

# Interannual and Interspecific Variability in Coral Resilience to Thermal Stress in the Turks and Caicos Islands during the 2014-2017 Global Coral Bleaching Event



Abigail Knipp, Dr. Justin C. Pettijohn, Dr. Hiedi Hertler, Dr. Catherine Jadot



Department of Earth, Society and the Environment, College of Liberal Arts and Sciences, University of Illinois at Urbana-Champaign

## ABSTRACT

Coral cover throughout the Caribbean has declined by approximately 80% since the 1970's with a large portion of it contributing to rising sea surface temperatures. Due to sea surface temperatures rising worldwide, stress on coral health has escalated, causing corals to bleach. These global bleaching events (GBE) have been found to coincide directly with El Niño warming phases in El Niño-Southern Oscillation (ENSO) cycle which have occurred in 1997-1998, 2004-2005, and 2014-2017. This study focuses on how coral reefs in The Turks and Caicos Islands during the 2014-2017 GBE were affected by the anomalously-high sea surface temperatures. Interannual and interspecific variability in coral health and bleaching offshore of South Caicos Island were evaluated between the 2012-2018 sampling interval using the CoralWatch citizen science Coral Health Chart method along belt transects at 8 dive and snorkeling coral reef sampling survey sites. The study includes 107 site surveys conducted from 15 October, 2012 to 18 July, 2018. Coral health was assessed for the 35 principal coral taxa. Data indicates that all coral taxa at the study site were resilient to the 2014-2017 GBE, and rebounded to their pre-GBE pigmentations within months of the anomalously-high thermal stress. However, boulder coral types were significantly more healthy in 2017 than in 2014, while because the CoralWatch methodology does not quantify total coral cover, our results only focus on surviving corals in the survey tracks.

## AIM

This study investigates the interannual and interspecific variability in the Turks and Caicos coral reef stress and subsequent recovery in response to the 2014-2017 global bleaching event.

- 1) How significantly were corals in the TCI affected by the 2014-2017 GBE?
- 2) Were different coral types in this region more resilient to the 2014-2017 bleaching event? If so, what is the interspecific variability in coral rebound and healing from this major thermal stress event? Were branching and plate corals more susceptible to stress from the mass event than bouldering corals in the region?
- 3) What insights into El Niño forced thermal stress events can NOAA's Coral Reef Watch (CRW) program products provide?

