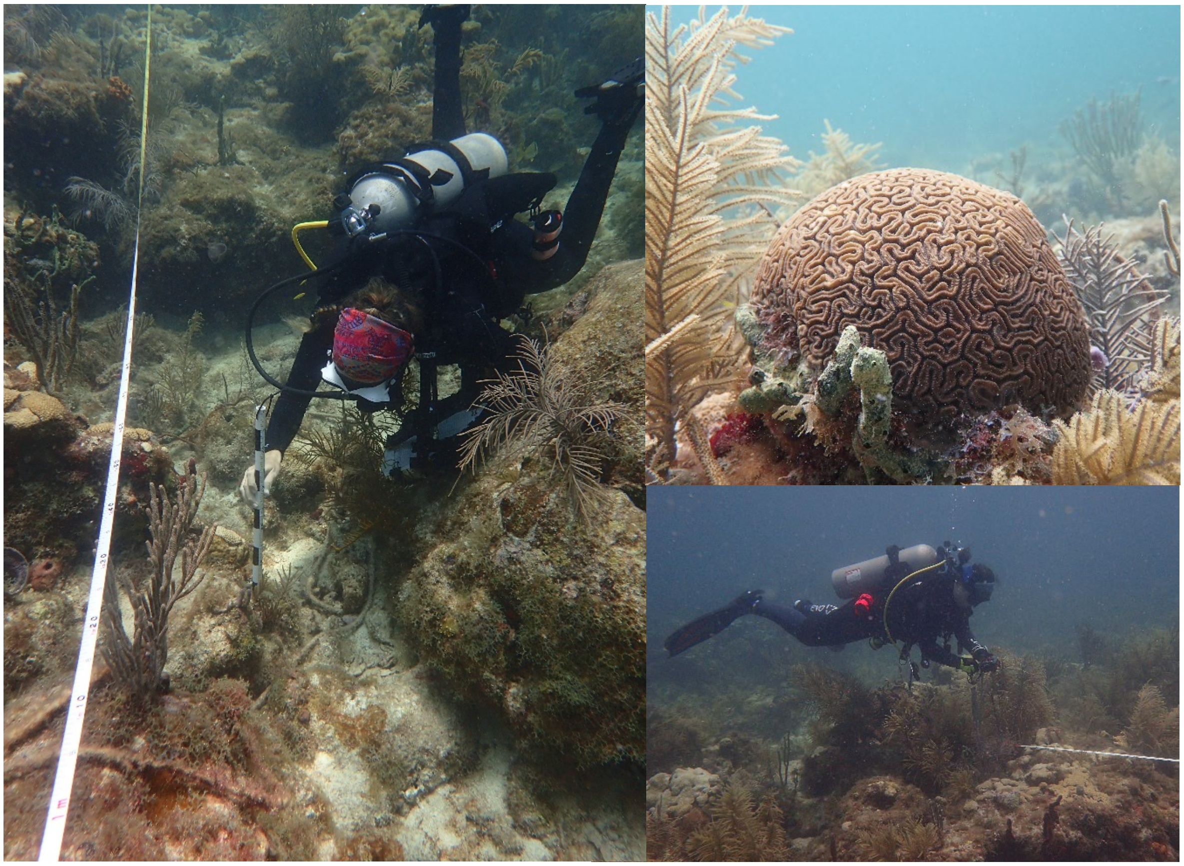
Southeast Florida Coral Reef Evaluation and Monitoring Project



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Southeast Florida Coral Reef Evaluation and Monitoring Project

2020 Year 18 Final Report

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LIST OF ACRONYMS

CRCP …………………………………..………. (DEP) Coral Reef Conservation Program
CREMP …………………..…………..…. Coral Reef Evaluation and Monitoring Program
DEP ………………………...……..…… Florida Department of Environmental Protection
FKNMS ………………….……………………... Florida Keys National Marine Sanctuary
FWC …………………….………. Florida Fish and Wildlife Conservation Commission
FWRI ……………………..……………………….....Fish and Wildlife Research Institute
SECREMP ……………….……. Southeast Coral Reef Evaluation and Monitoring Project
SCTLD ……………………….……………...………. Stony Coral Tissue Loss Disease
FCR ……………………….……………………………..…… Florida's Coral Reef
Coral ECA ……………..…. Southeast Florida Coral Reef Ecosystem Conservation Area
LTA……………………………………………….……………………Live Tissue Area

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Executive Summary

The Southeast Florida coral reef ecosystem is offshore a highly urbanized mainland (population > 6 million) influenced by numerous human activity-related local and global stressors. To document changes potentially related to increasing stressors, the Florida Department of Environmental Protection (DEP) working with Florida Fish and Wildlife Conservation Commission (FWC) and Nova Southeastern University (NSU) initiated a long-term annual coral reef monitoring program in 2003 along the Southeast Florida coast. In order to provide continuity in monitoring efforts along all of Florida's Coral Reef (FCR), the Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP) was established as an expansion of the FWC managed Coral Reef Evaluation and Monitoring Project (CREMP) in the Florida Keys. SECREMP provides local, state, and federal resource managers annual reports on the status and condition of the Southeast Florida (Miami-Dade, Broward, Palm Beach, and Martin counties) coral reef system as well as information on temporal changes in resource condition. Survey methods include photographic transects to quantify percent cover of major benthic taxa (stony corals, sponges, octocorals, macroalgae, etc.) and demographic surveys to quantify abundance, size distribution, and overall condition of stony corals, octocorals, and the giant barrel sponge. SECREMP is also a partnership between DEP, FWC, and NSU that facilitates collaboration and knowledge sharing benefiting coral reef ecosystems nationwide.

