William F. Precht



## The "Murky" Headlines

Activists sue to stop Government Cur coral	t dredge and protect	Voices: A fragile of growth spurt	environment pays the price for Miami's
BY JENNY STALETOVICH - JSTALETOVICH@MIAMIHERALD.COM 10/01/2014 7:22 PM   Updated: 10/01/2014 7:22 PM		Alas Gener, USA TODAS - FOLD # 20	17 December 15, 1943
Bay activists warn Corps to clean up dredge By JENNY STALETOVICH 07/17/2014 7:52 PM   Updated: 07/17/2014 8:20 PM	Miami-Dade County Hiami Herald	-	EleNew Jork Etimes Inter//interactions: us. Despite Protections, Miami Port Project Smothers
Bay dredging project threatens vital Miami reefs	Biscayne Bay coral at risk fro BY JENNY STALETOVICH - JSTALETOVICH@MIAMIH 02/05/2015 4:50 PM   Updated: 02/05/2015 6:24 PM		Coral Reef in Silt
Environmentalists ready	Miami's Choice: Bigger Coral Reefs? Wedging in Bisenyme Bay inflicts heavy damage on . By Scott Wylaud for National Geographic		Twitter Rumor: 1D Fans Supposed Massive PortMiami Dredge Project 'Wiping Out' Vast Coral Field
Local NOAA Says Port Miami Dredge August 18, 2015 4:40 PM	Disaster For Reef	Miami port dredgi say BY JENNY STALETOVICH 08/19/2014 0 36 PM (Updated: 08/19/	ing damaging sea life, state inspectors
NOAA Warns of "Rapid Deteri Endangered Corals Due to Dee By Michael E. Miller Thu., Sep. 18 2014 at 7:00 AM		Environment	
Florida – Deep Dredge Crit Species" LETTERS TO THE EDITO		nd to Stop "Destruct	tion of Endangered

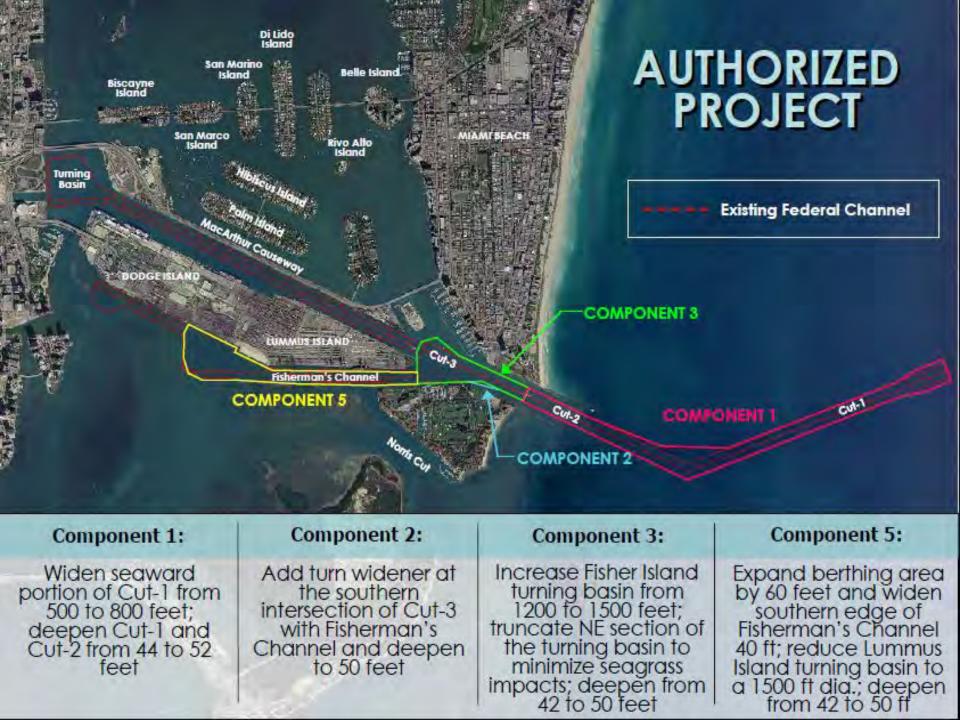
Dredging sediment killed our port coral

## The Hits Just Keep on Coming!

## THE DREDGING OF PORTMIAMI KILLED HALF A MILLION CORALS, ACCORDING TO A STUDY BY MIAMI WATERKEEPER

Science





# It's important to understand what happened in earlier similar projects!

Proceedings of the Fourth International Coral Reef Symposium, Manila, 1981, Vol. 1

### IMPACT OF DREDGING ON A SUBTROPICAL REEF COMMUNITY, SOUTHEAST FLORIDA, U.S.A.

**Donald S. Marszalek** 

Rosenstiel School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miami, Florida 33149 U.S.A.

Many of the small colonies of D. stokesii, M. cavernosa and other hemispherical forms showed a band of dead tissue adjacent to the substrate, buried beneath the layer of silt which covered the reef surface.