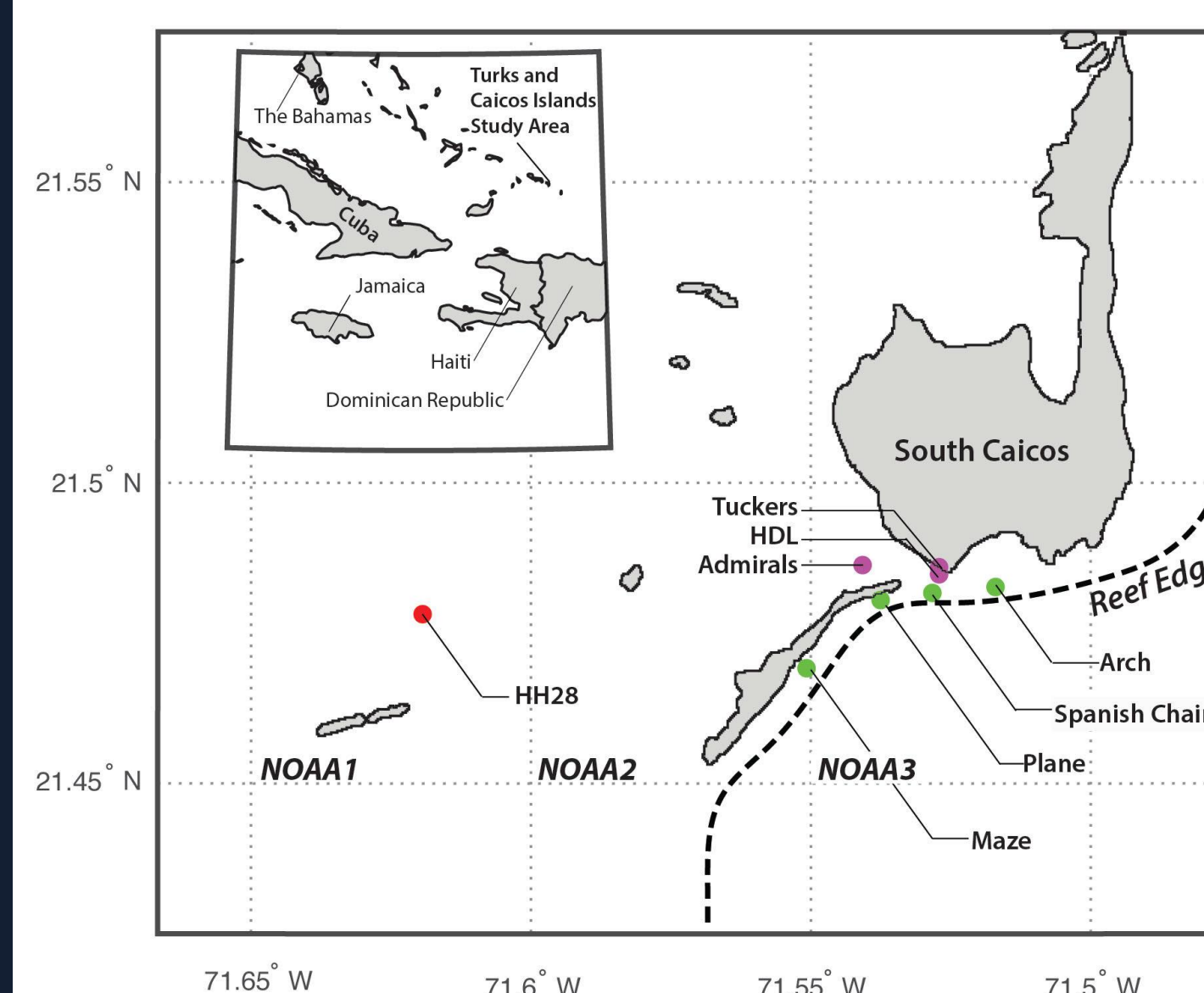
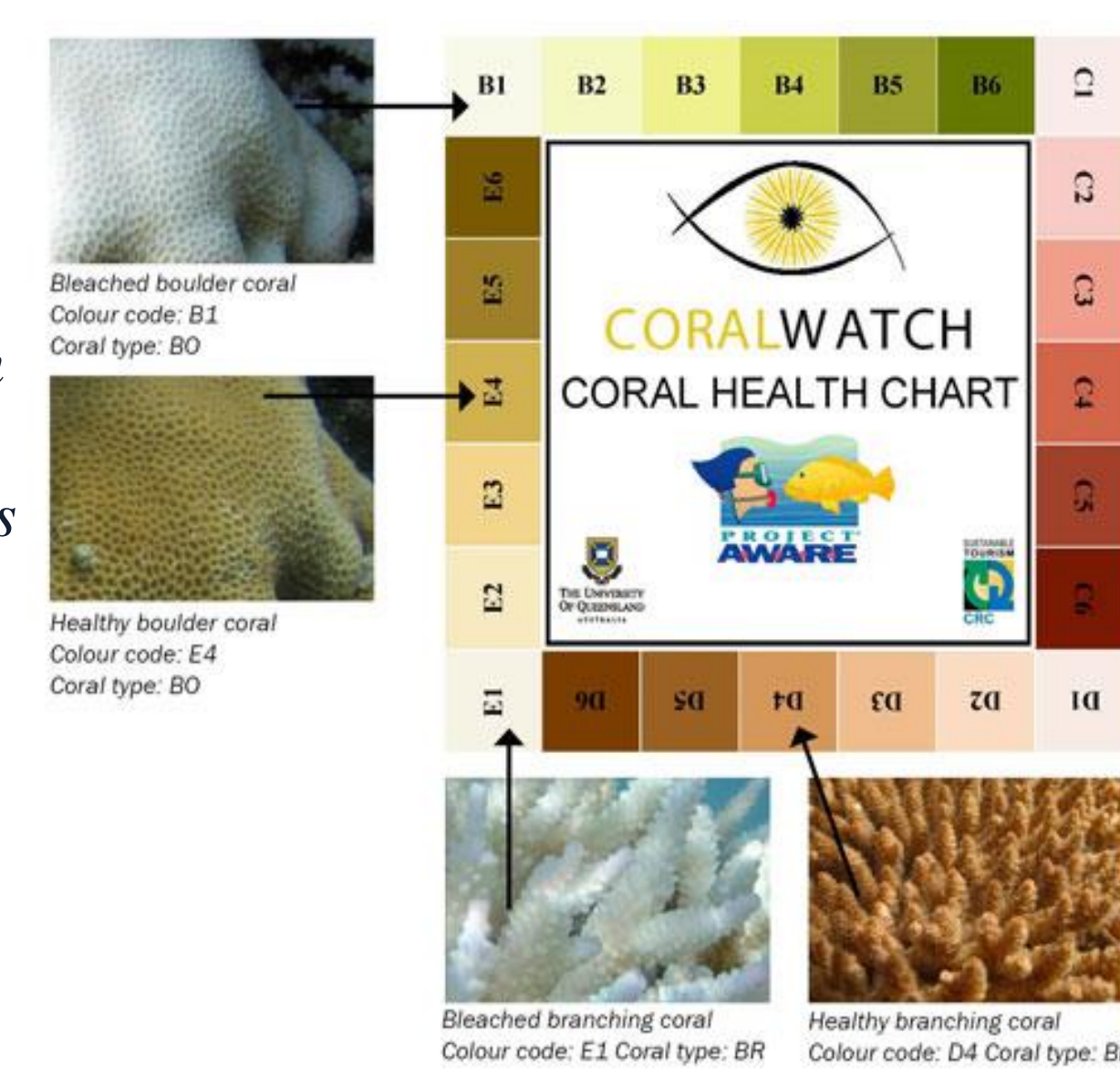
## METHOD

