

# Forecasting Coral Reef Microhabitats: competition and the community structure of future reefs

Integrative Marine and Coastal  
Ecology Lab



# Microhabitats

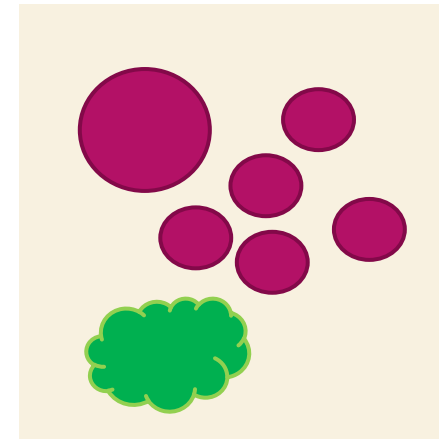


## MICROHABITAT:

A habitat which is of small or limited extent and which differs in character from some surrounding more extensive habitat.

# Objective

- ▶ To quantify microhabitats change over a period of 15 years (2003-2018) on a Florida coral reef.

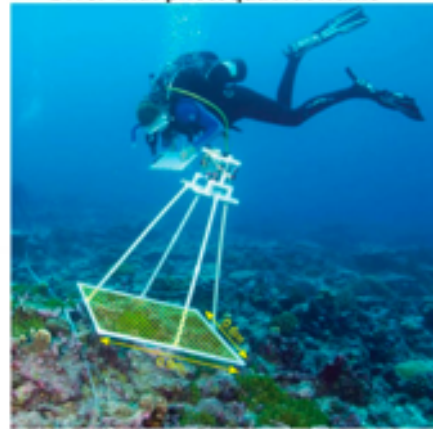


# Coral Reef Monitoring Methods

**Line-transect**



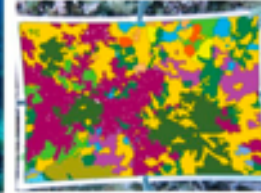
**Diver with photoquadrat frame**



**Photoquadrat**

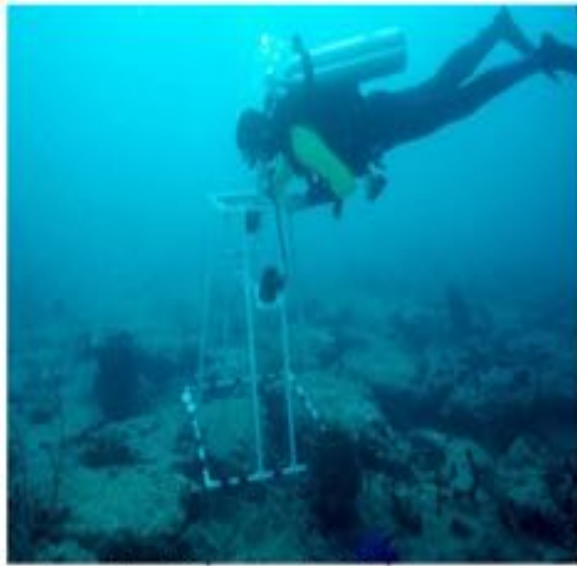


**Digitized photoquadrat**



Less Hard coral, more algae, sometimes more sponges  
Coral Reef are experiencing Habitat Fragmentation and Patchiness

