Southeast Florida large (>2 m) ESA threatened coral colony disease impact assessment

For

NOAA
CORAL REEF
CONSERVATION PROGRAM

Southeast Florida large (>2 m) ESA threatened coral colony disease impact assessment

Final Summary Report

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List of Acronyms

ESA	Endangered Species Act
FDEP	Florida Department of Environmental Protection
FRT	Florida Coral Reef Tract
FWC	Florida Fish and Wildlife Conservation Commission
NOAA CRCP	National Oceanic and Atmospheric Administration Coral Reef Conservation Program
NSU	Nova Southeastern University
SE FL	Southeast Florida

1. PROJECT DESCRIPTION

A coral disease event has devastated portions of the Florida Reef Tract since 2014 starting in southeast Florida (Walton et al., 2018; Precht et al. 2016). Many corals of many different species were affected including ESA threatened species (*Acropora cervicornis*, *Acropora palmata*, *Dendrogyra cylindrus*, *Orbicella annularis*, *Orbicella faveolata*, and *Orbicella franksi*) which have been identified as having dramatic declines in historical populations throughout the Caribbean and Western Atlantic. These coral species are the primary reef building species in the Atlantic and occur sparsely to rarely in SE FL except for *A. cervicornis* (Gilliam and Walker 2011; Gilliam and Walker 2012; Gilliam et al. 2013; Walker and Klug 2014; D'Antonio et al. 2016; Walker and Hoyt In prep). The result of this outbreak was widespread mortality for many individuals, reducing the already low amount of coral on the reefs in southeast Florida (Precht et al. 2016).

In 2015, a study was completed to assess and document the baseline conditions of the largest and oldest corals of the southeast Florida reefs which are analogous to the "redwoods" of our nearshore community (Walker and Klug 2015). This study found 115 live and 70 dead stony corals greater than or equal to two meters diameter in the nearshore habitats of the Broward-Miami region very close to the largest human populations in southeastern Florida. The majority of the living corals were *Orbicella faveolata* (78.2%), followed by *Montastrea cavernosa*, *Siderastrea siderea*, *Colpophyllia natans*, *Orbicella annularis*, and *Pseudodiploria strigosa*. Eight *O. faveolata* were larger than 4 m diameter. In SE FL, *Orbicella spp.* extension rates average 0.5 cm per year (Dodge and Helmle 2003) which equates to 1 cm per year increase in total colony diameter. Thus, corals greater than 2 meters in diameter are hundreds of years old. Aged at over 320 years (Richard Dodge, pers. comm), these are some of the oldest living organisms in SE FL, terrestrial or marine.

The largest corals in a population are the oldest and have exponentially more reproductive capacity than smaller ones, making them the most important demographic of their respective species. Their age illustrates their resilience because they have persisted through the multitude of anthropogenic impacts and stressors that have occurred in the region since the western colonization of Florida over 100 years ago. Their size also provides habitat for a diverse and abundant assemblage of fish. A large proportion of the large corals are in the relatively flat, nearshore habitats, and thus provide an oasis for many fish species.

Bleaching and disease are a sign of living coral stress. Walker and Klug (2015) found that over half (51%) of the colonies had at least partial bleaching and/or disease. Twenty-three percent of the colonies had active disease. Twenty-three percent had some bleaching and twenty-one percent had some paling. Eight percent of the colonies had both disease and bleaching.

The diseases visually observed in Walker and Klug (2015) were white plague (likely stony coral tissue loss disease (SCTLD)), white band, black band, dark spot and possibly Caribbean yellow band. Coral diseases were very difficult to identify precisely in the field and require histological and genetic analyses. Precht et al. (2016) described the main disease occurring throughout the region as white plague (SCTLD). Walker and Klug found some that were particularly unusual

based on some visual observations by Esther Peters, but without histopathology and microbiology we can't know the etiologic agent for sure (Esther Peters, pers. comm.).