The Southeast Florida Coral Reef Ecosystem Conservation Area (Coral ECA) experienced significant stony coral assemblage declines across the study period, with significant losses determined for all stony coral metrics examined (cover, Live Tissue Area (LTA), and density). These losses were predominately driven by a significant increase in Stony Coral Tissue Loss Disease (SCTLD), which peaked in 2016 but has subsequently decreased in prevalence every year since. As regional disease prevalence has dropped to < 1% in 2018, 2019, and 2020, total loss from this event can begin to be quantified, and recovery can start to be addressed. No significant decline in stony coral LTA or density was identified from 2018 through 2020, and density in 2020 was significantly higher than all previous years. However, from 2015-2018, those species susceptible to SCTLD lost >50% of regional LTA, while low susceptible species did not experience any significant change in LTA. This shift in species contribution to the stony coral assemblage could have a lasting impact as recovery begins to occur. Although the majority of SCTLD susceptible species had juvenile colonies in the sample sites, these juveniles were dominated by generalist, low relief species. It does not appear this disease event has had any significant impact on the octocoral and barrel sponge, *Xestospongia muta*, communities.

The chronic nature of disturbances to and the significant economic value of the coral reefs within the Southeast Florida Coral Reef Ecosystem Conservation Area requires comprehensive, long-term monitoring to define and quantify change and to help identify threats to the ecosystem. Both continual region-wide monitoring (i.e., SECREMP) and improved incident-specific monitoring are necessary if resource managers are to develop sound management plans for coral reefs that allow continued use and realization of the economic value of these fragile marine ecosystems. The value for a long-term region-wide monitoring program is highlighted by the information in this report, which will be vital in planning and monitoring the potential future recovery of this resource.

Introduction

Florida's Coral Reef (FCR) is an important aesthetic and economic resource that extends approximately 577 km from the Dry Tortugas in the south to the St. Lucie Inlet in the north. The northern third of this reef system is comprised within the Southeast Florida Coral Reef Ecosystem Conservation Area (Coral ECA) extending from the northern boundary of Biscayne National Park in Miami-Dade County to the St. Lucie Inlet in Martin County (approximately 170km) and within 3 km off the mainland Atlantic coast of Florida. These reefs support diverse benthic organisms and fish communities. Additionally, Coral ECA reef habitats are an important economic asset for the region. The reef system has been estimated to protect nearly 6,000 people, over $500 million in infrastructure and $300 million in economic activity from storm-related flooding (Storlazzi et al. 2019). These reefs have also been estimated to generate more than $3 billion in sales and income and support more than 35,000 jobs (Johns et al. 2001, 2004). While the reefs within the Coral ECA are clearly an important resource their location offshore a highly urbanized area (population > 6 million) drives ever-increasing human activity-related stress on the reefs.

Prior to 2003, most coral reef monitoring efforts (e.g., Gilliam et al. 2015) along the mainland southeast coast were associated with impact and mitigation studies (dredge impacts, ship groundings, pipeline and cable deployments, and beach renourishment). The temporal duration and spatial extent of these monitoring efforts were limited, being defined by an activity permit and focused on monitoring for effects specific to a given impact. In 2003, the Florida Department of Environmental Protection (DEP) was awarded funding for the inception of a long-term coral reef monitoring program along the Southeast Florida coast. Prior to this the primary focus for long-term coral reef monitoring was limited to the Florida Keys and Dry Tortugas in Monroe County. Coral reef monitoring efforts in the Keys grew with the establishment of the Florida Keys National Marine Sanctuary (FKNMS) in 1990. Since 1996, the Coral Reef Evaluation and Monitoring Project (CREMP) has documented changes in reef resources along the Keys portion of the Florida's Coral Reef (FCR) from Key West to Carysfort Reef (Ruzicka et al 2010; Ruzicka et al. 2013). In 1999 the project was expanded to include sites in the Dry Tortugas. In order to provide continuity in monitoring efforts along the FRC from the Keys through Southeast Florida, DEP established the Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP) as an expansion of CREMP. The goal of SECREMP has been to provide local, state, and federal resource managers an annual report on the status and condition of the Southeast Florida (Miami-Dade, Broward, Palm Beach, and Martin counties) reef system as well as information on temporal changes in resource condition.

Survey Sites

Off the mainland coast of Southeast Florida from Miami-Dade County north to central Palm Beach County, in particular offshore Broward County, the reef system within the Coral ECA is described as a series of linear reef complexes (referred to as reefs, reef tracts, or reef terraces) running parallel to shore (Moyer et al. 2003; Banks et al. 2007; Walker et al. 2008) (Figure 1). The Inner Reef (also referred to as the "First Reef") crests in 3 to 7 m depths. The Middle Reef ("Second Reef") crests in 12 to 14 m depths. A large sand area separates the Outer and Middle Reef complexes. The Outer Reef ("Third Reef") crests in 15 to 21 m depths. The Outer Reef is the most continuous reef complex, extending from Miami-Dade County to northern Palm Beach County. Inshore of these reef complexes, there are extensive nearshore ridges and colonized pavement areas. From Palm Beach County to Martin County, the reef system is comprised of limestone ridges and terraces colonized by reef biota (Walker and Gilliam 2013). Since the inception of SECREMP sites have been spread across these four habitats.

SECREMP began monitoring in 2003 at 10 sites, three each in Palm Beach and Miami-Dade counties and four in Broward County, including a nearshore monotypic stand of *Acropora cervicornis*. In 2006, two sites were added in Martin County extending efforts to the northernmost area of FCR. Four additional sites were added in 2010, two each in Palm Beach County and Miami-Dade County. Finally, in 2013 six sites were added, three each in Broward and Miami-Dade counties. Currently SECREMP monitors 22 sites from Miami-Dade County to Martin County distributed across all four described habitats. Figures 2 and 3 show the location of the 22 current sites along the Southeast Florida coast. Project sampling occurs annually between May and August. Table 1 provides reef type, depths, locations, and the 2018 sample date of each of the SECREMP sites.