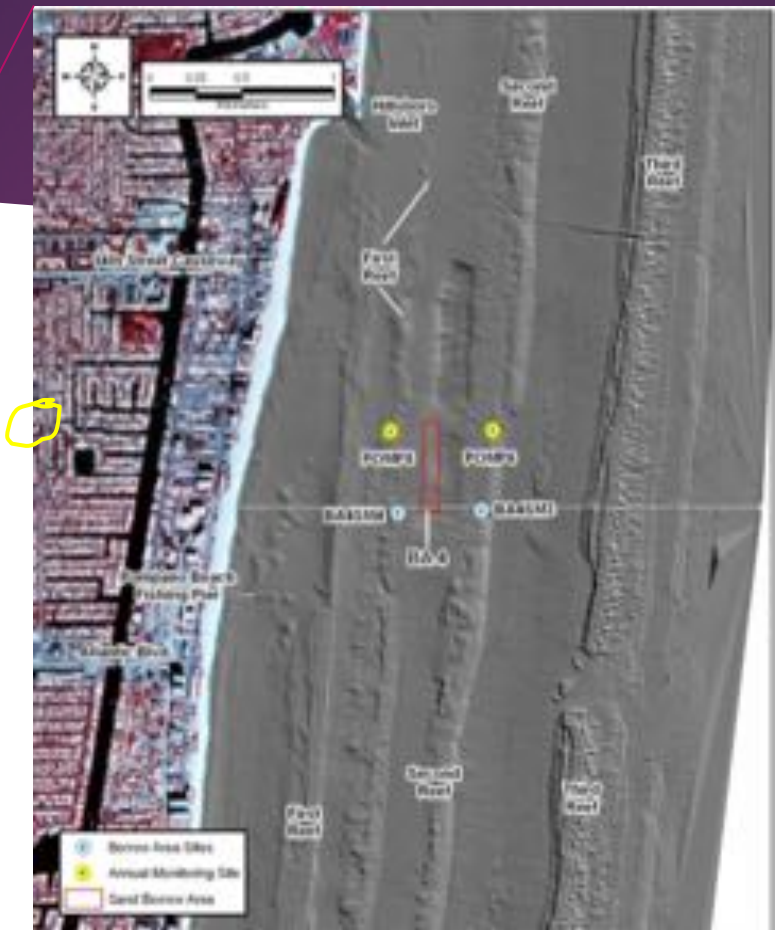
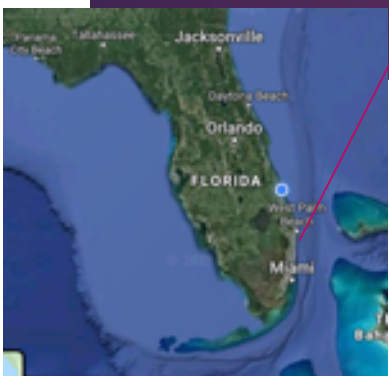
# Photoquadrats Monitoring



Monitor the change of a single quadrat ( $0.75m^2$ )

Fixed-position photo, taken from 2003-2018 (excluding 2009 & 2012)





- ▶ Five Photoquadrats to define microhabitats
- ▶ One Randomly selected quadrat frame from Pompano Beach for the model

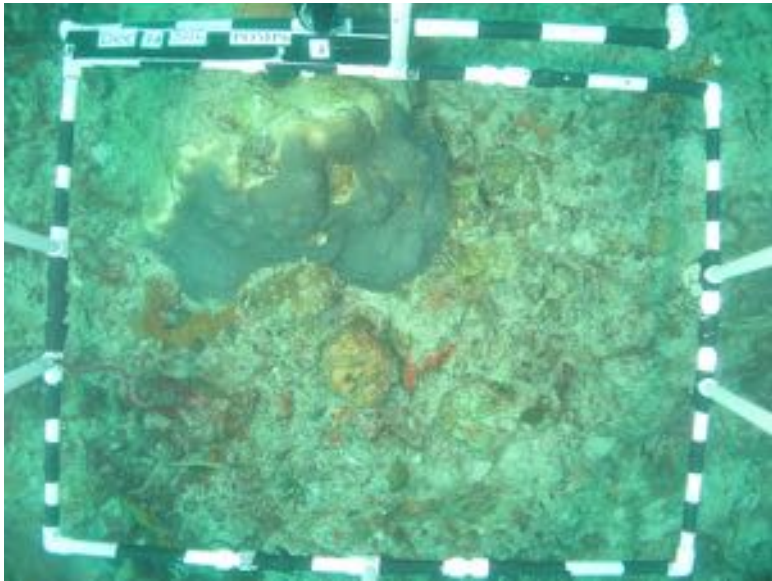


**CRRAM (Coral Reef  
Restoration, Assessment  
& Monitoring) Lab**

Retrieved from: Gilliam, D., Dodge, R., Spieler, R., Halperin, A., Walton, C., & Kilfoyle, K. (2015). MARINE BIOLOGICAL MONITORING IN BROWARD COUNTY, FLORIDA: YEAR 14 (2013) ANNUAL REPORT.