The stony corals at Miami Beach are near the northern limit of their ranges as evidenced by their relatively small size, low abundances, and rapid decrease in abundance north of Dade Country; thus the corals at Miami Beach are probably already under natural stresses, especially temperature and sediment reworking during the winter months. That corals are capable of surviving severe periods of stress can be seen from the numerous scars and overgrown areas on many coral colonies, and in the fact that most corals show no evidence of stress even at the most severely impacted sites. Their Scleractinian corals appeared to be the most impacted of the reef macrofauna. Although mass mortality of corals has not occurred the number of corals exhibiting stress symptoms has increased during the course of the dredging project. All species present in the study area showed a similar tolerance to dredging. In 1978, after two dredging seasons, about 5% of the corals near the dredge showed a partial loss of zooxanthellae (pale spots); after the 1980 dredging season, as many as 32.3% of scleractinian corals along a transect adjacent to the dredge exhibited pale spots or loss of tissue near the base of

#### CASE HISTORY OF A TYPICAL DREDGE-FILL PROJECT IN THE NORTHERN FLORIDA KEYS — EFFECTS ON WATER CLARITY, SEDIMENTATION RATES AND BIOTA

by George M. Griffin Harbor Branch Foundation, Inc. Route 1 — Box 196 Ft. Pierce, Florida 33450

December 1974

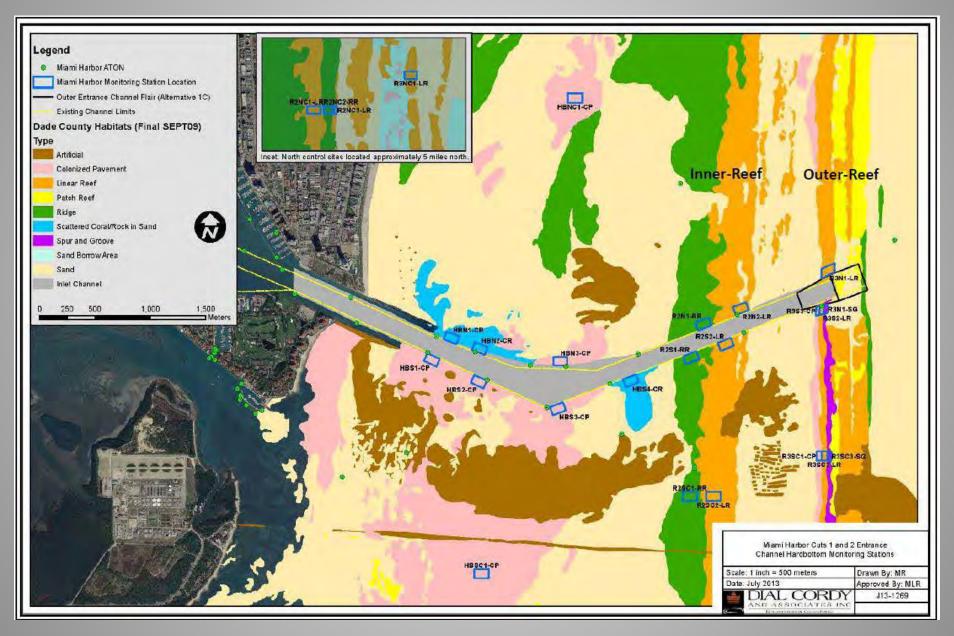
- The area of relatively intense plume, turbidity greater than 40 mg/1, rarely extended more than 100-200 m from the dredge.
- Concentration vs . distance plots show that the plume suspensate settles normally, with surface concentration declining in a logarithmetic manner and gradually fading into the background turbidity. In general, the area of plume influence rarely exceeds the limits of an area extending about 500 m downcurrent from the active dredge.
- Natural turbidity varied moderately in time and space. These natural variations are related to wind stress, resulting in higher turbidity especially during the winter and spring.
- Waves and currents wafted nearly all of the fine grained dredge effluent out of the project area within a few months following cessation of dredge operations.
- Considering the natural turbidity level and the measured spread of effluent from the dredge, it seems that the patch reef was too distant to have been affected by the dredging . In other words, a reef situated at least one-half mile from a dredge project in the Keys is not likely to be affected . This conclusion coincides with the results of the biological team . They monitored the health of the patch reef at the initiation of the project (November 1972) and after its termination (November 1973) . Based on a quantitative quadrant survey, they reported that no detectable changes had occurred and that the percentages of live and dead coral were identical before and after.

# Mandated FDEP Phase III Environmental Monitoring

 Cut 1 and Cut 2 hardbottom, middle, and outer reef monitoring at 26 channel side and reference sites, surveying habitat along 78 transects (three transects at each site), with up to ten (10) tagged stony corals per transect.



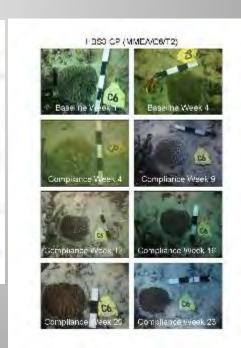
## **FDEP Mandated Monitoring Sites**



## Phase III Environmental Monitoring

- Agency Reporting weekly data collection, analysis, interpretation, and reporting for offshore and seagrass data.
- Data Management including raw data, spreadsheets, photos, video

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## **Scientific Diving**

The Key to Obtaining Scientifically Credible Data in a Safe and Efficient Manner



Organizational Member of AAUS



**Project Issues** 

- Strong and Variable Currents
- Often Poor Visibility
- High Boat Traffic
- Active Working Port



EM 385-1-1

Our Team Members Have Been Trained By and Operate Under the Most Stringent Scientific Diving Standards and Protocols!



## PortMiami Environmental Monitoring

- Scientific Dive Team has safely completed 10,865 project related dives and more than 1,000 snorkels since Sept 2013
- 2017 548 dives
- 2016 704 dives
- 2015\* 3,857 dives
- 2014\* 4,991 dives
- 2013 765 dives



\* Performed most scientific dives by an AAUS Organizational Member in 2014 and 2015.