Belt transects were used to record data at each location.



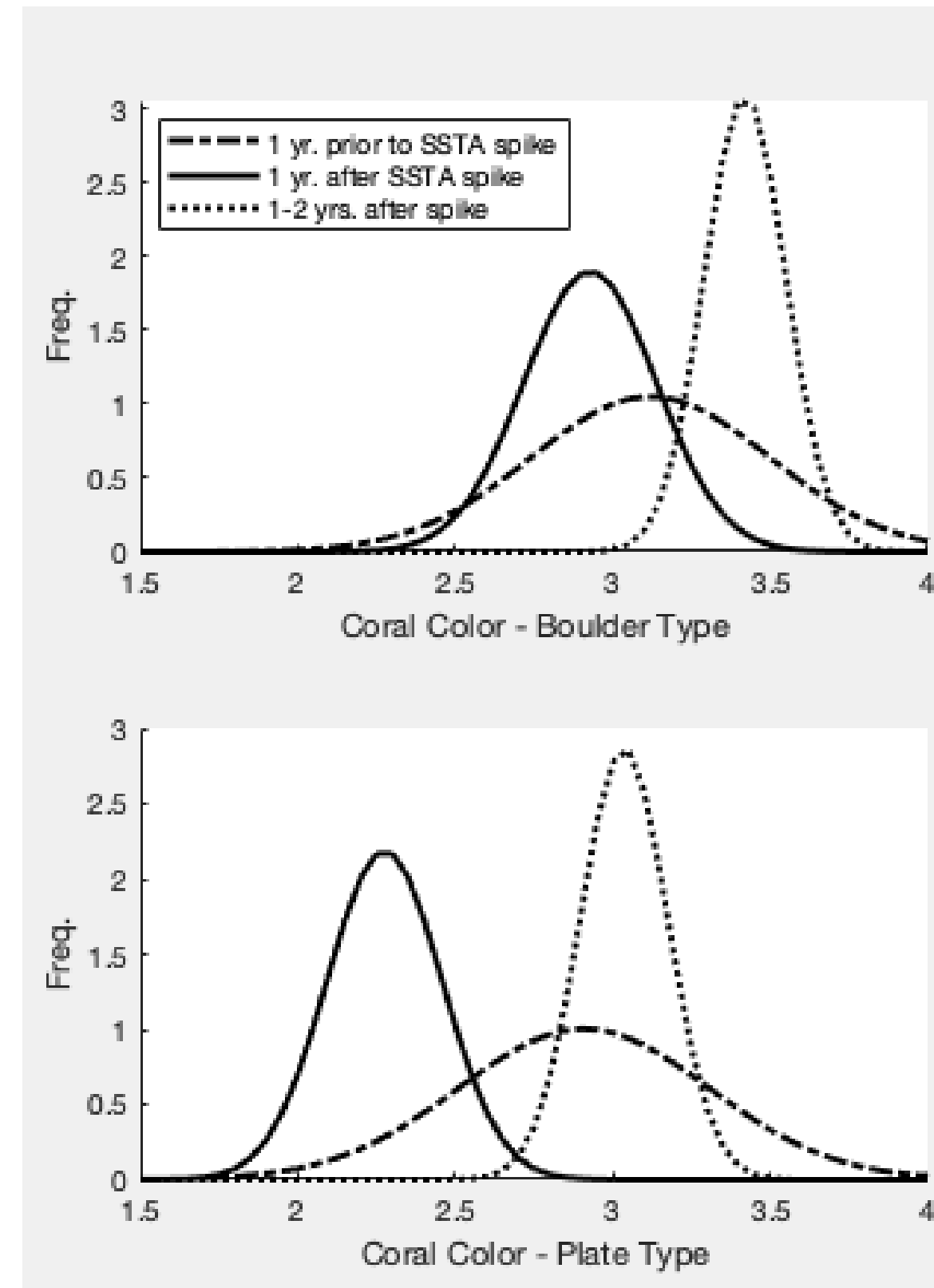
*Favia fragum*, also known as golfball coral is experiencing bleaching on the right, while displaying normal color hues on the left.