# Define Microhabitats (States)



Concept: If physical contact of organisms exists those organisms are in the same microhabitat (Competitive Interaction)

Classification	Description	Illustration
Soft corals	Exclusively soft corals, bleached and not bleached	
Fleshy Algae	Long, vibrant-green, fleshy algae that can easily be distinguished from turf algae	
Sponges	All sponges including encrusting, vertically morphed, etc.	
Turfing Algae/ Substratum	Small algae, usually white or unnoticeable unless magnified significantly. Abiotic substrates also included, such as sand, rock, mud etc.	
Coral/Algae	Any coral form (hard or soft) that is in physical contact with fleshy algae only	
Coral/Sponge	Any coral form (hard or soft) that is in contact with any sponge mentioned above	
Sponge/Algae	Any sponge that is in physical contact with fleshy algae only	
Coral/Sponge/Algae	Sponges, corals, and fleshy algae all in one microhabitat	
Hard corals	Exclusively Hard corals, bleached and not bleached	

Table 1. Classification of microhabitats for quadrats DB, HB, and Pomp.

# Methods: Microhabitats size



Retrieved from: <http://www.mxif.manchester.ac.uk/resources/software/imagej-and-fiji>

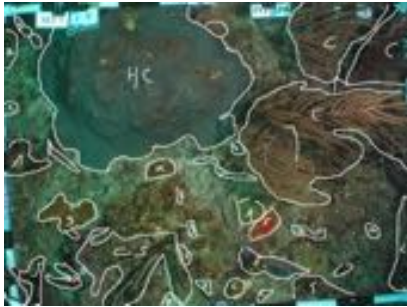
- ▶ Percent cover of each state in each quadrat determined from 2003-2018

- ▶ 
$$\frac{\text{Total area of state}}{\text{Total area of the image}} \times 100\%$$



# Microhabitat Transition Matrices

2003



2018



Coral Bleaching

classification (% cover)	2003	2004	2005	2006	2007	2008	2010	2011	2013	2014	2015	2016	2017	2018
Soft Coral	19.62	14.36	7.6	7.15	7.16	9.7	8.63	3.57	7.47	4.75	3.33	2.3	1.51	1.89
Fleshy Algae	1.55	1.2	0	1.13	0.47	0.65	0.95	0.33	2.68	5.65	4.94	2.83	5.86	22.65
Sponge	5.28	5.72	2.98	8.37	6.96	7.64	9.16	9.64	10.15	8.44	14.19	8.12	14.39	2.71
turf alage/substratum	46.78	56.15	64.62	57.92	60.91	60.01	54.35	58.17	54.46	49.32	42.72	53.7	72.49	62.84
Coral/Algae	0	0	0	0	0	0	0	0	0.71	0	0	0.47	0	2.62
Coral/Sponge	4.37	0	22.47	3.76	2.64	1.01	3.3	5.23	1.64	4.52	26.55	3.75	2.37	1.8
Algae/Sponge	0	0.17	0	0	0.58	0.84	0.84	1.49	2.94	2.79	6.32	7.46	1.89	4.74
Algae/Sponge/Coral	0	0	0	1.27	0	0	0	0	0	22.89	0	21.24	0	0
hard coral	22.4	22.4	2.33	20.4	21.28	20.15	22.77	21.57	19.95	1.64	1.95	0.13	1.49	0.75

Average  
Probability  
Matrix of  
change