In addition to the fast progressing disease killing corals, Walker and Klug (2015) noted bleaching recovery in less than two months which seemed to coincide with a period of noticeable cooler water temperatures. They also reported multiple years of corals bleaching and recovering for several colonies. Disease was not noted to occur in corals between years through their initial photo and video documentation evaluations, but it was observed in 2015 when not present in 2014. Dark spot disease developed in two large *S. siderea* colonies between 2014 and 2015. SCTLD also killed about 30% of the live tissue on an *O. faveolata* colony that appeared healthy in 2014.

Inventorying the SE FL large coral population and understanding how they were affected by SCTLD was critical to the management of the oldest and most resilient coral demographic in the SE FL coral reef ecosystem. Temporal assessments allow the identification of resilient individuals that recover from bleaching events and/or that are resistant to disease during the SCTLD epidemic. These resilient corals might give clues to the ability of certain corals to recover from adversity and help in the restoration of the species across the reef tract. Further, large coral colonies are more fecund, giving an exponentially increased amount of reproductive output also making these colonies particularly important in the species' recovery.

Recognizing the importance of this population, NOAA funded this work to assess the condition of the known large coral population to understand the impact of SCTLD and to recon additional targets that had not been assessed to build the large coral inventory. This report documents those activities.

2. METHODOLOGY

All 115 large live corals identified in Walker and Klug (2015) were assessed by SCUBA divers using the same methodology and personnel to compare the current coral condition to the previous baseline assessment. High resolution photographs and video were taken of the coral as a permanent record of its condition in the same orientation from above and at each main direction of the compass: north (0°), east (90°), south (180°), and west (270°). At many sites, qualitative video was collected by a diver swimming around with an underwater camera.

Additionally, hundreds of new targets were determined through a visual analysis of aerial photography and high-resolution bathymetry and visited through reconnaissance. These were added to the database to increase the known large coral inventory.

Coral condition was visually estimated using methods and personnel of Walker and Klug (2015). A diver hovered above the colony and estimated the percentage of live tissue, diseased tissue, bleached tissue, recent mortality, and old mortality. The presence of paling and the number of tissue isolates was also recorded.

Each live coral was measured in two ways. First by a rigid meter stick to measure height alongside of the coral, the linear distance along the longest axis, and the widest axis perpendicular to the first axis. Then by a flexible measuring tape stretched along the same axes to measure the distance over the surface of the coral.

No diseased and/or healthy tissue samples were requested so we did not collect any.

The 2018 assessment data of the 115 previously surveyed corals were compared to the baseline information in Walker and Klug (2015) to evaluate changes in coral condition. Corals with active disease were identified and presented to FDEP.

3. RESULTS

In total, we visited 344 target locations in our field efforts (Figure 1; Table 1). We found 155 corals > 2m diameter with at least some living tissue, 142 corals that died sometime in the past, and 30 colonies that were smaller than our size cut-off. Six sites were artificial structures and we found nothing at eleven sites. Of the 297 colonies > 2m diameter, 33% had between 5% and 100% live tissue, 14% were almost completely dead, 5% were diseased, and 48% were dead (Figure 2).

Table 1. Target visitation summary

All Targets, all assessments

	Category	Number	Total
Corals	Live (5-100%)	98	155
	Live (<5%)	42	
	Diseased	15	
	Dead	142	142
	1.5 - 2m	30	30
Artificial	Pipe	1	6
	Shipping crate	3	
	Anchor	2	
	Did not find	11	
	Grand Total	**344**	