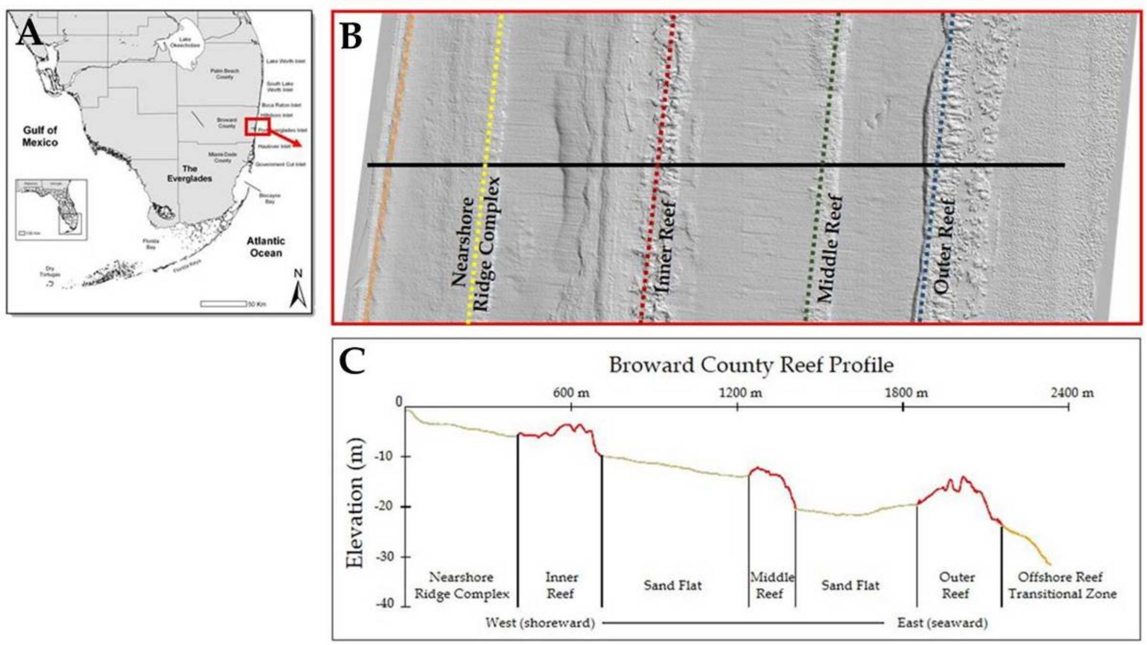

Figure 1. View of the Southeast Florida coastline. Panel A is a view of southern Florida showing an area off Broward County in red that corresponds to Panel B which is sea floor bathymetry from LIDAR (Light Detection and Ranging) data. The black line in Panel B shows the location of a bathymetric profile illustrated in Panel C.

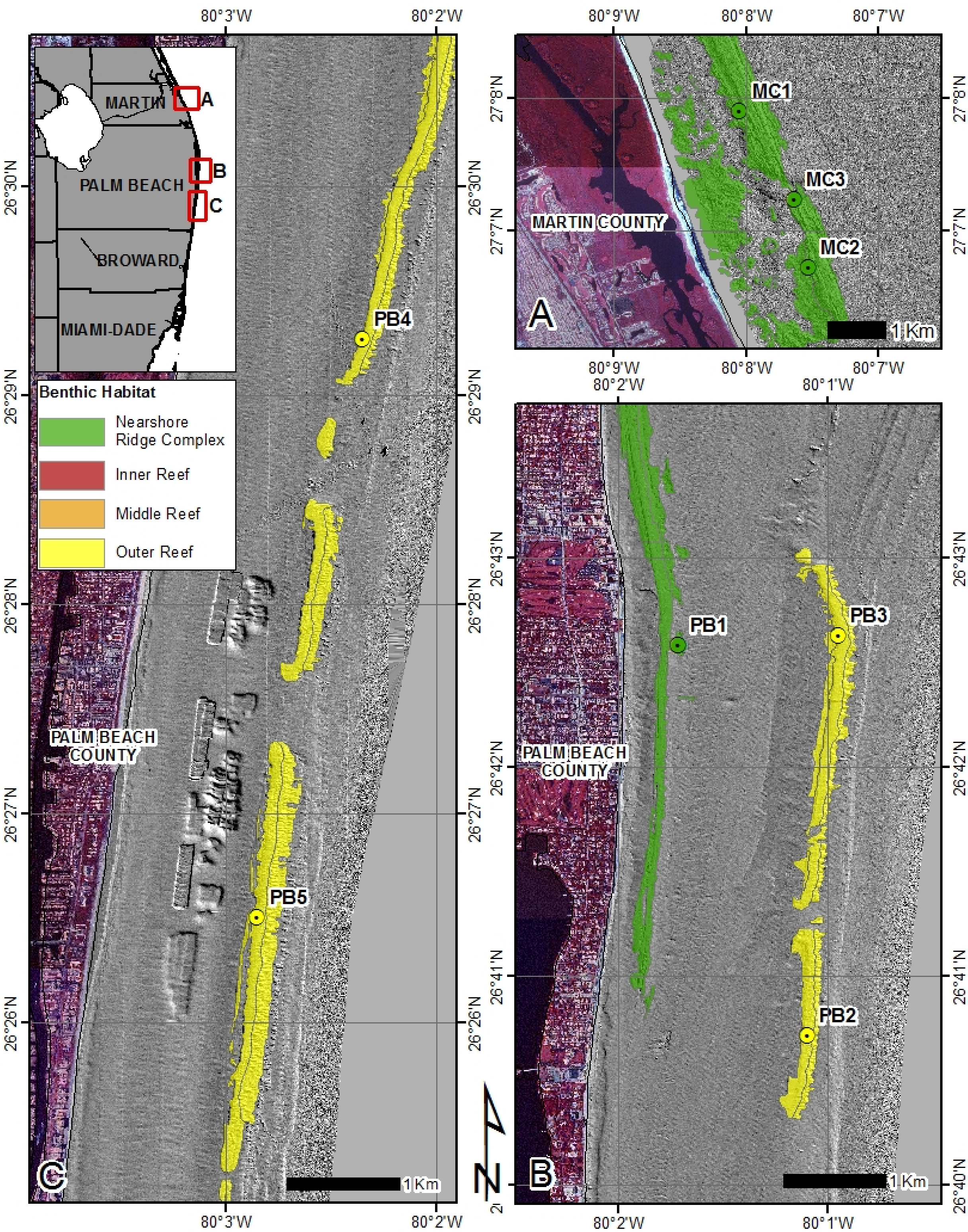

Figure 2. Site location and habitat map of Martin (Panel A) and Palm Beach (Panels B and C) counties.