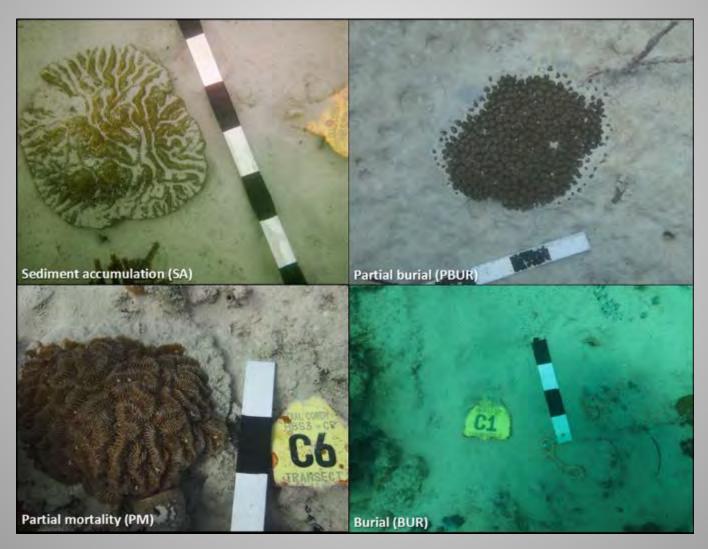
## **Coral Condition Monitoring** Data Collection, Analysis & Presentation

- Weekly data collection process
  - in situ condition assessment of marked corals by qualified personnel
  - Conditions are indicators of stress, modified from FRRP methods
  - Proportion of corals by site with "condition"
  - One way t-test, comparing the proportion of corals with condition between reference and channel-side sites
  - Report p≤0.05 weekly





Photographs of sedimentation indicators documented during compliance and post-construction surveys.



## **Partial Colony Mortality**





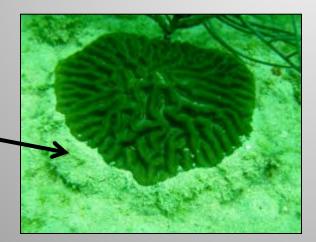
## **Project Related Sediment Impacts**

### Partial Colony Mortality

-				Parti	al Mortali	ty Relate	d to Sed	Iment s	tress		
Survey				All	Corals		W	thout D	lead Cor	als	
Zone	A	ea Site	#PM	N	Prop.	SD	#PM	N	Prop.	SD	
		R2N1-RR	-28	30	0.93	0.25	17	18	0.94	0.24	>8.4%
	E	R2N2-LR	15	24	0.63	0.49	12	20	0.60	0.50	
5	North	R2NC1-LR	2	28	0.07	1.25	2	24	0.08	0.27	Tissue
Reat		R2NC2-RR	2	30	0.07	.25	2	28	0.07	0.26	110004
Middle		R2S1-RR	17	27	0.63	0,49	14	20	0.70	0.47	loss
2	South	R2S2-LR	15	2	0.63	0 49	6	12	0.50	0.52	1033
191	8	R2SC1-RR	9	з	0.30	0 47	8	21	0.38	0.50	
		R2SC2-LR	2	2	0.08	0 28	1	11	0.10	0.32	
	÷	R3N1-LR	15	2	0.71	0 46	14	18	0.78	0.43	
	North	R3NC1-LR	7	2	0.29	0 46	5	18	0.28	0.46	
*		R3S1-CP	8	19	0.42	0.51	7	13	0.54	0.52	
Outer Reaf		R3S2-LR	1	25	0.04	.20	0	20	0.00	0.00	
5	6	R3S3-SG	9	25	0.36	1.49	7	19	0.37	0.50	
0	South	R3SC1-CP	4	24	0.17	0.38	3	20	0.15	0.37	
		R3SC2-LR	0	20	0.00	0.00	0	12	0.00	0.00	
		R39C3-9G	3	24	0.13	0.34	2	15	0.13	0.35	
	To	stal	137	400			100	289			



Partial Coral Mortality In CNAT



#### Whole Colony Mortality

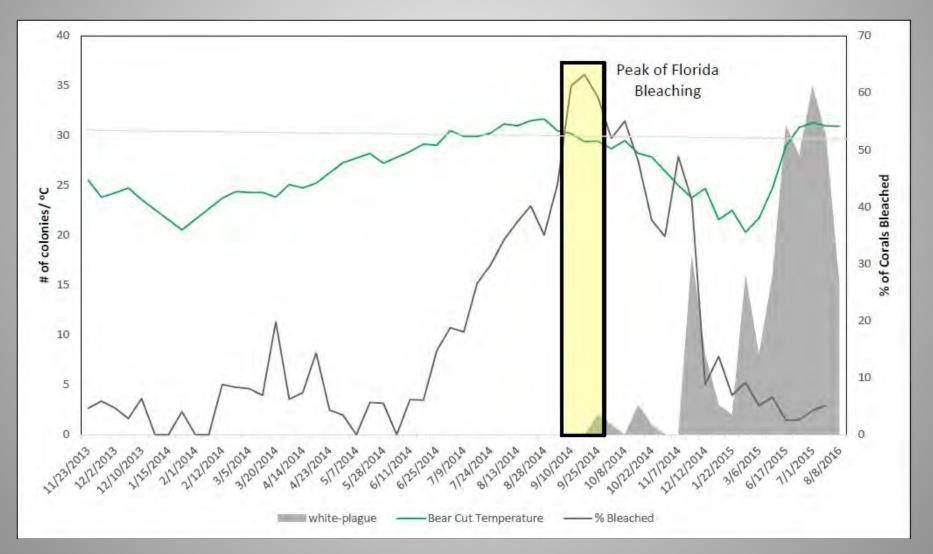
Table Total Scleractinan mortality from baseline through the Middle and Outer reef impact assessment as measured at each compliance monitoring site. Mortality has been broken into categories based on cause of coral mortality and include: sediment, disease and bleaching (white plague not included), and white plague disease. The white plague disease category includes colonies photographed with definitive signs of white plague disease and those consistent with white plague due to the resulting mortality patterns, timing, location, and species involved. Corals showing active white plague have also been included.