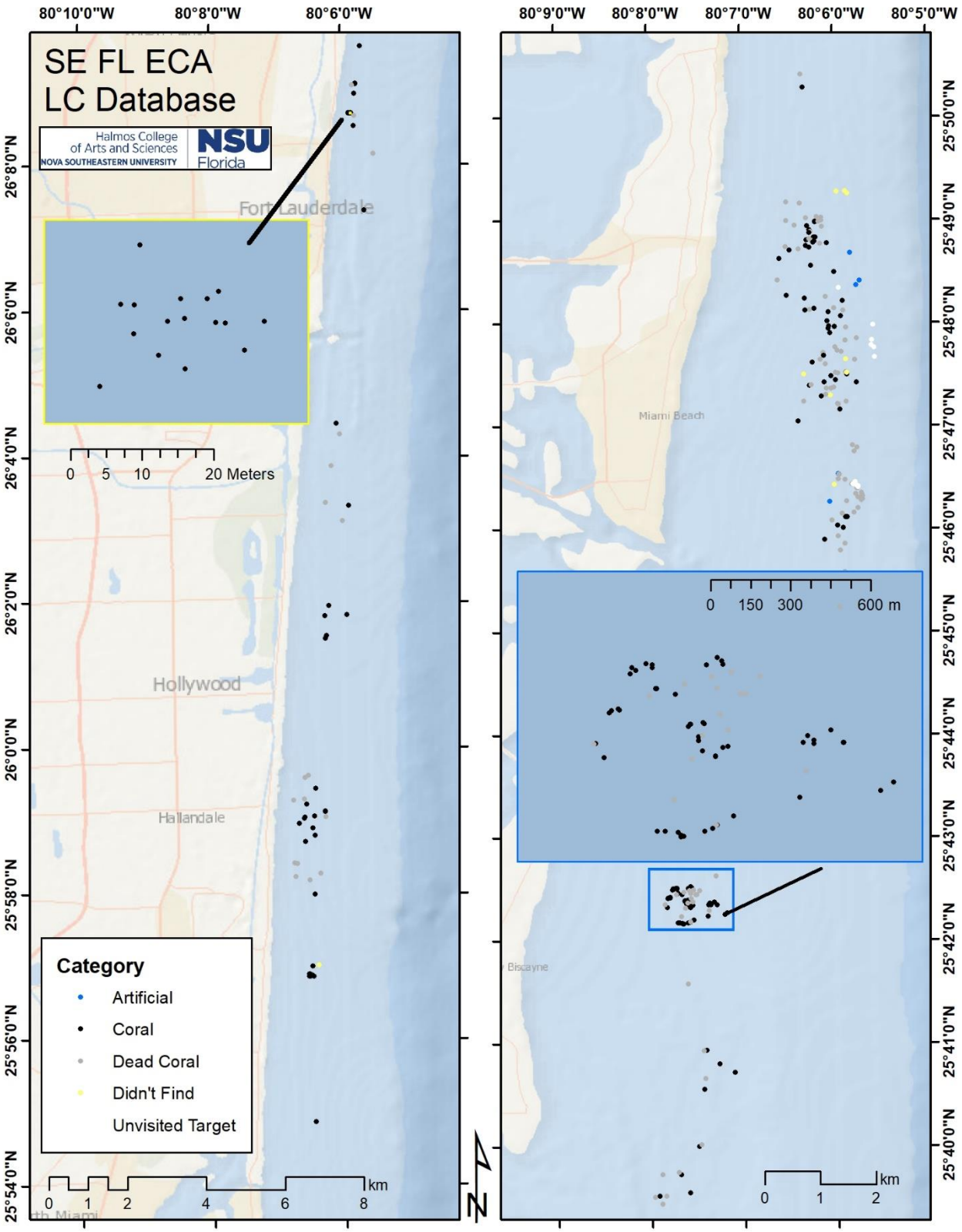


Figure 1. Map of all sites visited to date.