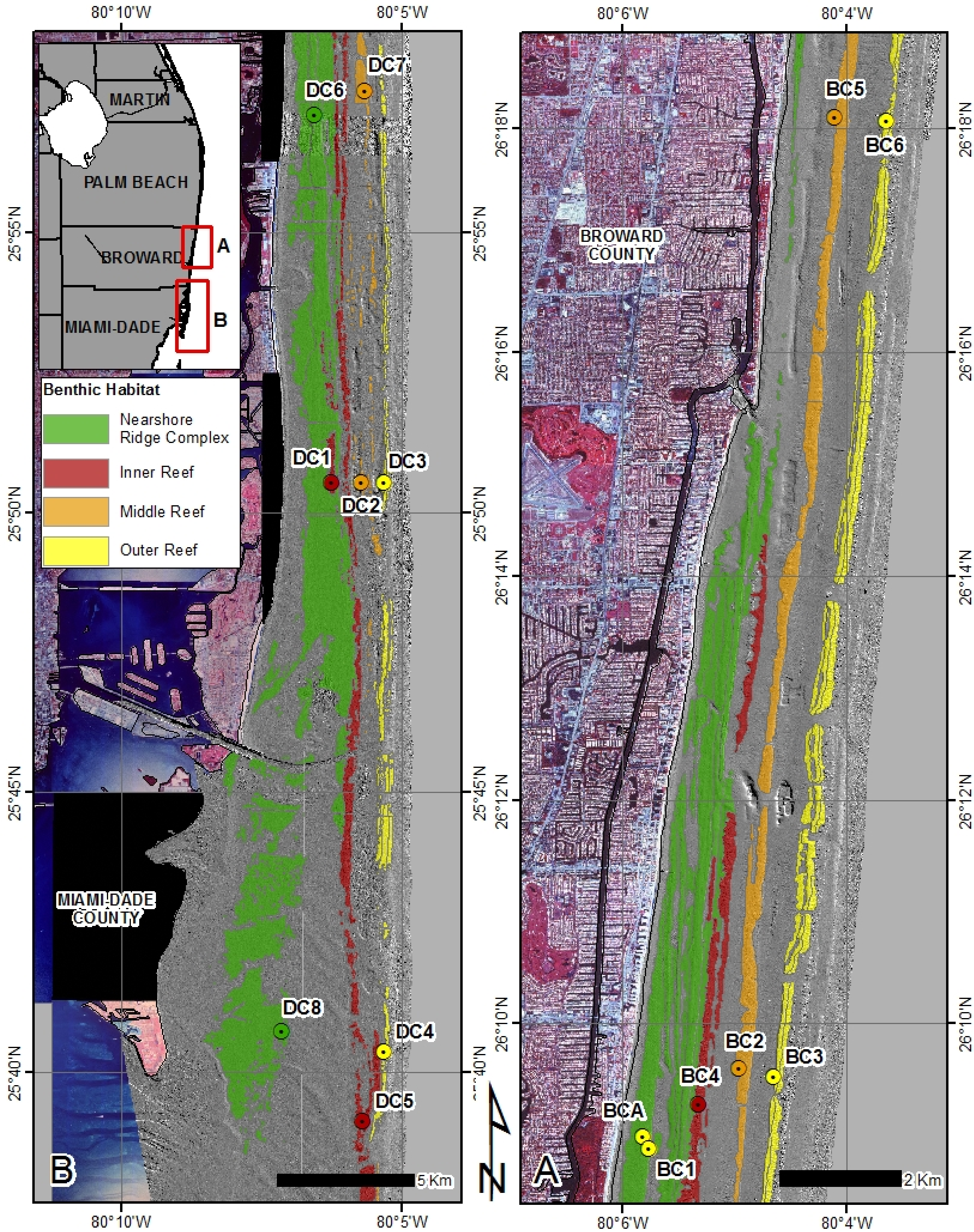

Figure 3. Site location and habitat map of Miami-Dade (Panel B) and Broward (Panel A) counties.

Table 1. Monitoring site reef types, depth (ft), location, and 2018 sample date (DC = Miami-Dade County; BC = Broward County; PB = Palm Beach County; MC = Martin County) (NRC = Nearshore Ridge Complex).

Site Code	Reef Type	Depth	Latitude (N)	Longitude (W)	Sample Date
DC1	Inner	25	25° 50.530’	80° 06.242’	10-Jul
DC2	Middle	45	25° 50.520’	80° 05.704’	10-Jul
DC3	Outer	55	25° 50.526’	80° 05.286’	5-Aug
DC4	Outer	41	25° 40.357’	80° 05.301’	8-Jul
DC5	Inner	24	25° 39.112’	80° 05.676’	8-Jul
DC6	NRC	15	25° 57.099’	80° 06.534’	6-Jul
DC7	Middle	55	25° 57.530’	80° 05.639’	6-Jul
DC8	NRC	15	25° 40.707’	80° 07.111’	9-Jul
BCA	NRC	25	26° 08.985’	80° 05.810’	9-Jun
BC1	NRC	25	26° 08.872’	80° 05.758’	9-Jun
BC2	Middle	40	26° 09.597’	80° 04.950’	10-Aug
BC3	Outer	55	26° 09.518’	80° 04.641’	10-Aug
BC4	Inner	30	26° 08.963’	80° 05.364’	27-May
BC5	Middle	45	26° 18.100’	80° 04.095’	27-Jul & 4-Aug
BC6	Outer	55	26° 18.067’	80° 03.634’	4-Aug
PB1	NRC	25	26° 42.583’	80° 01.714’	28-Aug
PB2	Outer	55	26° 40.710’	80° 01.095’	31-Aug
PB3	Outer	55	26° 42.626’	80° 00.949’	30-Sep
PB4	Outer	55	26° 29.268’	80° 02.345’	27-Jul
PB5	Outer	55	26° 26.504’	80° 02.854’	6-Aug
MC1	NRC	15	27° 07.900’	80° 08.042’	1-Jun
MC2	NRC	15	27° 06.722’	80° 07.525’	1-Jun

Methods

Each site consists of four monitoring stations demarcated by stainless steel stakes that are permanently placed in the substrate. Each station is 22 meters in length and has a north-south orientation, which is generally parallel to the reef tracts of Southeast Florida. Survey transects are delineated by a fiber glass tape stretched between the stainless-steel stakes at either end of a station. *In situ* sampling included photo transects at all site stations sampled each year (2003-2020). Starting in 2013, a stony coral population survey, an octocoral population survey, and a *Xestospongia muta* population survey, were conducted along the same transect covering a similar area of the substrate (Figure 4).