Survey Zone	Area	Ste	Scler	actinian Mo	ortality (Bas	eline throu	gh Midd	le and Oute	er Reef Im	pact Asser	sment)
Surv			N	Sediment	Bleaching / Disease	WP Mortality	WP	% Sediment Mortality	% WP Nortality	Total Nortality	% of Tagger Dead
		R2S1	27	0	0	7	0	0.00	25.93	7	25.93
	South	R2SC1	30	0	1	6	4	0.00	20.00	7	23.33
-	So	R252	24	0	0	9	4	0.00	37.50	9	37.50
Reet		R2SC2	25	0	2	11	0	0.00	44.00	13	52.00
Middle		R2N1	30	0	0	12	0	0.00	40.00	12	40.00
×	North	R2NC2	30	0	0	0	2	0.00	0.00	0	0.00
	Ŷ	R2N2	24	2	0	2	1	8.33	873	4	16.67
		R2NC1	28	0	0	0	1	0.00	0.00	0	0.00
		R3S1	19	1	0	0	0	5.26	0.00	1	5.26
		R3SC1	24	0	2	2	0	0.00	8.33	4	16.67
	South	R382	25	0	1	3	0	0.00	12.00	4	16.00
Reef	So	R3SC2	20	0	0	7	2	0.00	35.00	7	35.00
Outer		R383	25	0	0	4	4	0.00	16.00	4	16.00
Q		R3SC3	24	0	0	6	2	0.00	25.00	6	25.00
	5	R3N1	21	2	0	0	0	9.52	0.00	2	9.52
	North	R3NC1	24	0	0	4	1	0.00	16.67	4	16.67
		Totals	400	5	6	73	21	1.25	18.25	84	21.00

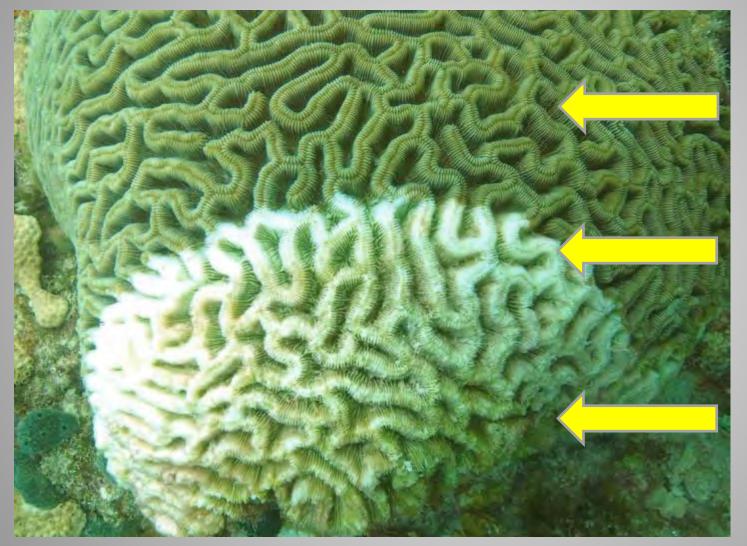
<2.7% total tagged Channel-side corals Over the course of project monitoring, <u>seven-tagged</u> channel-side scleractinian corals were buried and died as a direct result of sediment accumulation during dredging.

Partial mortality associated with sediment affected 58% of corals at channel-side sites and 19% of corals at control sites. The difference of 39% in sediment related partial mortality at the channel-side sites can thus be attributed to the dredging project.

### Proportion of corals with whiteplague disease increases following bleaching



## Crandon Reef – August 18, 2015



**Healthy CNAT** 

**Active WPD** 

**Turf Algae** 

Advancing front of White-Plague Disease on Colpophyllia natans

# SCIENTIFIC REPORTS

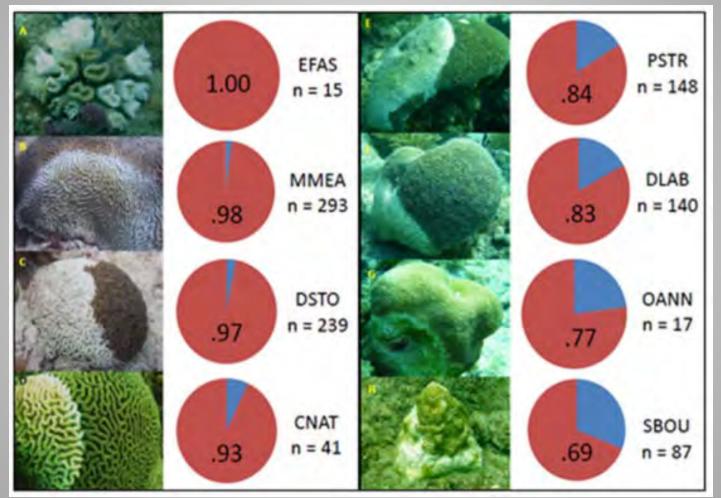
### OPEN Unprecedented Disease-Related Coral Mortality in Southeastern Florida

