



Florida Reef Resilience Program



Disturbance Response Monitoring Outcomes

What is the FRRP?

The Florida Reef Resilience Program (FRRP) began in 2004, to develop a resilience-based reef management concept and create a unified monitoring program for the entire Florida Reef Tract.

Goals

- Identify reefs that are likely to resist or recover from bleaching or other disturbances
- Guide the protection and management of coral reefs



Australian Government
Great Barrier Reef
Marine Park Authority



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FRRP Partnership

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Institute for
Marine Remote Sensing



Southeast
Florida
Coral Reef
Initiative

Acting above to protect what's below.

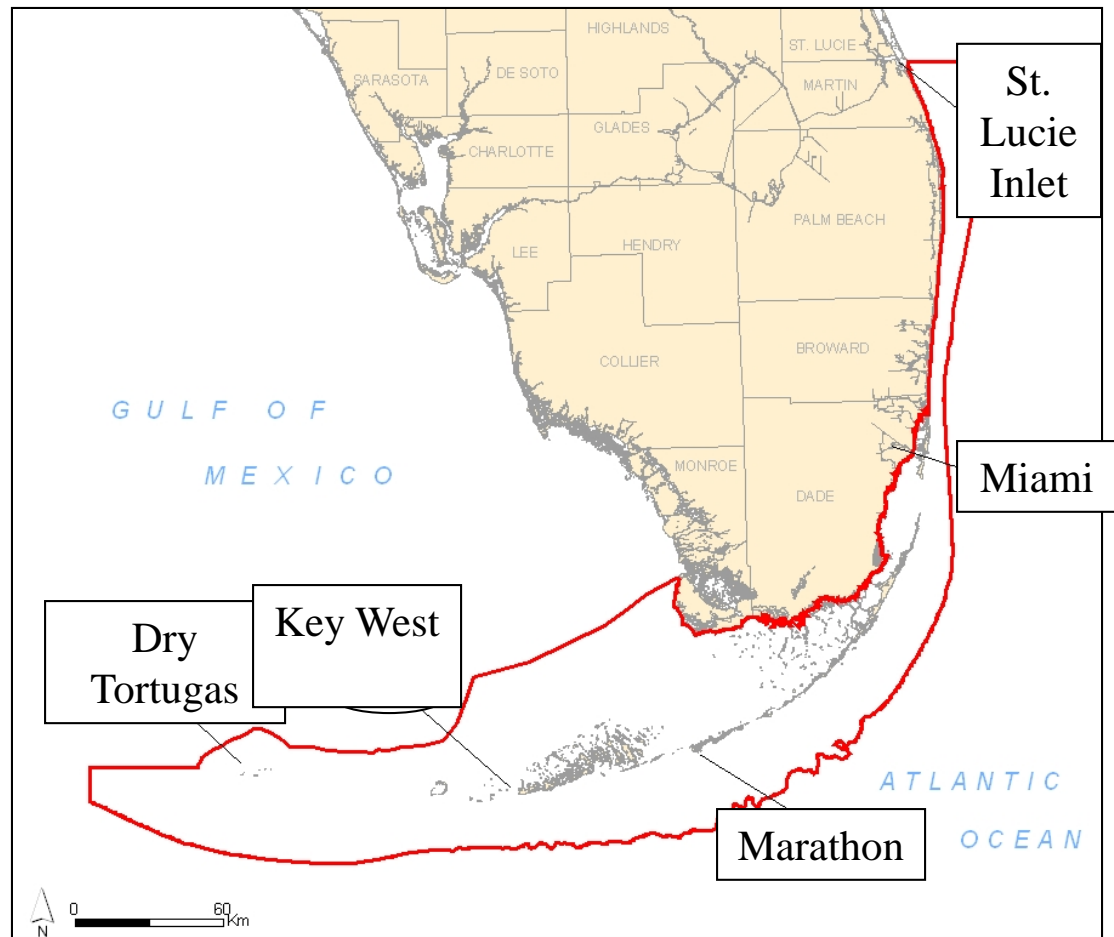


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FRRP Region

The FRRP spans the reefs from St. Lucie Inlet to the Dry Tortugas



Bleaching Response Plan

Chapter 1: Early Warning System

Chapter 2: Impact Assessment★

Chapter 3: Communications

Chapter 4: Management Actions

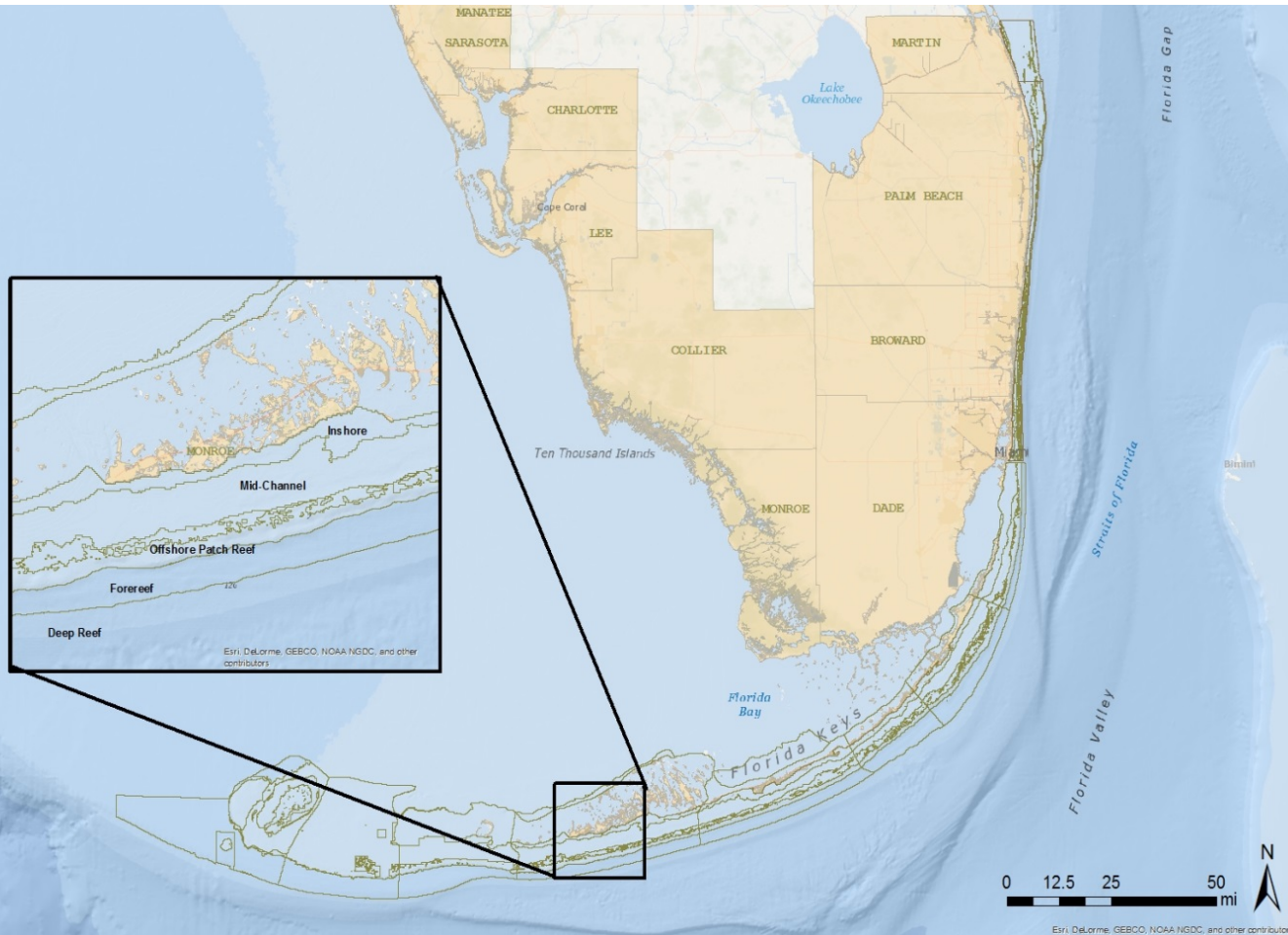


Photo by Mitsu Martins-Laboratory

Florida Reef Tract