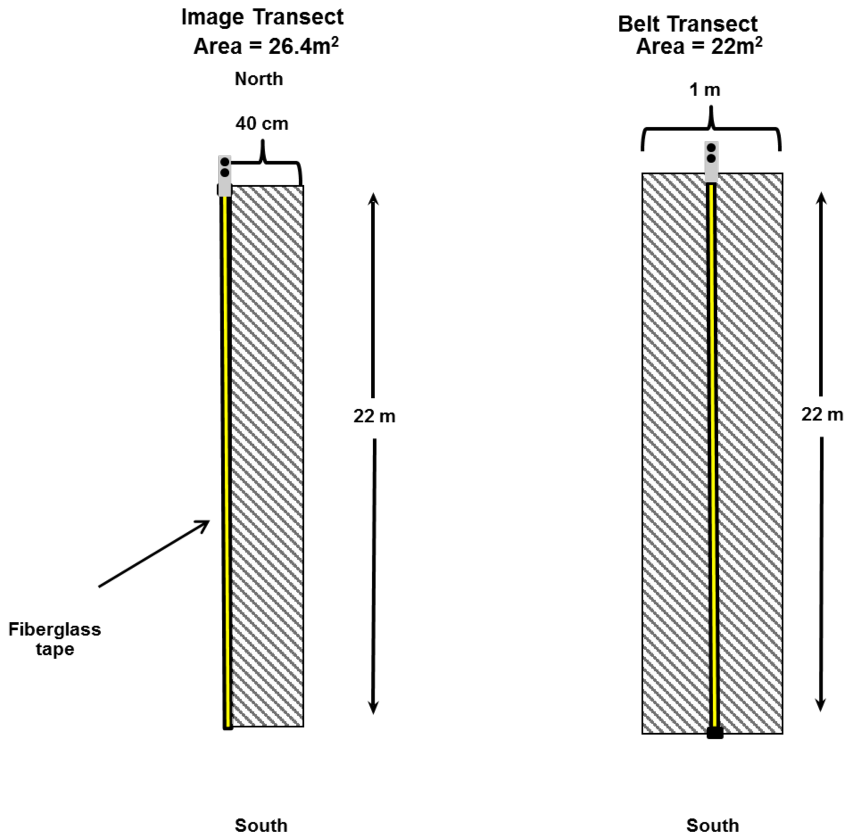

Figure 4. Layout of each SECREMP station showing the areas (hatched) within which the image and belt transect data were collected (note the gorgonian belt area is 1 m x 10 m).

Image Transects

Transect images were taken at all stations at all sites sampled each year (2003-2020). All transect images were taken to the east of the fiberglass tape delineating a transect. In 2020, the images were taken using an Olympus TG-4 tough digital camera. Each image was captured at ~40 cm above the reef substrate to yield images approximately 40 cm wide by 30 cm in height. A constant distance above the substrate was maintained using an aluminum bar affixed to the bottom of the camera housing. Benthic features seen in the top border of the camera viewfinder and the fiberglass tape were used as visual reference points to take abutting images with minimal overlap. This results in a transect consisting of about 60 images and covering an area of approximately 0.4 m x 22 m.

In the lab, images were formatted for PointCount '99 image analysis software. Fifteen random points were overlaid on each image, which is consistent with CREMP protocol. Underneath each point, select benthic taxa were identified to species (e.g. stony corals, *Gorgonia ventalina*, *Xestospongia muta*), genus (e.g. *Dictyota* spp., *Halimeda* spp., and *Lobophora* spp), or higher taxonomic levels (e.g. encrusting or branching octocoral, crustose coralline algae, zoanthid, sponge, and macroalgae). Uncolonized substrate was identified as sand or substrate (consolidated pavement or rubble). After all images were analyzed, the data were checked for quality assurance and entered into the Microsoft Access database managed by FWC.

Stony Coral Demographic Survey

Stony coral population surveys were performed at all site stations starting in 2013. Divers conducted a 1 m x 22 m belt transect from north to south along the transect tape identifying every stony coral colony to species (Figure 4). From 2013-2017, all colonies ≥ 4 cm in diameter were identified to species and the maximum diameter and the maximum height, perpendicular to the plane of growth, were measured. Each colony was then visually assessed for the presence of diseases, bleaching and other conditions (i.e. predation, damselfish, Clionaids etc.). Where these conditions resulted in partial mortality the percentage was visually estimated. Diseases include those with conditions that resulted in tissue mortality (i.e. Stony Coral Tissue Loss Disease (SCTLD) or black band disease) as well as conditions that may not visually result in tissue mortality (i.e. dark spot syndrome and tissue growth anomalies). Mortality was considered ''recent'' if the corallite structure was clearly distinguishable and there was minimal overgrowth by algae or other fouling organisms. Otherwise, mortality was classified as ''old''. In 2018, the minimum colony size for demographic data was reduced to ≥ 2 cm in diameter. Also starting in 2018, colonies < 2 cm were identified to lowest taxonomic level possible and tallied at each station. However, for this report, only colonies ≥ 4 cm in diameter were included in the demographic data analysis. All corals < 4 cm in diameter were presented as tallied data only. For *Millepora alcicornis* (fire coral) only colony presence or absence was recorded.