The citizen science CoralWatch Health Chart. There are four color hues typical of corals. A six point brightness/saturation scale is associated with coral health. Lighter colors may represent less zooxanthellae and therefore, bleaching may be occurring. Darker colors may represent recovering and healthy corals.



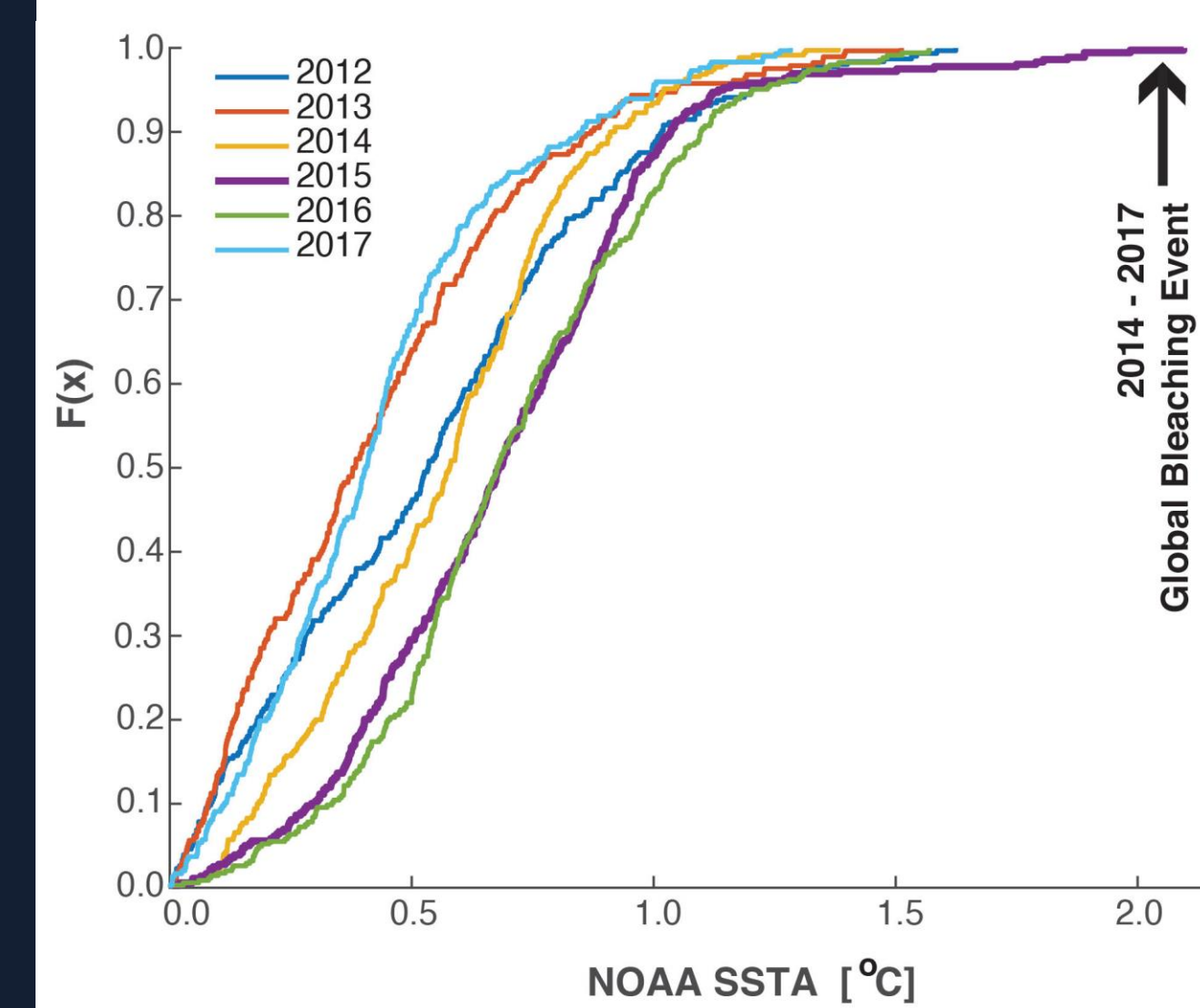
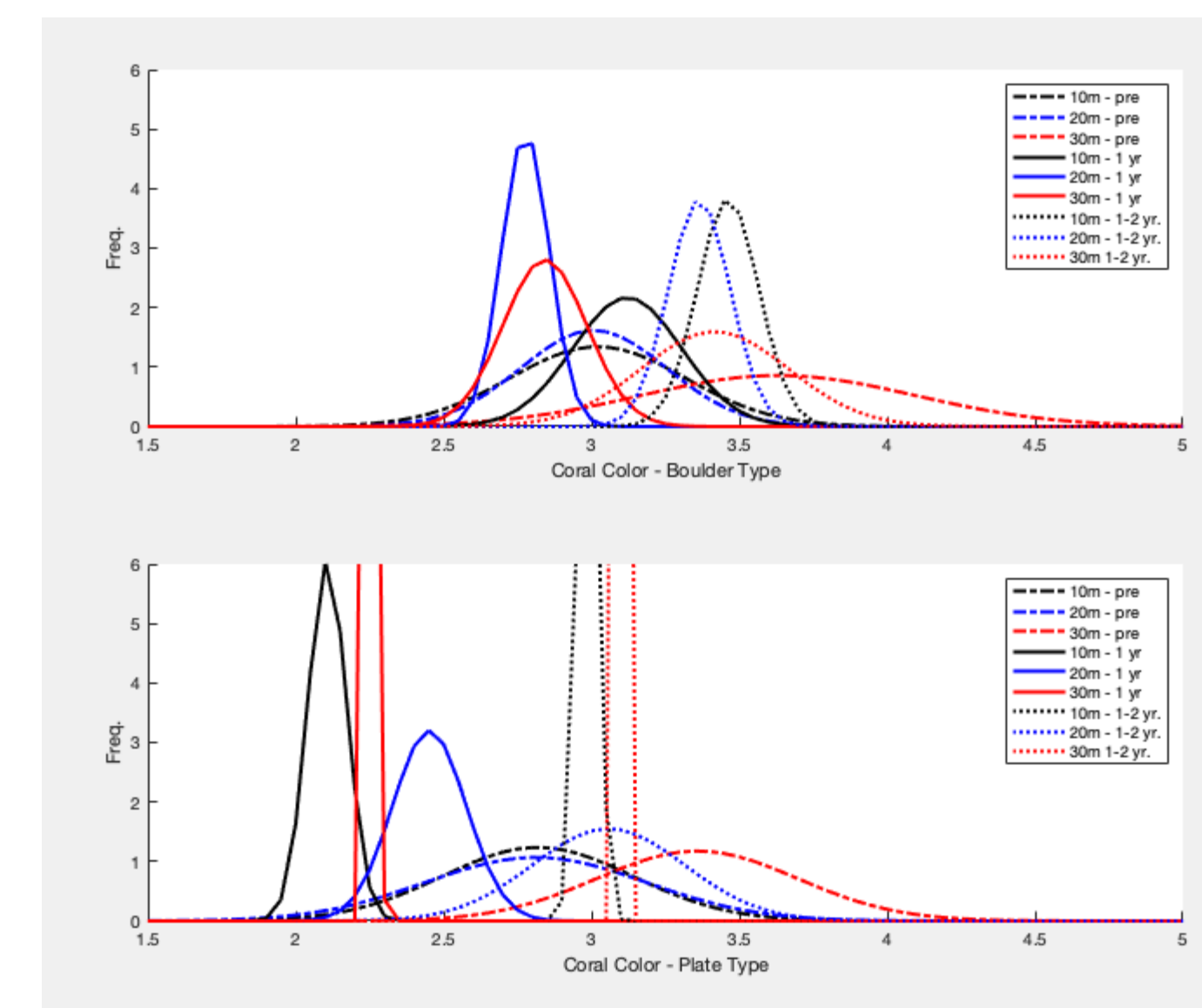
Study site including locations of the 8 snorkel and dive sites where samples were taken.