Coral Bleaching Response Plan



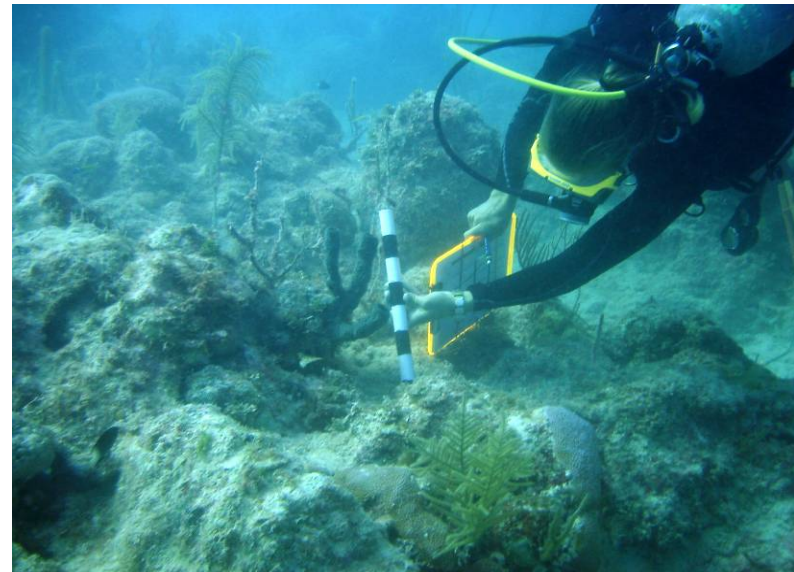
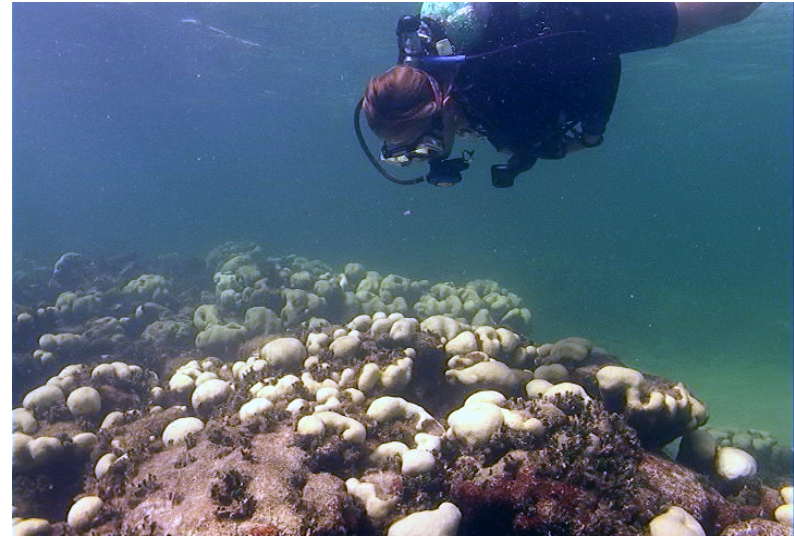
Spatial Framework



- Provides a unified method of dividing up and looking at the reef tract
- There are 16 sub-regions (e.g. Upper Keys, Broward) and 156 bio-zones (e.g. inshore, middle reef)
- The spatial framework and sampling grid were revised in Spring 2014 using new spatial and benthic data.

Disturbance Response Monitoring

- Surveys designed to monitor coral reef condition during and after disturbance
- 2005-2014 focused on coral bleaching
- Trained experts survey corals during peak annual temperatures (typically mid-August through mid-October)
- Follow-up surveys are completed after moderate/severe bleaching years. This is determined by FRRP Coral Bleaching Response Plan.



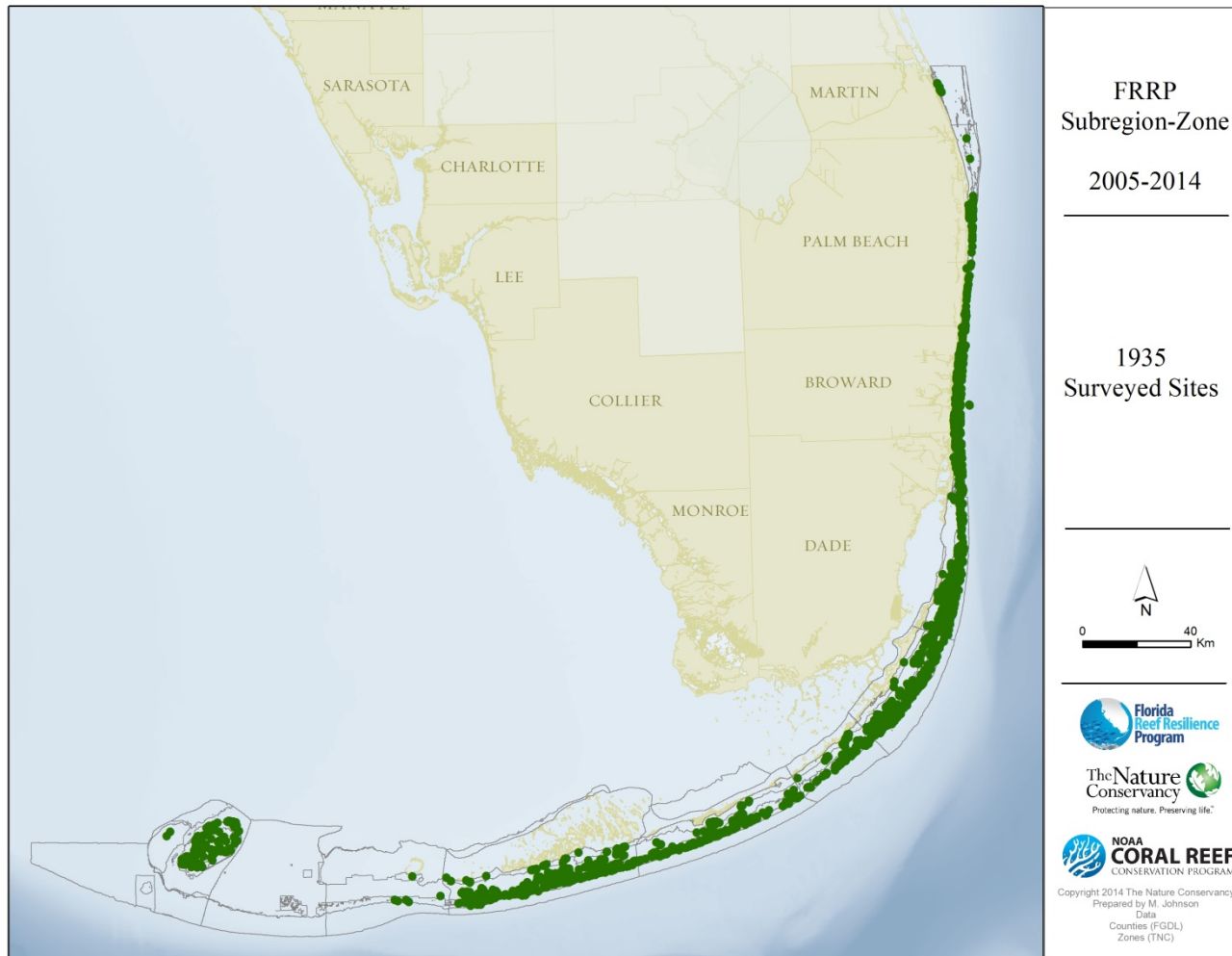
DRM Field Methodology

- Random sites generated and assigned to teams
- 1 x 10m belt transects (2/site)
- Measure/assess all corals (≥ 4 cm); # of tissue isolates
- Species level identification
- Degree of paling/bleaching, % mortality, disease presence
- Data entered online
- Database queried for results