Octocoral Demographic Survey

Octocoral population surveys starting in 2013, were also conducted at all stations but covered a reduced survey area. Divers conducted a 1 m x 10 m belt transect starting at the northernmost stake for each station. Octocoral surveys were completed in two parts. First, all octocoral colonies within the belt transect were counted, regardless of species, to provide a measurement of overall octocoral density. Second, for three target species, *Antillogorgia americana* (formerly *Pseudopterogorgia americana*)*, Eunicea flexuosa* (formerly *Plexaura flexuosa*)*,* and *Gorgonia ventalina*, all colonies within the belt transect were recorded, the maximum height was measured and the colony was visually assessed for the presence of disease, bleaching and/or various other conditions (e.g., predation, overgrowths, etc.). These species were selected because they are generally more confidently distinguishable in the field and are relatively abundant in their preferred reef habitat along Florida's Coral Reef. While colony conditions were assessed the condition data are not presented in this report.

Barrel Sponge Demographic Survey

A barrel sponge (*Xestospongia muta*) population survey, starting in 2013, was also conducted at each station. *Xestospongia muta* density was determined by counting all sponges within the 1 m x 22 m belt centered under the transect tape (Figure 4). For each sponge the maximum diameter, maximum base diameter, and maximum height were measured, and the sponge was visually assessed for the presence of disease, bleaching and other conditions (i.e. damage/injury, predation). The percent of the sponge affected by injury, disease, and/or bleaching was also recorded. Similar to octocorals, sponge conditions are not presented in this report.

Monitoring Site Temperature Record

The deployment of Onset (www.onsetcomp.com) temperature loggers has been part of the SECREMP sampling protocol since 2007. Temperature loggers were deployed at all existing sites annually and at new sites as they were established. Throughout the course of the project three models of temperature loggers have been deployed: StowAway TidbiT™, Hobo Pendant Temperature Data Logger, and Hobo Water Temp Pro v2. Two temperature recorders were deployed at each site and were replaced during each annual sampling event. Two loggers were deployed at each site in order to provide redundancy in case one logger failed or was lost. The loggers were programmed to record data at a sampling interval of two hours. The two loggers were attached approximately 10 cm off the substrate to the 'northern' stakes identifying Stations 1 and 2 at each site. Data from both loggers were downloaded. If data from both loggers were successfully downloaded, the data from the logger attached to Station 1 was reported.

Analyses

To provide an additional metric to evaluate changes to the stony coral community (only colonies ≥ 4 cm diameter because colonies 2-4 cm were only first included in 2018), stony coral colony width, height and percent mortality (sum of old and recent) were used to calculate total live tissue area (LTA) for each site for 2013-2020. Region-wide LTAs were also calculated for select stony coral species for 2013-2020. The LTA for each colony was calculated using the following equation:

$$SA = 2\pi\left(\frac{\mathrm{a^p}\left(\frac{1}{2}\mathrm{b}\right)^{\mathrm{p}} + \mathrm{a^p}\left(\frac{1}{2}\mathrm{b}\right)^{\mathrm{p}} + \left(\frac{1}{2}\mathrm{b}\right)^{\mathrm{p}}\left(\frac{1}{2}\mathrm{b}\right)^{\mathrm{p}}}{3}\right)^{\frac{1}{\mathrm{p}}}$$

This equation was modified from Knud Thomsen's formula for the estimated surface area (SA) of an ellipsoid. The original SA equation was multiplied by ½ to estimate the surface area of a coral as the equivalent of the top half of an ellipsoid. In this modified version a = maximum height of the colony, b = the maximum diameter of the colony, and p ≈ 1.6075, a constant yielding a relative error of at most 1.061%. Following calculation of the SA, the value was converted to LTA via the following formula:

$$LTA = SA\left(1 - \left(\frac{\%\ Old\ Mortality + \%\ Recent\ Mortality}{100}\right)\right)$$

Mortality was divided by 100 to convert to a proportion. Additionally, LTA was calculated in cm^2 and then converted to m^2.

Region-wide stony coral (colonies ≥ 4 cm diameter) density, LTA, and disease prevalence, octocoral density, and barrel sponge density were tested for differences between years 2013 – 2020. Additionally, stony coral species were grouped into SCTLD susceptibility groups, as defined in the SCTLD Case Definition (NOAA 2018). Those species defined as 'Highly Susceptible' and 'Intermediately Susceptible' were combined into Intermediately-High Susceptibility. Additional groups include species defined as 'Low Susceptible' and

'Presumed Susceptible' (NOAA 2018). These groups (Intermediately-High, Presumed, Low) were then examined for changes in LTA between years. Similar to stony corals, the three octocoral target species were tested for differences in density and mean height between years. For metrics meeting the assumptions of a repeated measures analysis of variance (ANOVA), the ANOVA was performed using the linear mixed-effects model (lme) and anova functions in the nlme (Pinheiro et al. 2017) and base R packages, respectively, in R (version 3.3.3 (2017-03-06)) (R Core Team 2017). The lme equation was "metric" ~ year with site as the repeated measure within Year. Following the lme function, the anova function was used to perform the ANOVA on the lme model. Significant differences between years for all metrics were identified by $p \leq 0.05$. For metrics analyzed via the lme and anova test and identified as significant, a general linear hypothesis (glht) and multiple comparisons "post-hoc" were performed to determine which years were significantly different. The "post-hoc" was performed using the glht function in the multcomp package (Hothorn et al. 2008) in R. Significant differences between years were identified by multiple comparison adjusted (Tukey single-step method) p-values ($p \leq 0.05$).

Region-wide stony coral disease prevalence was calculated for the 2013 – 2020 (colonies ≥ 4 cm diameter). Regional prevalence was calculated by taking the total number of diseased stony coral colonies for the region and dividing it by the total number of all stony coral colonies and multiplying by 100% to get prevalence as a percent. Site level prevalence values were calculated by dividing the total number of diseased colonies within a site by the total number of colonies and multiplying by 100% to get prevalence as a percent. Disease was then grouped into SCTLD or Other, where Other consisted of all other diseases recorded within sample sites: black band disease, yellow band disease, dark spot disease, white band disease (for acroporids) and rapid tissue loss (for acroporids).