Received: 07 January 2016 Accepted: 12 July 2016 Published: 10 August 2016

William F. Precht<sup>1</sup>, Brooke E. Gintert<sup>1,2</sup>, Martha L. Robbart<sup>1</sup>, Ryan Fura<sup>1</sup> & Robert van Woesik<sup>3</sup>

Anomalously high water temperatures, associated with climate change, are increasing the global prevalence of coral bleaching, coral diseases, and coral-mortality events. Coral bleaching and disease outbreaks are often inter-related phenomena, since many coral diseases are a consequence of opportunistic pathogens that further compromise thermally stressed colonies. Yet, most coral diseases have low prevalence (<5%), and are not considered contagious. By contrast, we document the impact of an extremely high-prevalence outbreak (61%) of white-plague disease at 14 sites off southeastern Florida. White-plague disease was observed near Virginia Key, Florida, in September 2014, and after 12 months had spread 100 km north and 30 km south. The disease outbreak directly followed a high temperature coral-bleaching event and affected at least 13 coral species. *Eusmilia fastigiata, Meandrina meandrites*, and *Dichocoenia stokesi* were the most heavily impacted coral species, and were reduced to <3% of their initial population densities. A number of other coral species, including *Colpophyllia natans*, *Pseudodiploria strigosa*, *Diploria labyrinthiformis*, and *Orbicella annularis* were reduced to <25% of their initial densities. The high prevalence of disease, the number of susceptible species, and the high mortality of corals affected suggests this disease outbreak is arguably one of the most lethal ever recorded on a contemporary coral reef.

# It's important to understand what happened regionally.



2014-2015 were bad years for corals in southeast Florida due to thermal stress (bleaching) and disease.

## Mortality due to White-Plague Disease

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Meanacroa comadetra	n+9										- 3
Pseudortipione striggta	ne4										
Colasiphylika merone	n+1										-
Montalinni savendo	0+27										
Pueudostalenia chuson	n=6		1								
Sehuluativa bauman	a-12		£								
Sidecolore sidered	n=17										
Pantet astronides	n=17										
Strahenolonier intinlegso	n=5						Pr	oje	ct C	ont	rols
Drácesla Jouróista	n=2										
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Aquitia opiniens	n=1										
Apurisia operatives	n=1									_	
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Apurisia operatives		30	30	30	40	50	80	70	ы	10	100
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Apuritish operatives B Examples discoversion Messallindo messallistis. Dishowerkia stoleni Coginghylle messalli Preusikalistoris inspisoo Dishowerkialistoris inspisoo Dishowerkialistoris Onlinesita assutario Saleniseztea bournaise	0 1015 10393 10238 1043 1044 1044 1044 1044	30	20	30	40	50	80	73	10	30 	100
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**Energy and Environment** 

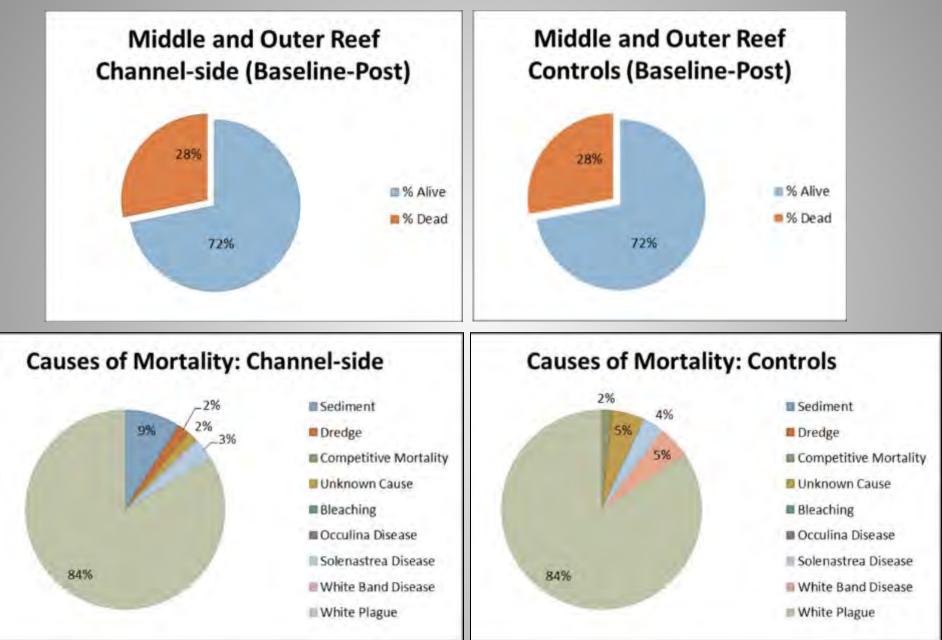
## Bleaching and disease are devastating the biggest coral reef in the continental U.S.