DRM Survey Sites

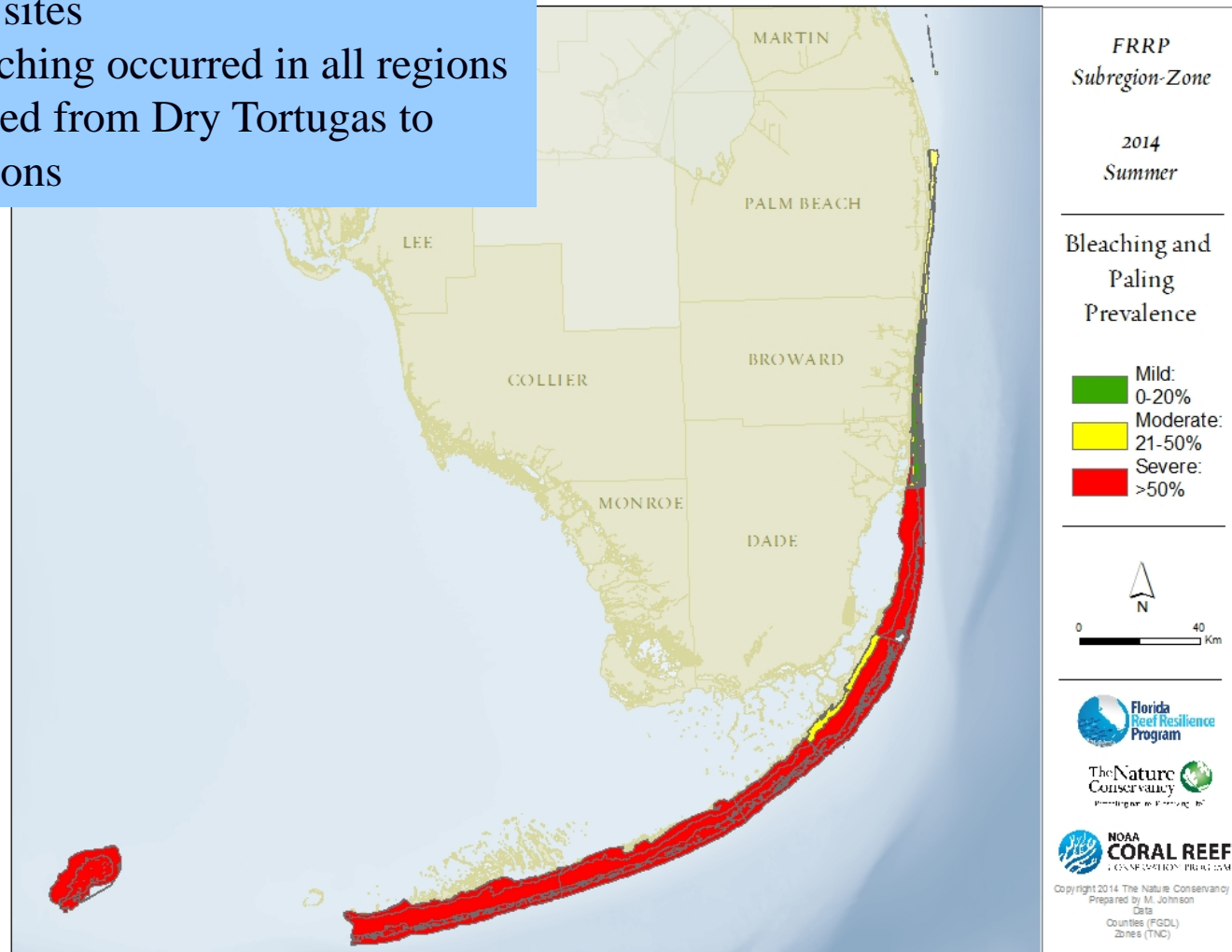
From 2005-2014, **1935** surveys were completed



2014 Summer Bleaching Results

- For 2014, 172 surveyed sites
- Moderate to severe bleaching occurred in all regions
- Severe bleaching occurred from Dry Tortugas to Broward-Miami sub-regions

Each year, a Quick-Look Report is produced based on the survey results. This can be found online at www.frrp.org.



2014 Summer Bleaching Results

Sub-Region	Zone	% Paling Prevalence	% Bleaching and Paling Prevalence	# of Sites
Dry Tortugas	Lagoon	19.55	70.20	11
Dry Tortugas	Forereef	20.41	55.38	17
Lower Keys	Inshore	33.52	77.18	3
Lower Keys	Mid-Channel	6.09	71.42	6
Lower Keys	Offshore Patch	15.86	80.22	9
Lower Keys	Forereef	18.98	79.83	24
Middle Keys	Inshore	32.65	52.42	2
Middle Keys	Mid-Channel	18.73	68.86	2
Middle Keys	Offshore Patch	24.73	77.66	5
Middle Keys	Forereef	29.79	59.06	8
Upper Keys	Inshore	16.67	50.00	2
Upper Keys	Mid-Channel	54.04	72.78	9
Upper Keys	Offshore Patch	12.66	90.37	2
Upper Keys	Forereef	17.18	77.98	11
Biscayne	Inshore	27.05	89.26	3
Biscayne	Mid-Channel	4.35	65.22	1
Biscayne	Forereef	10.75	61.38	15
Broward- Miami	Undetermined	11.54	42.31	1
Broward-Miami	Inshore	16.16	61.56	10
Broward-Miami	Deepwater	7.84	15.69	1
Broward-Miami	Inner Reef	18.95	54.41	8
Broward-Miami	Middle Reef	7.22	28.20	8
Broward-Miami	Outer Reef	13.75	29.90	5
Deerfield	Inshore	5.56	22.22	1
South Palm Beach	Inshore	9.38	25.00	2
South Palm Beach	Outer Reef	1.96	5.88	2
North Palm Beach	Inshore	28.57	28.57	2
Martin	Inshore	1.91	29.39	2

Sub-Region	Zone	% Disease Prevalence	# of Sites
Tortugas--Dry Tortugas NP	Forereef	0.00	17
Tortugas--Dry Tortugas NP	Lagoon	0.00	11
Lower Keys	Forereef	0.00	24
Lower Keys	Inshore	2.27	3
Lower Keys	Mid Channel	0.00	6
Lower Keys	Offshore Patch Reef	0.00	9
Middle Keys	Forereef	0.85	8
Middle Keys	Inshore	0.00	2
Middle Keys	Mid Channel	0.00	2
Middle Keys	Offshore Patch Reef	1.99	5
Upper Keys	Forereef	0.69	11
Upper Keys	Inshore	0.00	2
Upper Keys	Mid Channel	14.64	9
Upper Keys	Offshore Patch Reef	0.85	2
Biscayne	Forereef	0.00	15
Biscayne	Inshore	0.00	3
Biscayne	Mid Channel	0.00	1
Broward-Miami	Deepwater	0.00	1
Broward-Miami	Inner Reef	0.00	8
Broward-Miami	Inshore	0.71	10
Broward-Miami	Middle Reef	0.00	8
Broward-Miami	Outer Reef	0.00	5
Broward-Miami	Undetermined	3.70	1
Deerfield	Inshore	5.56	1
North Palm Beach	Inshore	0.00	2
South Palm Beach	Inshore	0.00	2
South Palm Beach	Outer Reef	0.00	2
Martin	Inshore	0.00	2

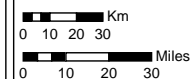
2014 Summer Disease Results

**FRRP
Subregion
Zone**

**2014
Summer**

**Disease
Prevalence**

- 0-5%
- 6-10%
- >10%



The Nature Conservancy



NOAA
CORAL REEF

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Prepared by J. Stein
Data: Counties (FGDL), Zones (TNC)