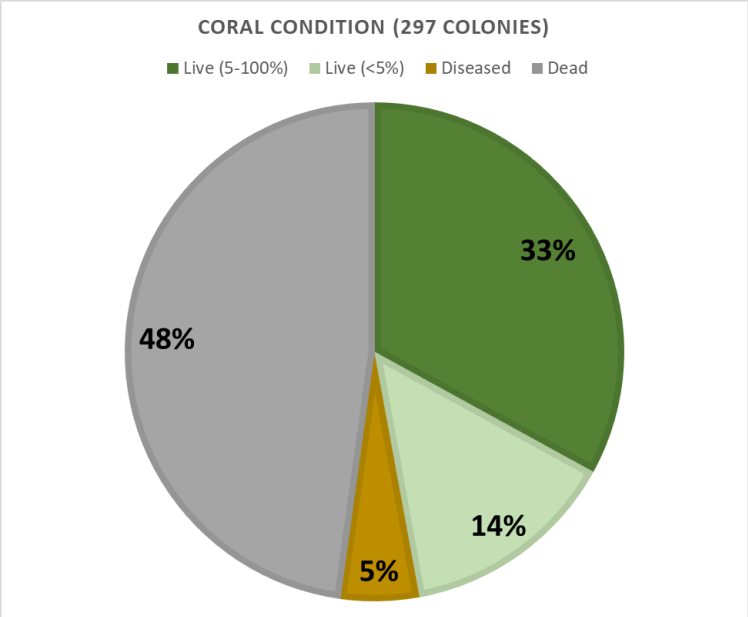


Figure 2. Coral condition by category.

Of the 115 previous corals, we could not find LC-102. Therefore, the change in condition of 114 large corals was captured. Losses in the percentage of live tissue was extensive (Figure 3). The number of corals with 10-25% mortality dropped from 31 to 19 while the number of colonies with 50-75% mortality increased from 25 to 50. Nine large corals completely died within the three-year timespan.

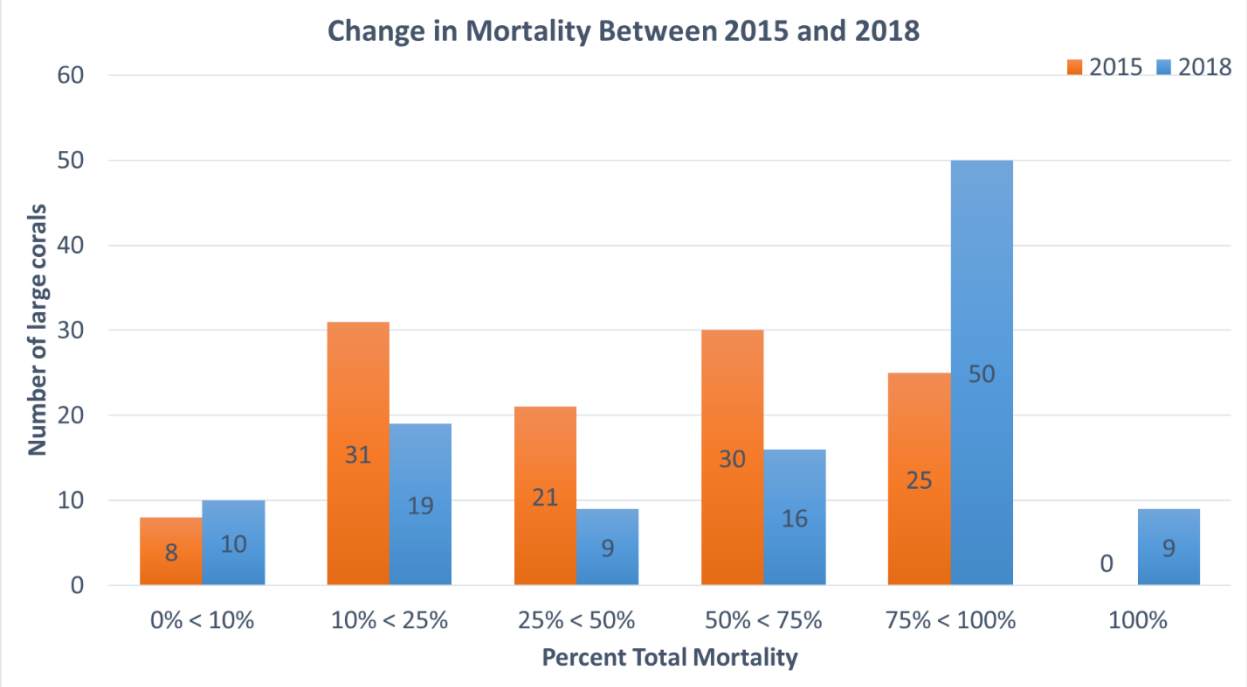


Figure 3. Changes in Live Tissue cover between 2015 and 2018.