By Chelsea Harvey October 26

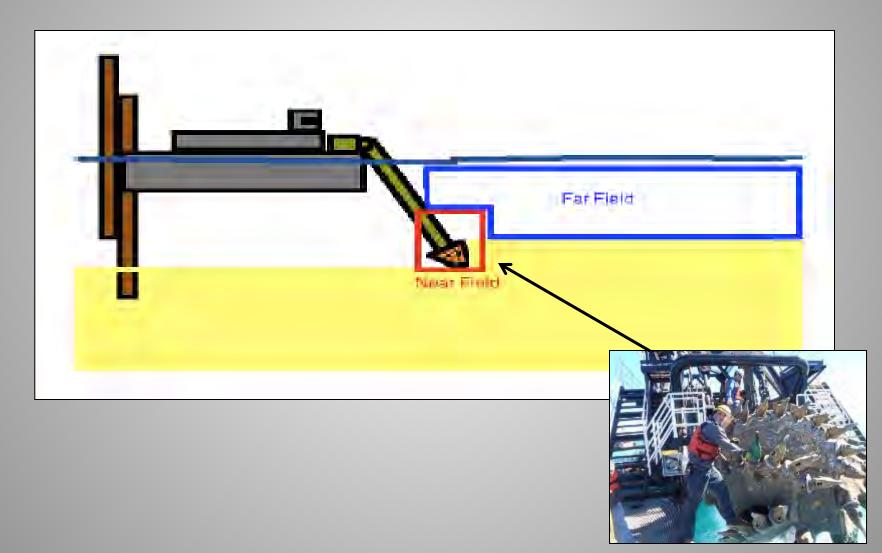
The disease outbreaks have been especially severe in the area off the coast of Miami, where bleaching was particularly heavy, Morton said. While several different types of coral disease have been observed, a disease known as "white plague" has been the most prevalent.



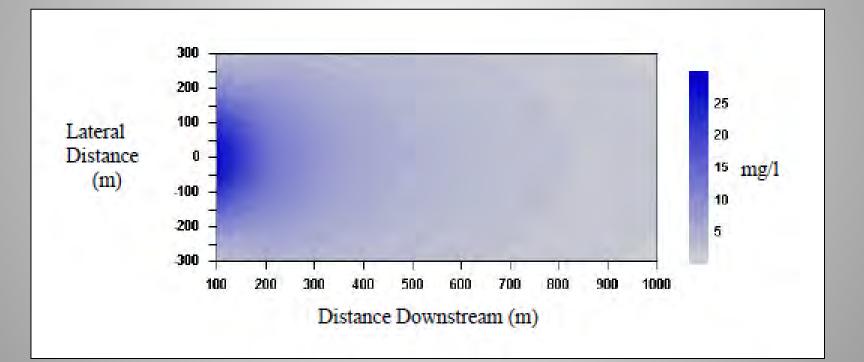
## What does the data say?



## Potential Sediment Effects from Cutter-Head Dredge

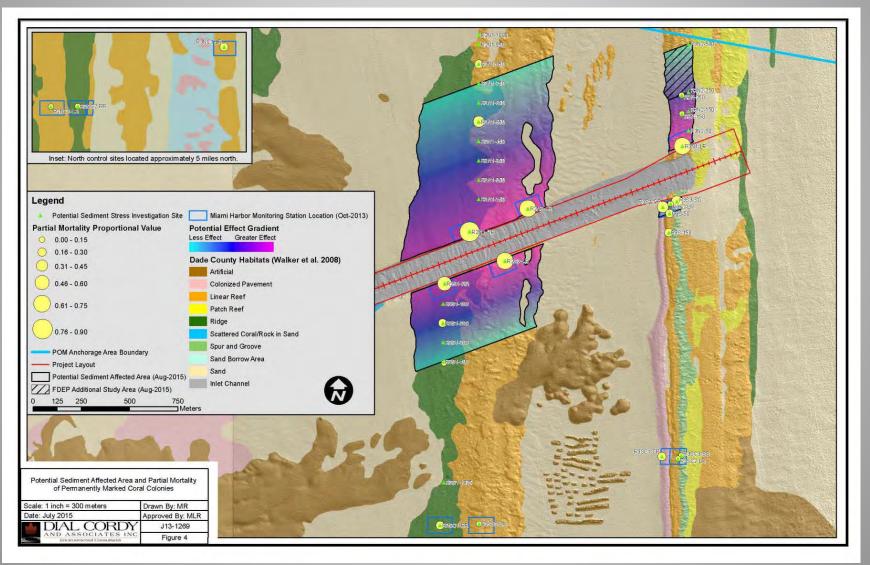


## Model Projections of Far-Field Turbidity from Cutter-Head Dredge Operations



Henriksen P.T.L. (2009) Near-field Sediment Resuspension Measurement and Modeling for Cutter Suction Dredging Operations. PhD Dissertation, Texas A&M, College Station, TX

## Sediment Impacts Observed at End of Dredging





## Extensive coral mortality and critical habitat loss following dredging and their association with remotely-sensed sediment plumes



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<sup>b</sup> Daniel P. Haerther Center for Conservation and Research, John G. Shedd Aquarium, 1200 South Lake Shore Drive, Chicago, IL 60605, USA

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<sup>d</sup> College of Marine Science, University of South Florida, 140 7th Avenue South, MSL119, St. Petersburg, FL 33701, USA