2014 Summer Recent Mortality


**FRRP
Subregion
Zone**


**2014
Summer**

**Recent Mortality
Prevalence**

- 0-5%
- 5-10%
- >10%



 Km
0 10 20 30

 Miles
0 10 20 30

The Nature
Conservancy 

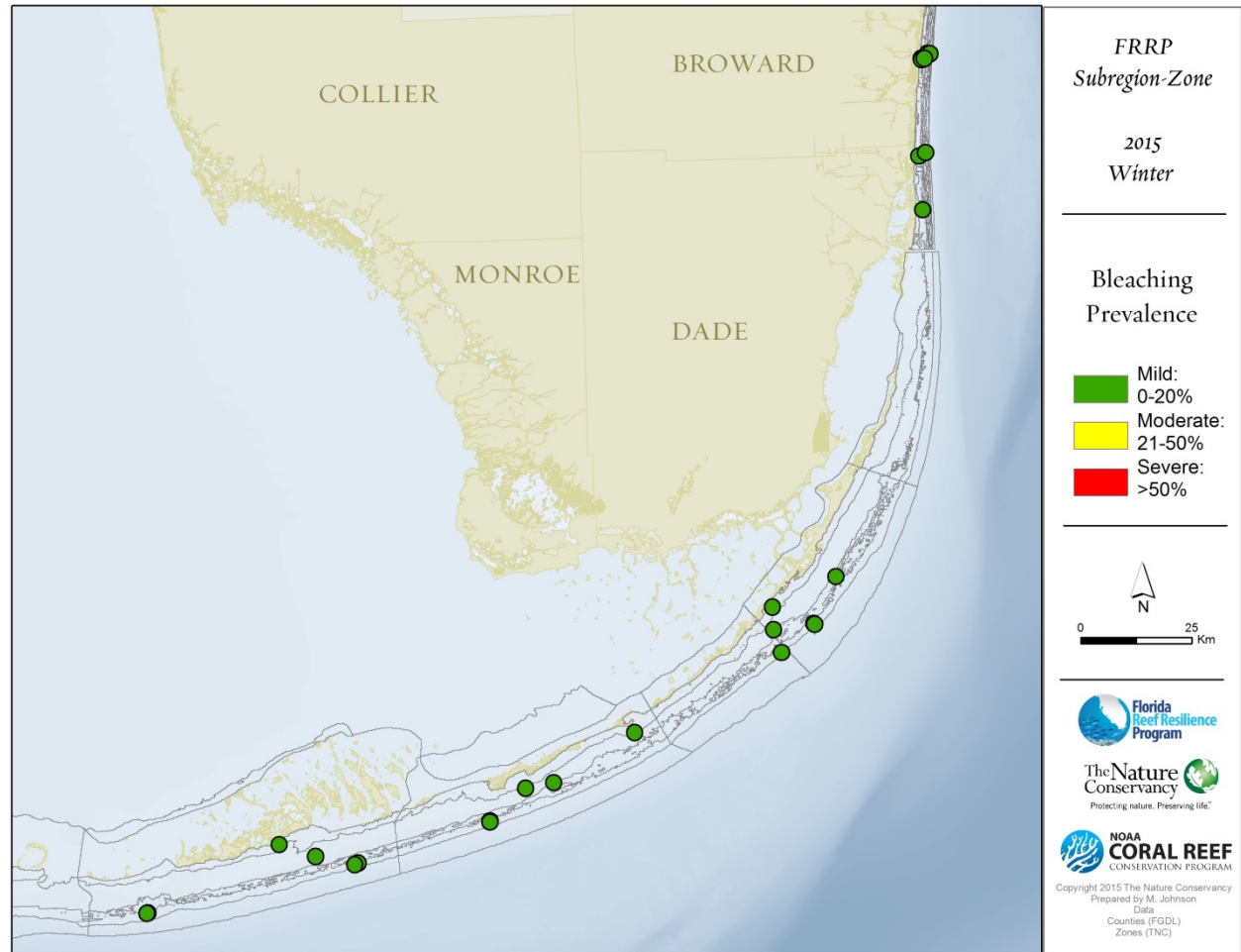


NOAA
CORAL REEF
CONSERVATION PROGRAM

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Data: Counties (FGDL), Zones (TNC)

2015 Winter Post-Bleaching Surveys

- Surveys completed at 25 CREMP and SECREMP sites
- Surveys took place from January-February 2015
- Mild bleaching occurred at all sites.
- This data shows bleaching only, NO paling

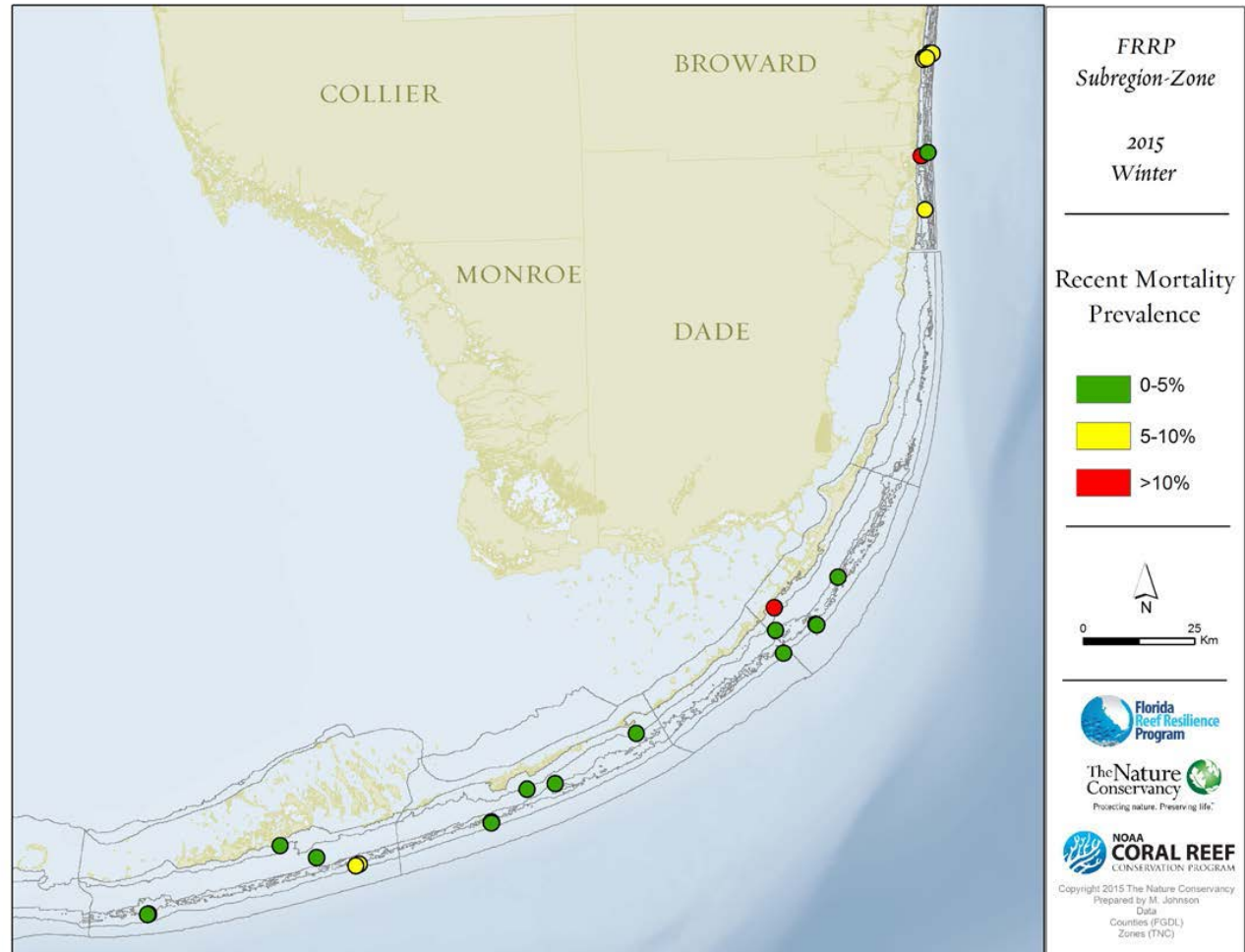


2015 Winter Post-Bleaching Surveys

Site	Sub-Region	Zone	% Bleaching Prevalence	% Bleaching and Paling Prevalence
N1001	Lower Keys	Inshore	0.00	0.00
N1002	Lower Keys	Mid-Channel	0.86	11.11
N1003	Lower Keys	Forereef	6.09	20.87
N1004	Lower Keys	Forereef	8.38	22.16
N1005	Lower Keys	Forereef	1.82	1.82
N2003	Lower Keys	Forereef	0.00	0.00
N1006	Middle Keys	Mid-Channel	2.44	3.05
N1007	Middle Keys	Mid-Channel	1.21	5.46
N1008	Middle Keys	Offshore Patch	1.47	17.65
N1009	Middle Keys	Forereef	3.85	9.23
N1010	Middle Keys	Forereef	0.00	33.33
N1016	Mid-Upper Keys Transition	Forereef	4.83	26.21
N1011	Upper Keys	Inshore	1.55	33.33
N1012	Upper Keys	Mid-Channel	5.10	18.88
N1013	Upper Keys	Forereef	4.94	14.07
N1014	Upper Keys	Forereef	8.21	22.02
N1015	Upper Keys	Forereef	3.33	4.44
N2023	Broward-Miami	Inner Reef	3.20	5.60
N2028	Broward-Miami	Inshore	0.99	3.96
N2029	Broward-Miami	Undetermined	0.00	2.86
N2031	Broward-Miami	Inshore	0.00	5.88
N2032	Broward-Miami	Inshore	0.00	2.38
N2033	Broward-Miami	Middle Reef	0.00	11.11
N2034	Broward-Miami	Outer Reef	2.04	2.04
N2035	Broward-Miami	Inner Reef	1.09	5.98

2015 Winter Recent Mortality

- Moderate to severe recent mortality occurred in the Lower Keys, Upper Keys and Broward-Miami sites
- Severe recent mortality occurred **ONLY** in the inshore zones of both the Upper Keys and Broward-Miami sub-regions
- Disease occurrence was very low