## RESULTS



Boulder corals were found to be significantly healthier after the GBE than before the GBE. Plate corals were also found to return to a healthy state, but not that of the boulder corals. However, all coral types were found to return to a healthy 1-2 years following the GBE.

Shift in CoralWatch values shown at different depths pre-GBE, 1 year following GBE spike and 12-24 months following the spike.



SSTA was found to be significantly different between 2013 and 2015, 2014 and 2016, 2015 and 2017.

Coral Species	Number of times this species was surveyed	Coral Type	Species	Number of times this species was surveyed	Coral Type
<i>Acropora cervicornis</i>	5	Branching	<i>Sophyhalma rigidus</i>	13	Boulder
<i>Acropora palmata</i>	3	Branching	<i>Madraca surmirensis</i>	1	Boulder
<i>Agavecaea planulata</i>	170	Plate	<i>Madraca mada</i>	46	Boulder
<i>Agavecaea fragilis</i>	1	Plate	<i>Madraca arabica</i>	12	Boulder
<i>Agavecaea humilis</i>	31	Plate	<i>Madraca nassidensis</i>	264	Boulder
<i>Agavecaea sp.</i>	1655	Plate	<i>Madraca albicans</i>	20	Soft
<i>Agavecaea tenuis</i>	92	Plate	<i>Orbicella annularis</i>	1159	Boulder
<i>Colophaea natans</i>	62	Boulder	<i>Myriophyllia binnertiana</i>	2	Boulder
<i>Dendrogya cylindrus</i>	19	Branching	<i>Palutaea carbonaria</i>	4	Boulder
<i>Dichocoenia stokesii</i>	117	Boulder	<i>Platygyria sp.</i>	1	Soft
<i>Diploria labyrinthiformis</i>	143	Boulder	<i>Porites adamoensis</i>	1001	Boulder
<i>Diploria sp.</i>	56	Boulder	<i>Porites diademata</i>	4	Boulder
<i>Eusmilia fastigiata</i>	165	Boulder	<i>Porites porites</i>	149	Boulder
<i>Favia fragum</i>	255	Boulder	<i>Sclerinia sp.</i>	1	Boulder
<i>Gorgonia sp.</i>	17	Soft	<i>Siderastrea radialis</i>	189	Boulder
			<i>Siderastrea siderea</i>	323	Boulder
			<i>Siderastrea sp.</i>	431	Boulder
			<i>Staphanoeca heteropora</i>	35	Boulder
			<i>Staphanoeca exulans</i>	9	Boulder



The potential for a particular coral species to recover from a stress event is largely determined by its environment. Reef fish are extremely important organisms that aid in reef resilience by controlling macroalgae populations and establishing nutrient transport between habitats.

*Agaricia sp.*, *Porites sp.*, and *Orbicella sp.* have become dominating corals on reefs in the TCI, as shown in the table displaying survey data.



## CONCLUSIONS

- Coral resilience to abnormally high thermal stress on South Caicos Island seems to be allowing boulder and plate corals, specifically, to thrive.
- Coral bleaching is definitely occurring and affecting all coral types, but some species are more resilient to stress than others: *Agaricia sp.*, *Orbicella sp.*, *Porites sp.*, and *Siderastrea sp.*
- Future studies should include an analysis of resilient endosymbiont types, as coral resilience has been linked to changing endosymbiont types during bleaching. Understanding this could provide incredible insight into emerging assisted evolution science.

## ACKNOWLEDGEMENTS

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