## Natural vs. Project Related Sediment Impacts



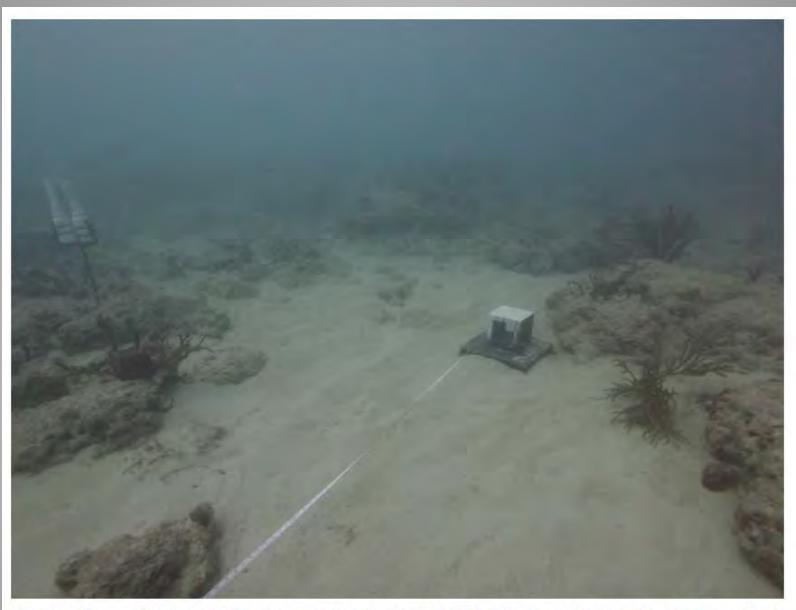
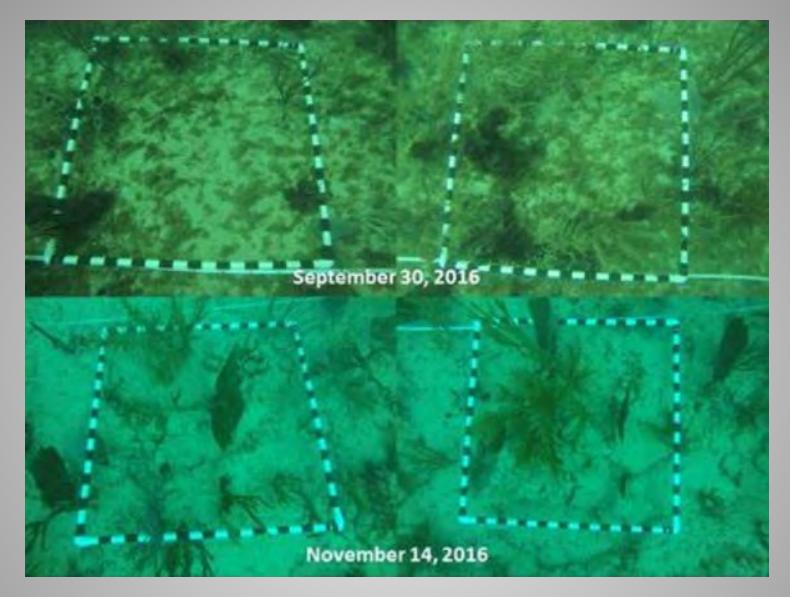


Figure 47. Photograph of permanent site R2N2-LR taken during the first week of middle reef baseline surveys (11/20/2013). Maintenance dredging began in the hardbottom habitat on 11/20/2013, more than 750 m away, as allowed by permit. The sediment pictured accumulated prior to dredge operations.