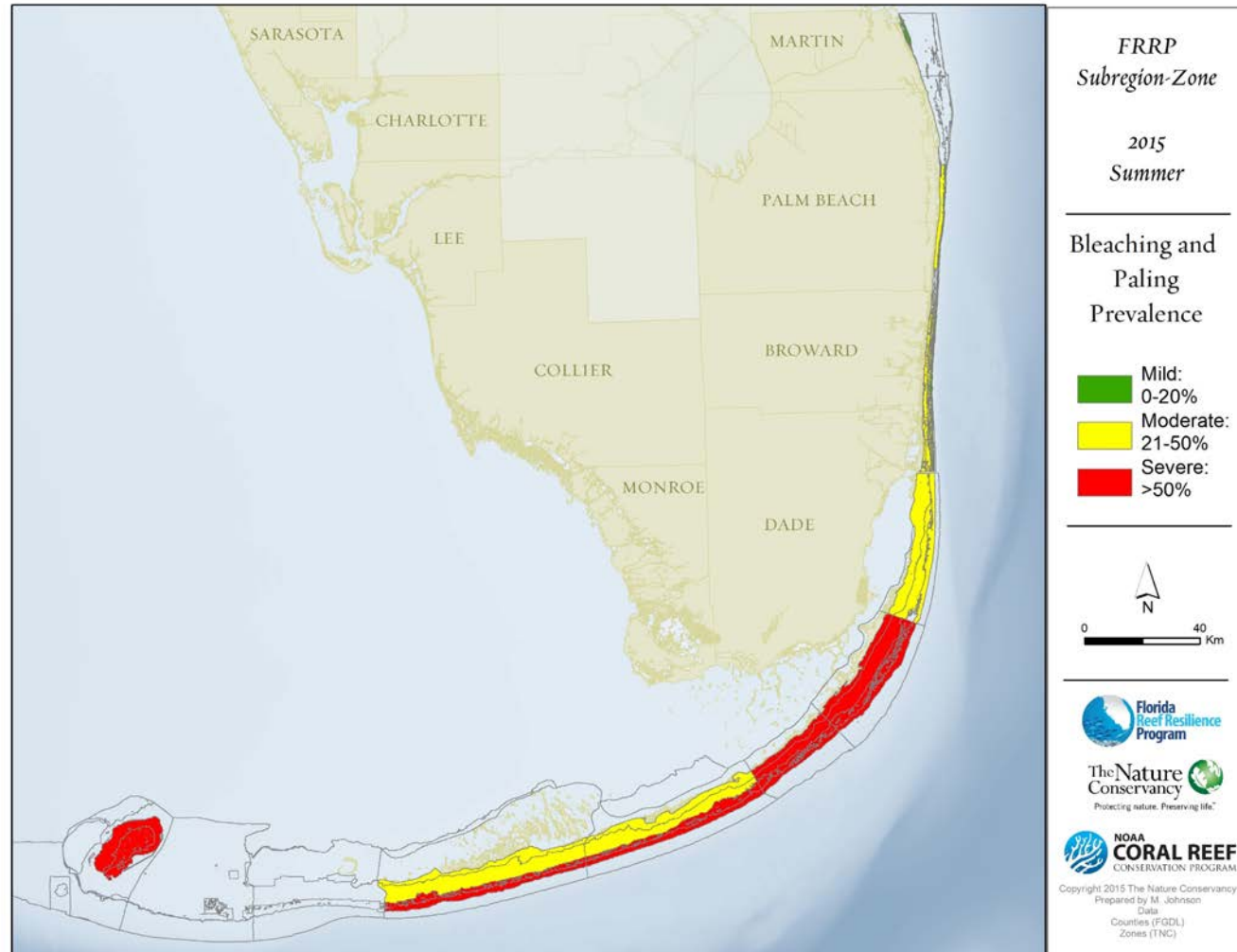


2015 Winter Recent Mortality

Site	Sub-Region	Zone	% Recent Mortality Prevalence
N1001	Lower Keys	Inshore	0.00
N1002	Lower Keys	Mid-Channel	2.56
N1003	Lower Keys	Forereef	7.83
N1004	Lower Keys	Forereef	9.58
N1005	Lower Keys	Forereef	0.00
N2003	Lower Keys	Forereef	1.11
N1006	Middle Keys	Mid-Channel	0.00
N1007	Middle Keys	Mid-Channel	1.83
N1008	Middle Keys	Offshore Patch	3.33
N1009	Middle Keys	Forereef	5.88
N1010	Middle Keys	Forereef	3.08
N1016	Mid-Upper Keys Transition	Forereef	1.49
N1011	Upper Keys	Inshore	33.33
N1012	Upper Keys	Mid-Channel	2.07
N1013	Upper Keys	Forereef	3.10
N1014	Upper Keys	Forereef	5.10
N1015	Upper Keys	Forereef	5.32
N2023	Broward-Miami	Inner Reef	10.40
N2028	Broward-Miami	Inshore	13.86
N2029	Broward-Miami	Undetermined	2.86
N2031	Broward-Miami	Inshore	17.65
N2032	Broward-Miami	Inshore	5.56
N2033	Broward-Miami	Middle Reef	1.85
N2034	Broward-Miami	Outer Reef	8.16
N2035	Broward-Miami	Inner Reef	9.78

2015 Summer Bleaching Results

- For 2015, 250 surveyed sites
- Severe bleaching and paling occurred in the forereef and offshore zones of the Middle and Lower Keys, and in all zones of the Upper Keys and Dry Tortugas sub-regions.
- Moderate bleaching and paling occurred in at least one zone within the Martin, South Palm Beach, Deerfield, Broward-Miami, Biscayne, Middle and Lower Keys sub-regions.