Differences in stony coral, macroalgae, octocoral, and sponge percent cover between 2019 and 2020 at each site were tested using a two-way mixed model ANOVA, with year and site (stations nested within site) as fixed effects. Station data were pooled and square-root transformed. Significant differences within sites between years were identified using a Bonferroni adjusted ($p \leq 0.002$) post-hoc Tukey-Kramer test. All analyses were completed using a generalized linear mixed model (GLIMMIX) with SAS/STAT® v 9.2 software. In order to provide a comprehensive review of percent cover data including all survey sites and all survey years multiple analyses were conducted. Each group of survey sites was analyzed separately with the groups delineated based on their initial survey years. Group A consists of nine original survey sites (DC1, DC2, DC3, BC1, BC2, BC3, PB1, PB2 and PB3). The tenth original site, BCA, was analyzed on its own due to the special nature of the *Acropora cervicornis* patch at this location. Group B consists of the two Martin County sites first surveyed in 2006 (MC1 and MC2). Group C consists of the four sites added in 2010 (PB4, PB5, DC4 and DC 5) and Group D consists of the six sites added in 2013 (BC4, BC5, BC6, DC6, DC7 and DC8).

For all assessments annual survey data were blocked into different time intervals that generally reflect when additional sites were added to the survey (interval I, 2003-2005; interval II, 2006-2009; interval III, 2010-2012; interval IV, 2013-2015; interval V, 2016-2018, interval VI 2019-2020). Whereas long-term trend analysis can provide information on whether a taxa is increasing or decreasing in percent cover over the entire 18 year period, shorter term or more recent changes in percent cover can often be overlooked. Many taxa groups may both increase and decrease over an 18-year period, which potentially makes fitting a linear trend less informative. Pooling annual survey data in this manner allows for shorter term changes and more recent changes to be examined in a historical context while at the same time limiting the effects of both observer variability and temporary ephemeral events.

All analyses were conducted in SAS Enterprise Guide® v7.1. Percent cover data for the four major taxa groups (stony corals, octocorals, macroalgae [including cyanobacteria], and sponges) were analyzed using generalized linear mixed models (PROC GLIMMIX) with site and time intervals designated as fixed effects. A 'random' statement was added to all analyses to account for the effects of repeated measures on the residual error structure. Each group of sites (defined above) were analyzed separately. Data were square-root transformed prior to analysis and the default link function (gaussian) was used for all analyses. Each group of sites (defined above) were analyzed separately. To identify significant differences between time intervals Tukey-Kramer post-hoc comparisons were used in each analysis. The adjusted P-values based upon the multiple comparisons in the Tukey-Kramer analyses were used to determine significance at $\alpha = 0.05$.

Year 18 (2020) Results

Stony Coral

Year to year analysis of regional (all sites combined) stony coral cover showed no significant difference from 2019 to 2020 (two-way mixed model ANOVA: $p > 0.05$, see Appendix 1 for region wide and site mean values and Appendix 2 for statistical p-values). At the site level, one site, BCA, had a significant decrease from 2019 to 2020, and one site, MC1, had a significant increase in stony corral cover from 2019 to 2020; at all other sites no significant difference was identified (two-way mixed model ANOVA: $p < 0.05$, see Appendix 1 for region wide and site mean values and Appendix 2 for statistical p-values).

For nearly all site groups, stony coral cover generally increased through the time interval IV (2013-2015) but then significantly decreased by time interval V (2016-2018) and remained low for time interval VI (2019-2020). For site group A, nine original survey sites, stony coral cover steadily increased from time interval I through time interval III, though not significantly. Time interval IV (2.63% ± 0.73) had the highest stony coral cover and was significantly greater than time intervals I and II ($P < 0.0001$ and $P < 0.0001$, respectively); however, the final two time intervals, intervals V and VI, were not significantly different from each other and had significantly lower coral cover than all previous intervals with the lowest coral cover occurring in time interval VI (1.35 ± 0.37 and 1.32 ± 0.47, for interval V and VI respectively, for each comparison $P < 0.0001$). Similarly, for site group C, the four sites added in 2010 from Palm Beach and Miami-Dade, coral cover increased slightly from time interval III (1.56 ± 0.11) to time interval IV (1.77 ± 0.14) with time interval V and VI being significantly less than both previous time intervals (0.67 ± 0.09 and 0.84 ± 0.12, respectively; $P < 0.0001$ for each comparison). For site group D, the six sites added in 2013 from Broward and Miami-Dade, coral cover significantly decreased from time interval IV (1.82 ± 0.32) to time intervals V and VI (1.19 ± 0.27 and 1.05 ± 0.23, respectively; $P < 0.0001$ for both comparisons of IV to V and IV to VI, intervals V and VI were not significantly different from each other). For site group B, the two Martin County sites, there were no significant changes in stony coral cover through 2018 with the highest value in time interval IV (2.35 ± 0.48) and the lowest in time interval V (1.72 ± 0.58). Time interval VI was significantly lower than time intervals II, III and IV (1.14 ± 0.66; $P = 0.0069$, $P = 0.0208$ and $P = 0.0015$, respectively). For site BCA, the *Acropora cervicornis* site, stony coral cover significantly decreased through 2018 with the highest value, 37.07 ± 2.68, in time interval I and the lowest in time interval V, 3.58 ± 0.77 ($P < 0.0001$ for all comparisons but one, for interval III to interval IV $P = 0.0013$). Time interval VI (5.2 ± 0.91), while significantly lower than all time periods from 2003 – 2015 ($P < 0.0001$ for all comparisons) had stony coral cover increase slightly, though not significantly, from time interval V.

Live tissue area in 2017 (3.53 ± 1.09 m^2), 2018 (2.72 ± 1.01 m^2), 2019 (3.08 ± 1.08 m^2), and 2020 (3.11 ± 1.03 m^2) was significantly lower than the LTA in 2013 (6.11 ± 1.87 m^2), 2014 (6.38 ± 2.16 m^2), and 2015 (6.48 ± 2.38 m^2) (Figure 7, $p < 0.05$; see Appendix 4 for region-wide, site mean values and Appendix 5 for regional p-values). Twelve sites (DC2, DC3, DC5, DC6, DC8, BC1, BC3, BC4, PB1, PB4, MC1, and MC2) had their lowest LTA values recorded in 2018, while only one site in 2019 (DC1) and one site in 2020 (PB2) had their lowest LTA recorded in those years (Appendix 4). Nine sites (DC3, DC4, DC6, BC2, BC5, BC6, BCA, PB1, and PB3) had an increase in LTA from 2019 to 2020 of > 5% (Appendix 4).