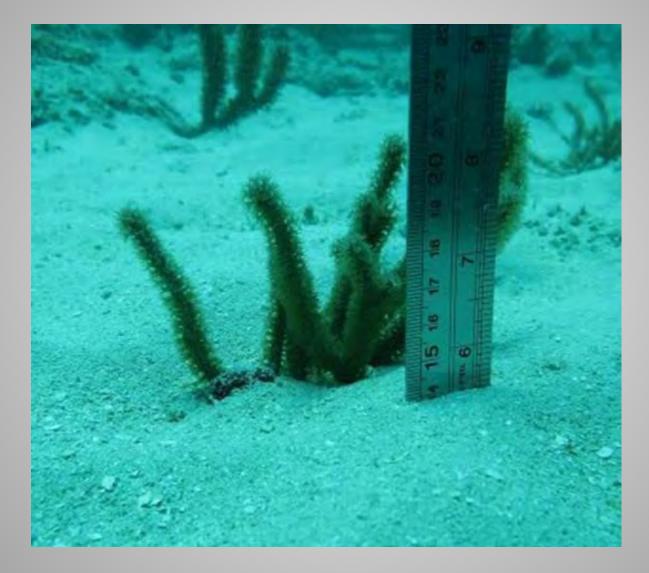
## Hurricane Matthew 2016

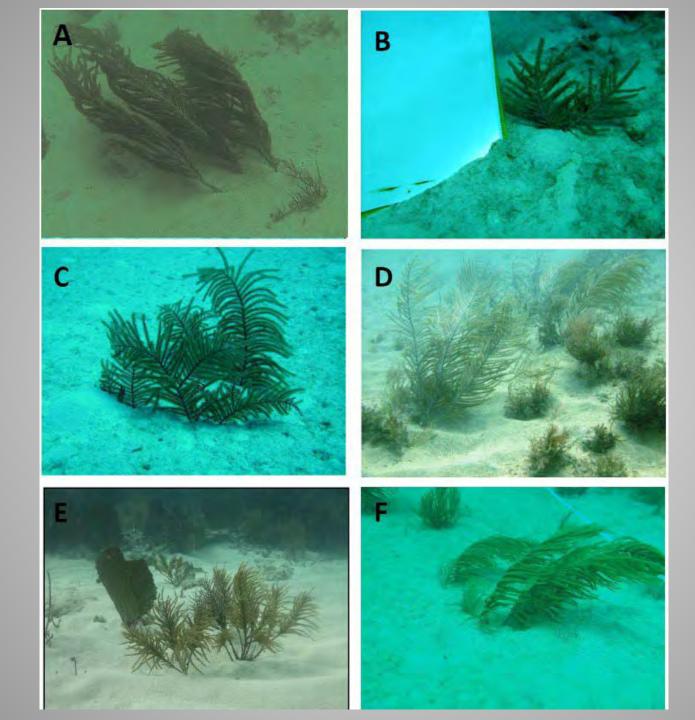




BEFORE AND AFTER HURRICANE MATTHEW QUADRAT PHOTOS COLLECTED AT R2N-75-RR ON SEPTEMBER 30, 2016 (BEFORE) AND NOVEMBER 14, 2016 (AFTER), NOTICE MACROALGAE COVER IN BEFORE PHOTO AND LACK OF MACROALGAE IN AFTER PHOTOS AS WELL AS PRESENCE OF FINE WHITE SEDIMENT OVER THE BOTTOM.

## **NMFS Report Photo**

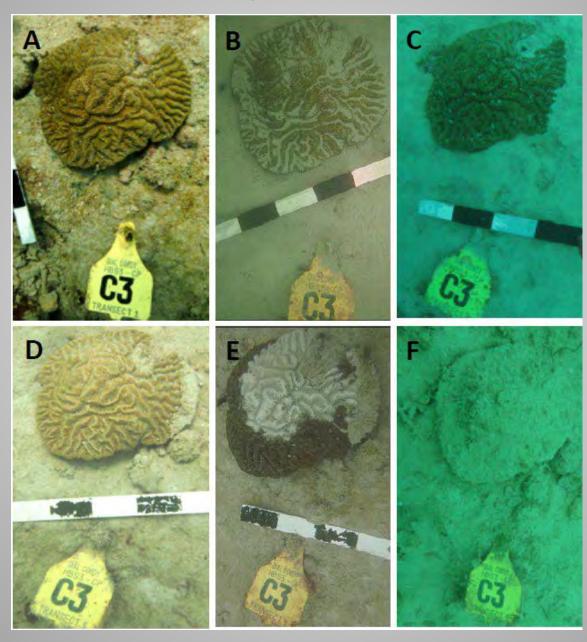




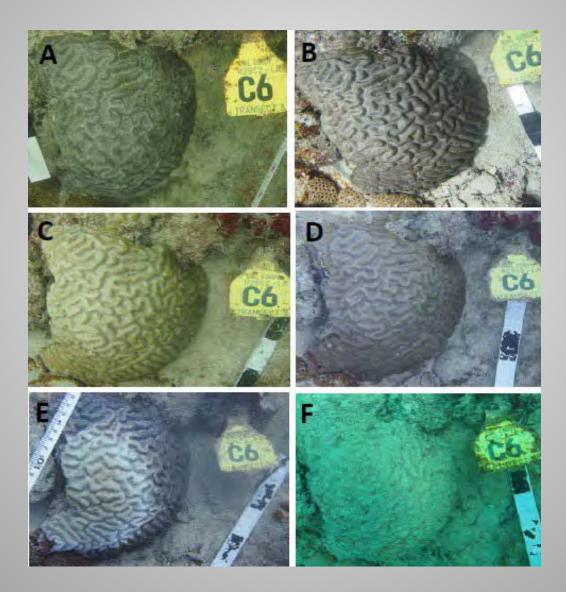
## How would you know how this coral died ?



## Unless you had this!



## Same Sequence at Control Sites



A closely spaced repeated measure sampling design (as was mandated by the FDEP permit) reduces the chances of drawing invalid conclusions leading from the logical fallacy that correlation implies causation.

Between October 19, 2013 and July 13, 2015 each tagged coral, at each site, was monitored and photographed at least 40 times. In the laboratory, these ~25,000 individual observations of in situ coral condition were compared to paired photographs. In cases where corals had died, we were generally able to discern the exact cause of mortality by carefully evaluating the sequence of events recorded (and photographed), prior to death.

# Conclusions

The regular monitoring of tagged corals at control and near project sites provided the detailed information needed to assign the correct cause of mortality to corals in the project area as opposed to the undocumented assertions of project opponents who conducted one-off surveys.

The actual monitoring results from the project emphasize the requirement for implementing scientifically-based, not ideologically-based management of natural systems to best understand and protect our fragile coral resources.

#### CASE HISTORY OF A TYPICAL DREDGE-FILL PROJECT IN THE NORTHERN FLORIDA KEYS — EFFECTS ON WATER CLARITY, SEDIMENTATION RATES AND BIOTA

by

George M. Griffin Harbor Branch Foundation, Inc. Route 1 — Box 196 Ft. Pierce, Florida 33450

December 1974

- The problem mentioned most often in newspaper and magazine accounts was a supposed relationship between excess siltation produced by dredging and the decline in health of the coral reefs. It appeared from these popular accounts, that the only living coral reefs in the continental United States were in imminent danger of extinction.
- Although the news stories concerning the decline of the reefs have been shown in our research to be more fictional than factual, they did serve the useful purpose of kindling scientific interest into the problems posed by dredging.