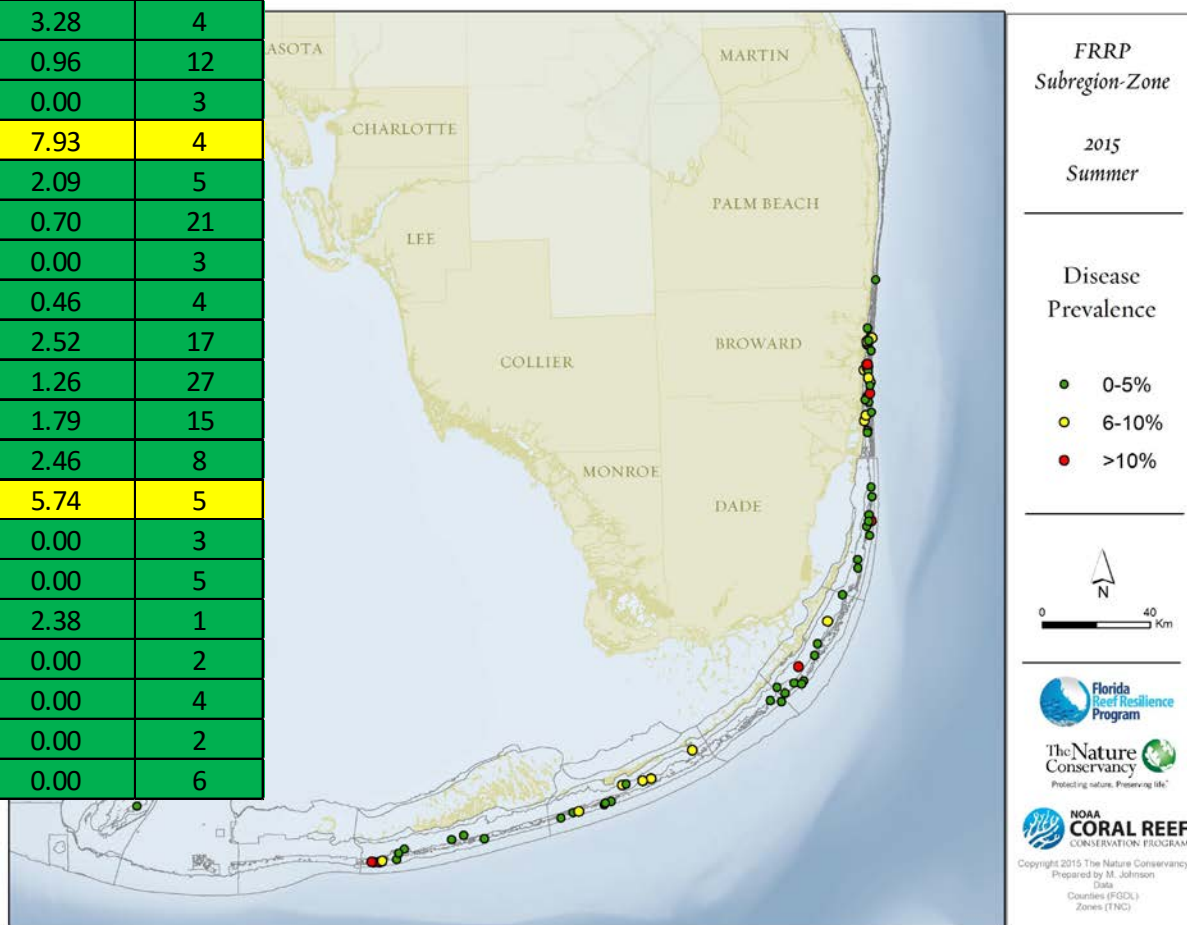


2015 Summer Bleaching Results

Sub-Region	Zone	% Paling Prevalence	% Bleaching and Paling	# of Sites
Dry Tortugas	Lagoon	17.26	68.93	6
Dry Tortugas	Forereef	17.37	68.95	14
Lower Keys	Inshore	25.96	39.60	10
Lower Keys	Mid-Channel	27.09	46.57	10
Lower Keys	Offshore Patch	27.66	68.85	7
Lower Keys	Forereef	25.39	72.98	35
Middle Keys	Inshore	15.00	30.00	2
Middle Keys	Mid-Channel	29.95	42.05	4
Middle Keys	Offshore Patch	37.69	79.51	4
Middle Keys	Forereef	24.96	80.20	12
Upper Keys	Inshore	64.29	75.00	3
Upper Keys	Mid-Channel	30.53	61.30	4
Upper Keys	Offshore Patch	21.53	58.59	5
Upper Keys	Forereef	22.48	59.62	12
Biscayne	Inshore	7.42	42.69	3
Biscayne	Mid-Channel	16.55	49.89	4
Biscayne	Forereef	10.32	36.64	21
Broward- Miami	Undetermined	8.90	32.80	5
Broward-Miami	Inshore	19.59	48.23	27
Broward-Miami	Inner Reef	13.63	38.50	17
Broward-Miami	Middle Reef	10.41	24.43	15
Broward-Miami	Outer Reef	6.45	19.60	8
Deerfield	Inshore	35.38	39.56	3
Deerfield	Middle Reef	12.94	26.06	5
Deerfield	Outer Reef	14.29	33.33	1
South Palm Beach	Inshore	0	8.33	1
South Palm Beach	Outer Reef	6.24	9.04	4
Martin	Inshore	0.64	9.51	6

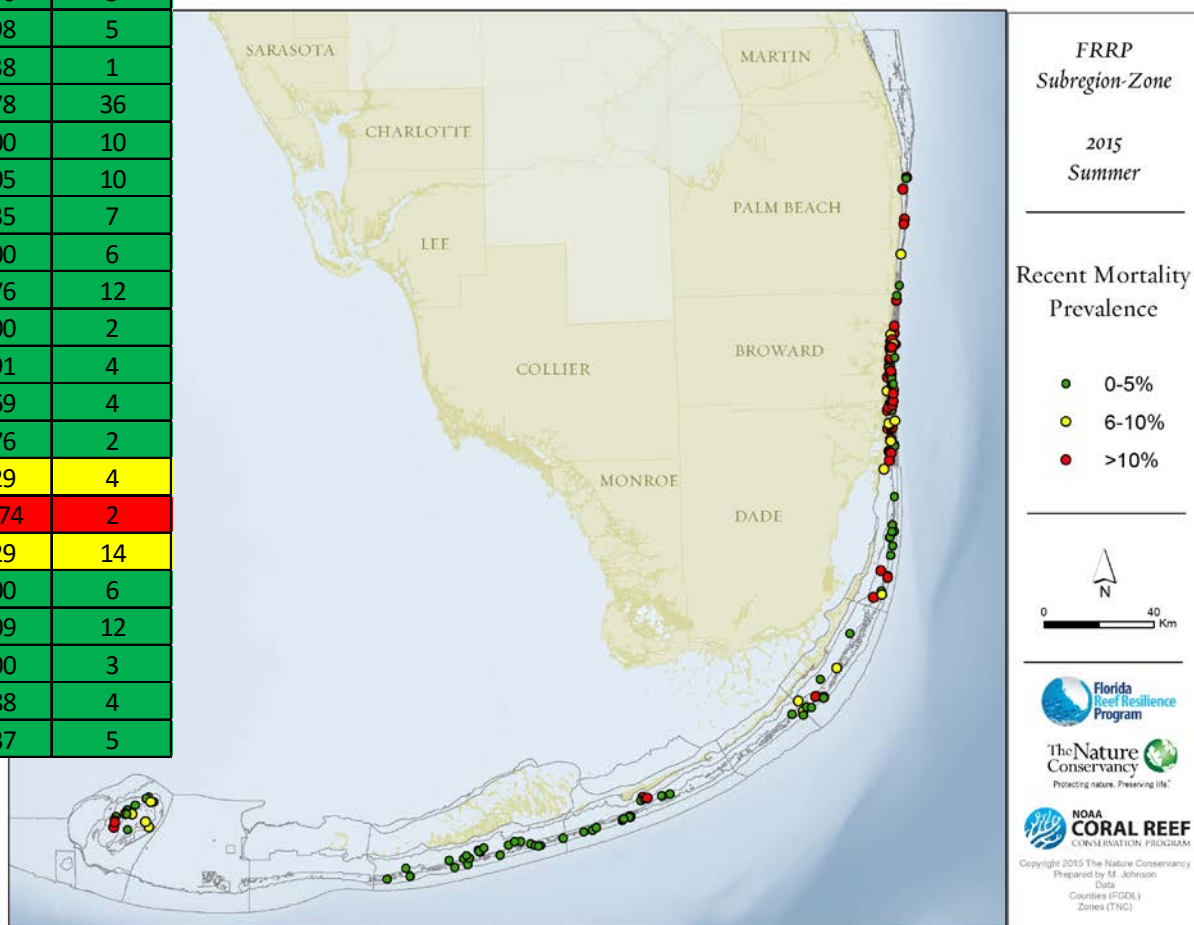
Sub-Region	Zone	% Disease Prevalence	# of Sites
Tortugas--Dry Tortugas NP	Forereef	0.34	14
Tortugas--Dry Tortugas NP	Lagoon	0.40	6
Lower Keys	Forereef	1.27	36
Lower Keys	Inshore	0.00	10
Lower Keys	Mid Channel	0.12	10
Lower Keys	Offshore Patch Reef	1.21	7
Middle Keys	Forereef	1.32	12
Middle Keys	Inshore	0.00	2
Middle Keys	Mid Channel	2.93	4
Middle Keys	Offshore Patch Reef	3.28	4
Upper Keys	Forereef	0.96	12
Upper Keys	Inshore	0.00	3
Upper Keys	Mid Channel	7.93	4
Upper Keys	Offshore Patch Reef	2.09	5
Biscayne	Forereef	0.70	21
Biscayne	Inshore	0.00	3
Biscayne	Mid Channel	0.46	4
Broward-Miami	Inner Reef	2.52	17
Broward-Miami	Inshore	1.26	27
Broward-Miami	Middle Reef	1.79	15
Broward-Miami	Outer Reef	2.46	8
Broward-Miami	Undetermined	5.74	5
Deerfield	Inshore	0.00	3
Deerfield	Middle Reef	0.00	5
Deerfield	Outer Reef	2.38	1
South Palm Beach	Inshore	0.00	2
South Palm Beach	Outer Reef	0.00	4
South Palm Beach	Undetermined	0.00	2
Martin	Inshore	0.00	6