4. SUMMARY

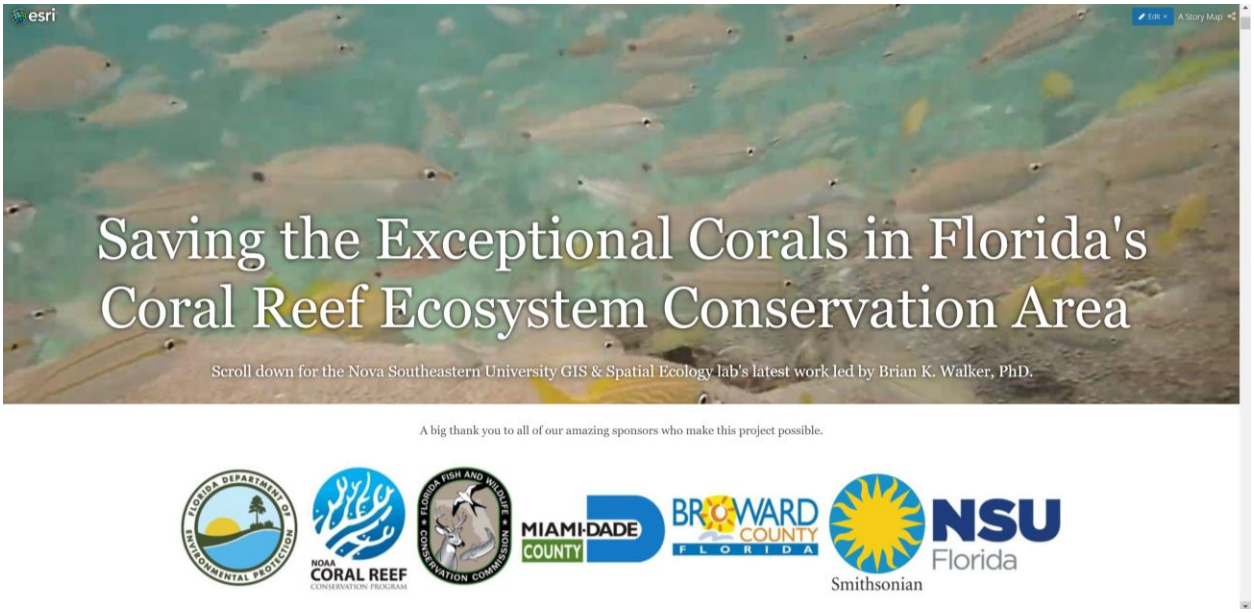
This project provided the impetus that led to significant additional funding. The large number of corals found during this effort substantially increased the number of known live colonies providing a better understanding of the large coral population in SE FL. The comparison in condition of the corals visited in 2015 indicated substantial loss of live tissue. Even though most of the large corals lost live tissue, there are still many corals worth monitoring closely and applying successful disease intervention techniques. Catching the disease early before it spreads across large portions of the colony will save significant amounts of tissue and may leave the coral more resistant to fighting off new infections.