2015 Summer Disease Results



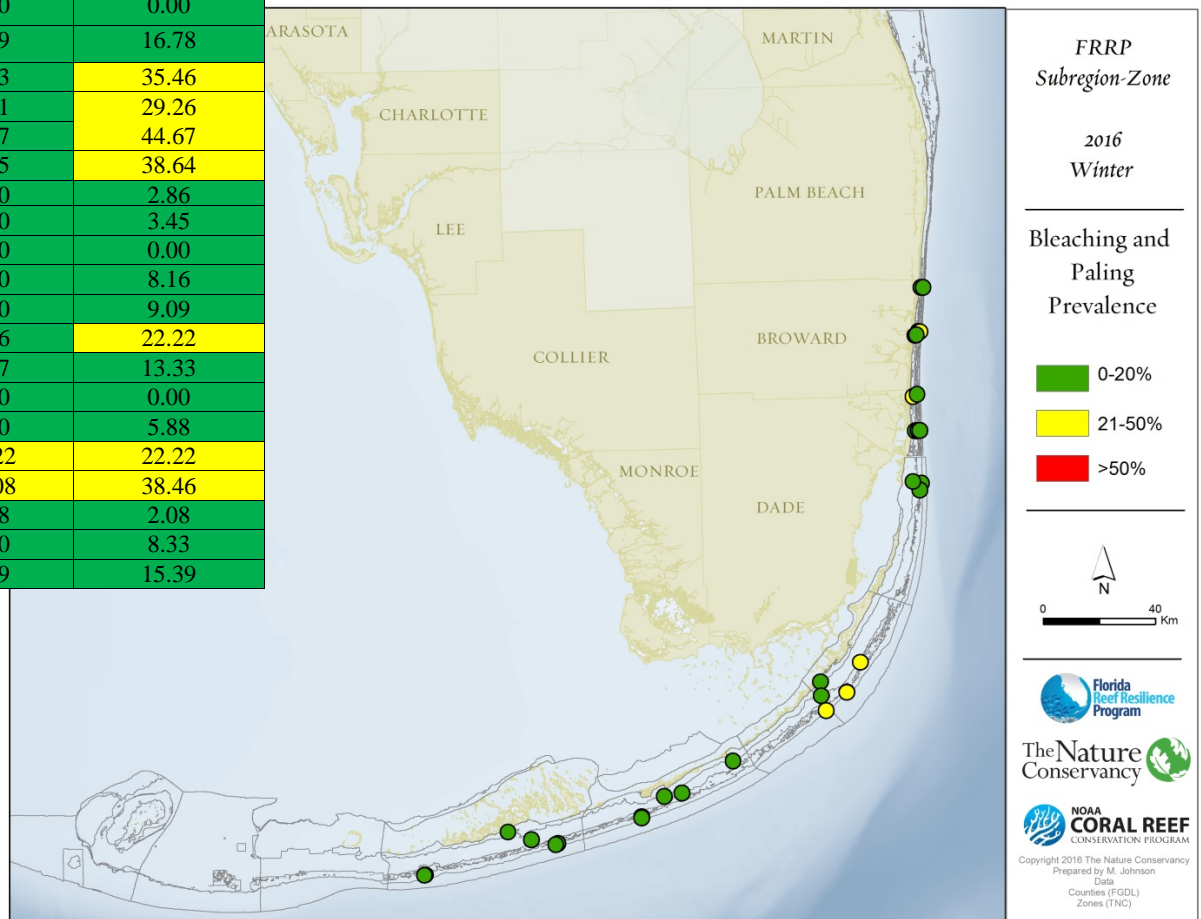
Sub-Region	Zone	% Recent Mortality	# of Sites
Biscayne	Forereef	3.13	21
Biscayne	Inshore	3.54	3
Biscayne	Mid Channel	3.45	4
Broward-Miami	Inner Reef	8.68	17
Broward-Miami	Inshore	6.84	27
Broward-Miami	Middle Reef	5.98	15
Broward-Miami	Outer Reef	5.33	8
Broward-Miami	Undetermined	10.66	5
Deerfield	Inshore	0.00	3
Deerfield	Middle Reef	3.98	5
Deerfield	Outer Reef	2.38	1
Lower Keys	Forereef	0.78	36
Lower Keys	Inshore	0.00	10
Lower Keys	Mid Channel	1.05	10
Lower Keys	Offshore Patch Reef	0.35	7
Martin	Inshore	0.00	6
Middle Keys	Forereef	1.76	12
Middle Keys	Inshore	5.00	2
Middle Keys	Mid Channel	3.91	4
Middle Keys	Offshore Patch Reef	2.69	4
South Palm Beach	Inshore	4.76	2
South Palm Beach	Outer Reef	7.29	4
South Palm Beach	Undetermined	21.74	2
Tortugas--Dry Tortugas NP	Forereef	5.29	14
Tortugas--Dry Tortugas NP	Lagoon	4.00	6
Upper Keys	Forereef	3.09	12
Upper Keys	Inshore	0.00	3
Upper Keys	Mid Channel	2.88	4
Upper Keys	Offshore Patch Reef	3.37	5

2015 Summer Recent Mortality



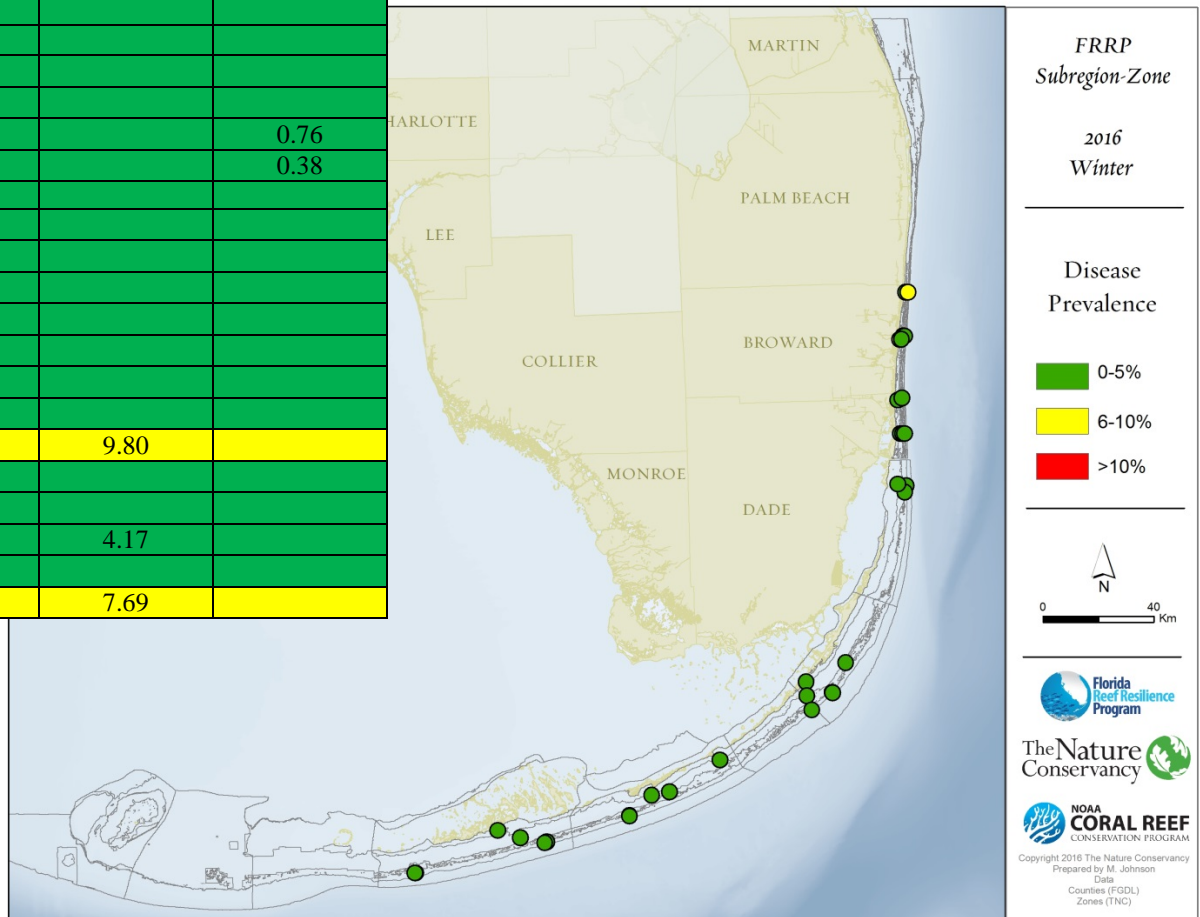
Site	Sub-Region	Zone	% Bleaching Prevalence	% Bleaching and Paling Prevalence
4001	Lower Keys	Inshore	0.00	2.94
4002	Lower Keys	Mid Channel	0.00	3.92
4003	Lower Keys	Forereef	2.90	10.87
4004	Lower Keys	Forereef	1.16	9.83
4005	Lower Keys	Forereef	0.00	2.63
4006	Lower Keys	Forereef	4.69	18.75
4007	Middle Keys	Mid Channel	0.00	0.00
4008	Middle Keys	Mid Channel	0.00	11.03
4009	Middle Keys	Offshore Patch	0.00	10.19
4010	Middle Keys	Forereef	2.44	20.73
4011	Middle Keys	Forereef	2.94	5.88
4012	Upper Keys	Inshore	0.00	0.00
4013	Upper Keys	Mid Channel	6.29	16.78
4014	Upper Keys	Forereef	2.73	35.46
4015	Upper Keys	Forereef	7.41	29.26
4016	Upper Keys	Forereef	7.87	44.67
4017	Upper Keys	Forereef	4.55	38.64
4018	Broward-Miami	Inner Reef	0.00	2.86
4019	Broward-Miami	Middle Reef	0.00	3.45
4020	Broward-Miami	Outer Reef	0.00	0.00
4021	Biscayne	Forereef	0.00	8.16
4022	Biscayne	Forereef	0.00	9.09
4023	Broward-Miami	Inshore	5.56	22.22
4024	Broward-Miami	Middle Reef	6.67	13.33
4025	Biscayne	Inshore	0.00	0.00
4027	Broward-Miami	Inshore	0.00	5.88
4028	Broward-Miami	Middle Reef	22.22	22.22
4029	Broward-Miami	Outer Reef	23.08	38.46
4030	Broward-Miami	Inner Reef	2.08	2.08
4031	Deerfield	Middle Reef	0.00	8.33
4032	Deerfield	Outer Reef	7.69	15.39