Another output of this project was a publicly accessible story map that explains the work on the large corals and presents two maps, one of the 2015 colonies and a present-day map. It is a website that explains the SE FL large coral projects including their inventory, condition, and disease intervention work. Since new information is collected regularly on a subset of the corals, it has required updating the data analyses section. Below are a few screen shots of the story map. It has been released for public access at the following URLs:

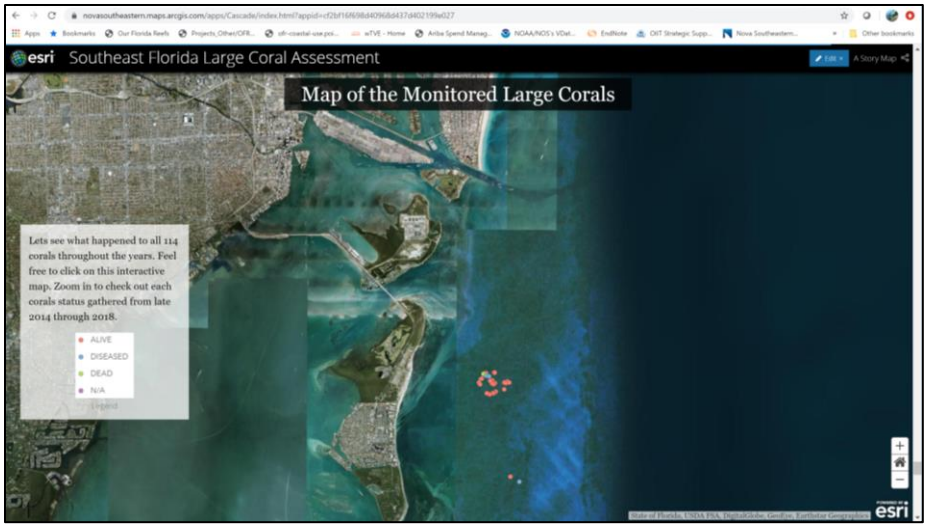
https://novasoutheastern.maps.arcgis.com/apps/Cascade/index.html?appid=cf2bf16f698d40968d437d402199e027

http://www.miamidade.gov/environment/reefs.asp

DEP website: Coral ECA subpage and Reconnaissance and Intervention - Coral Disease Response Team subpage.



Screen shot of the start of the Large Coral Story Map title screen.



Screen shot of the start of the interactive Large Coral Map in the Story Map.

5. REFERENCES

D'Antonio NL, Gilliam DS, Walker BK (2016) Investigating the spatial distribution and effects of nearshore topography on Acropora cervicornis abundance in Southeast Florida. PeerJ 4:e2473

Dodge R, Helmle K (2003) Past Stony Coral Growth (Extension) Rates on Reefs of Broward County, Florida: Possible Relationships with Everglades Drainage Joint Conference on the Science and Restoration of the Greater Everglades and Florida Bay Ecosystem Palm Harbor, Florida

Gilliam D, Brinkhuis V, Ruzicka R, Walton C (2013) Southeast Florida Coral Reef Evaluation and Monitoring Project 2012 Year 10 Final Report., Miami Beach, FL 53

Gilliam DS, Walker BK (2011) Benthic Habitat Characterization for the South Florida Ocean Measurement Facility (SFOMF) Protected Stony Coral Species Assessment. Prepared for Seaward Services, Inc, Fort Lauderdale, FL 54

Gilliam DS, Walker BK (2012) Shallow-Water Benthic Habitat Characterization and Cable/Benthic Activity Impact Assessment for the South Florida Ocean Measurement Facility (SFOMF). Prepared for Commander Naval Surface Warfare Center, Carderock Division, West Bethesda, MD 75

Precht WF, Gintert BE, Robbart ML, Fura R, van Woesik R (2016) Unprecedented Disease-Related Coral Mortality in Southeastern Florida. Scientific Reports 6:31374

Walker B, Klug K (2014) Southeast Florida shallow-water coral reef community baseline habitat mapping and characterization of mapped communities. Florida DEP Coral Reef Conservation Program report, Miami Beach, FL 83

Walker B, Hoyt R (In prep) Mapping and characterizing the condition of previously known and newly identified large dense Acropora cervicornis patches in southeast Florida

Walker BK, Klug K (2015) Southeast Florida Large Coral Assessment 2015. Florida DEP Coral Reef Conservation Program report, Miami Beach, FL 151