2016 Winter Bleaching Results



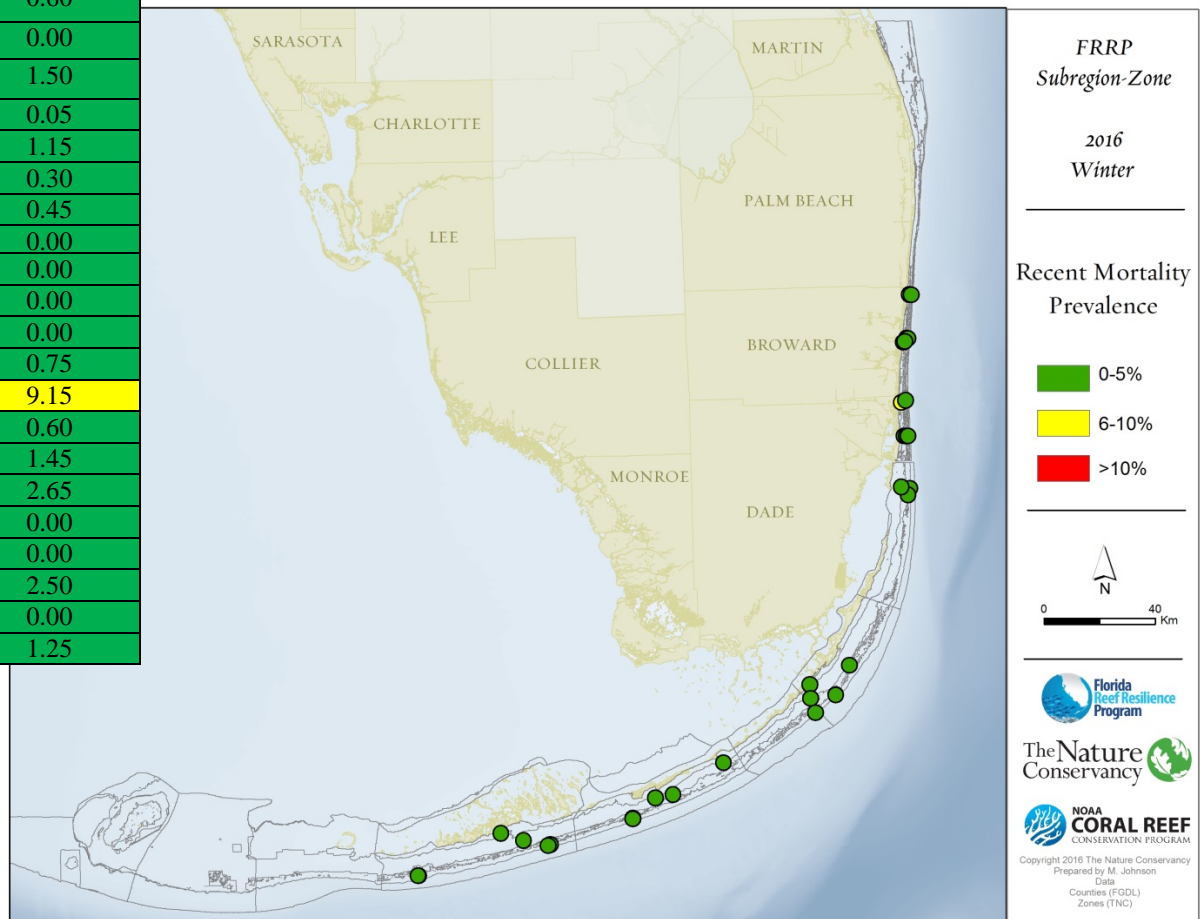
2016 Winter Disease Results

Site	Sub-Region	Zone	% Disease Prevalence	% White Plague	% Dark Spots
4001	Lower Keys	Inshore	0.00		
4002	Lower Keys	Mid Channel	0.00		
4003	Lower Keys	Forereef	0.00		
4004	Lower Keys	Forereef	0.00		
4005	Lower Keys	Forereef	1.32		1.32
4006	Lower Keys	Forereef	4.69		4.69
4007	Middle Keys	Mid Channel	0.00		
4008	Middle Keys	Mid Channel	0.69		0.69
4009	Middle Keys	Offshore Patch	2.78		2.78
4010	Middle Keys	Forereef	0.00		
4011	Middle Keys	Forereef	0.49		0.49
4012	Upper Keys	Inshore	0.00		
4013	Upper Keys	Mid Channel	0.00		
4014	Upper Keys	Forereef	0.00		
4015	Upper Keys	Forereef	0.37		
4016	Upper Keys	Forereef	0.76		0.76
4017	Upper Keys	Forereef	0.38		0.38
4018	Broward-Miami	Inner Reef	2.86		
4019	Broward-Miami	Middle Reef	0.00		
4020	Broward-Miami	Outer Reef	0.00		
4021	Biscayne	Forereef	0.00		
4022	Biscayne	Forereef	0.00		
4023	Broward-Miami	Inshore	0.00		
4024	Broward-Miami	Middle Reef	0.00		
4025	Biscayne	Inshore	0.00		
4027	Broward-Miami	Inshore	9.80	9.80	
4028	Broward-Miami	Middle Reef	0.00		
4029	Broward-Miami	Outer Reef	0.00		
4030	Broward-Miami	Inner Reef	4.17	4.17	
4031	Deerfield	Middle Reef	0.00		
4032	Deerfield	Outer Reef	7.69	7.69	



Site	Sub-Region	Zone	% Recent Mortality Prevalence
4001	Lower Keys	Inshore	0.00
4002	Lower Keys	Mid Channel	0.00
4003	Lower Keys	Forereef	1.60
4004	Lower Keys	Forereef	0.05
4005	Lower Keys	Forereef	0.05
4006	Lower Keys	Forereef	0.30
4007	Middle Keys	Mid Channel	0.15
4008	Middle Keys	Mid Channel	2.60
4009	Middle Keys	Offshore Patch	0.30
4010	Middle Keys	Forereef	0.95
4011	Middle Keys	Forereef	0.60
4012	Upper Keys	Inshore	0.00
4013	Upper Keys	Mid Channel	1.50
4014	Upper Keys	Forereef	0.05
4015	Upper Keys	Forereef	1.15
4016	Upper Keys	Forereef	0.30
4017	Upper Keys	Forereef	0.45
4018	Broward-Miami	Inner Reef	0.00
4019	Broward-Miami	Middle Reef	0.00
4020	Broward-Miami	Outer Reef	0.00
4021	Biscayne	Forereef	0.00
4022	Biscayne	Forereef	0.75
4023	Broward-Miami	Inshore	9.15
4024	Broward-Miami	Middle Reef	0.60
4025	Biscayne	Inshore	1.45
4027	Broward-Miami	Inshore	2.65
4028	Broward-Miami	Middle Reef	0.00
4029	Broward-Miami	Outer Reef	0.00
4030	Broward-Miami	Inner Reef	2.50
4031	Deerfield	Middle Reef	0.00
4032	Deerfield	Outer Reef	1.25

2016 Winter Recent Mortality



Questions?

www.frrp.org

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