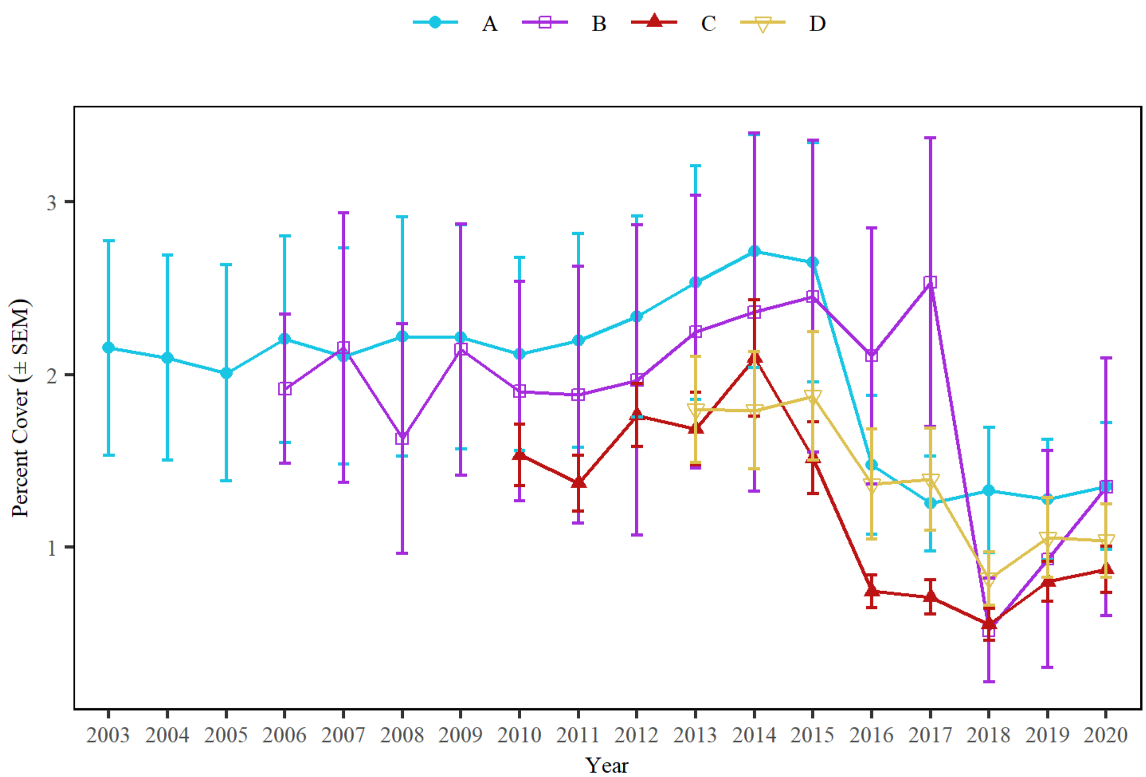

Figure 5. Mean stony coral percent cover (±SEM) for Groups A, B, C and D.

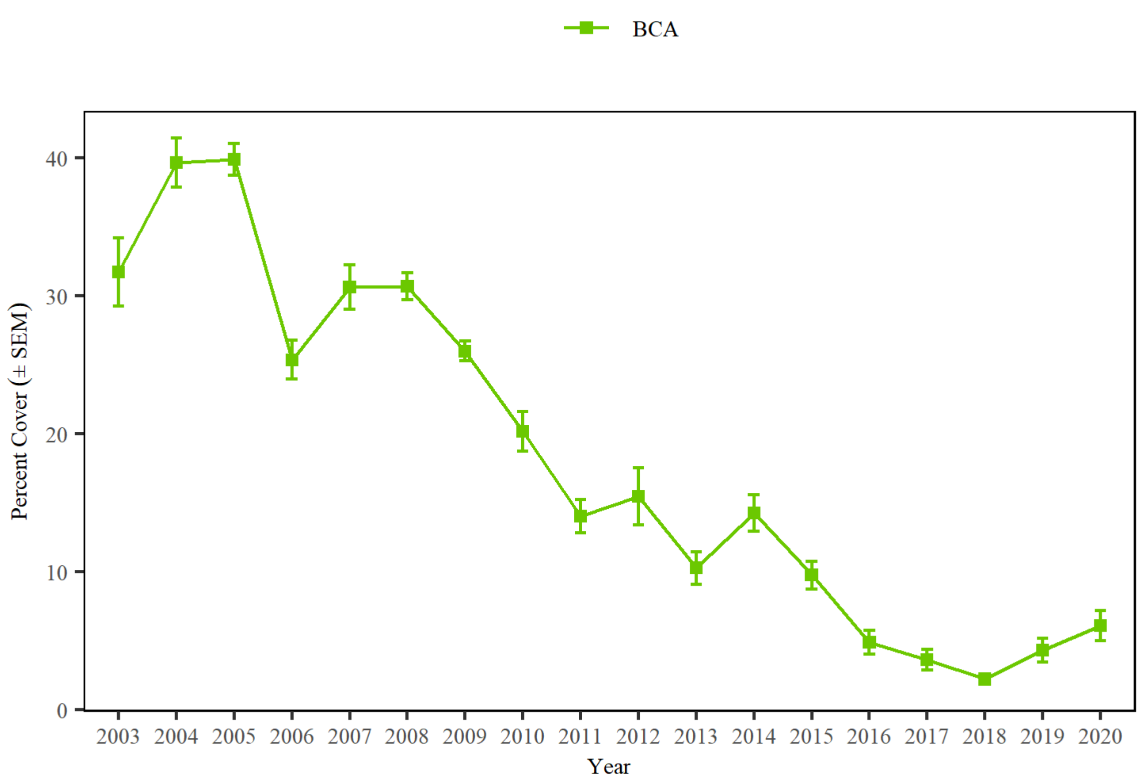

Figure 6. Mean stony coral percent cover (±SEM) for site BCA.

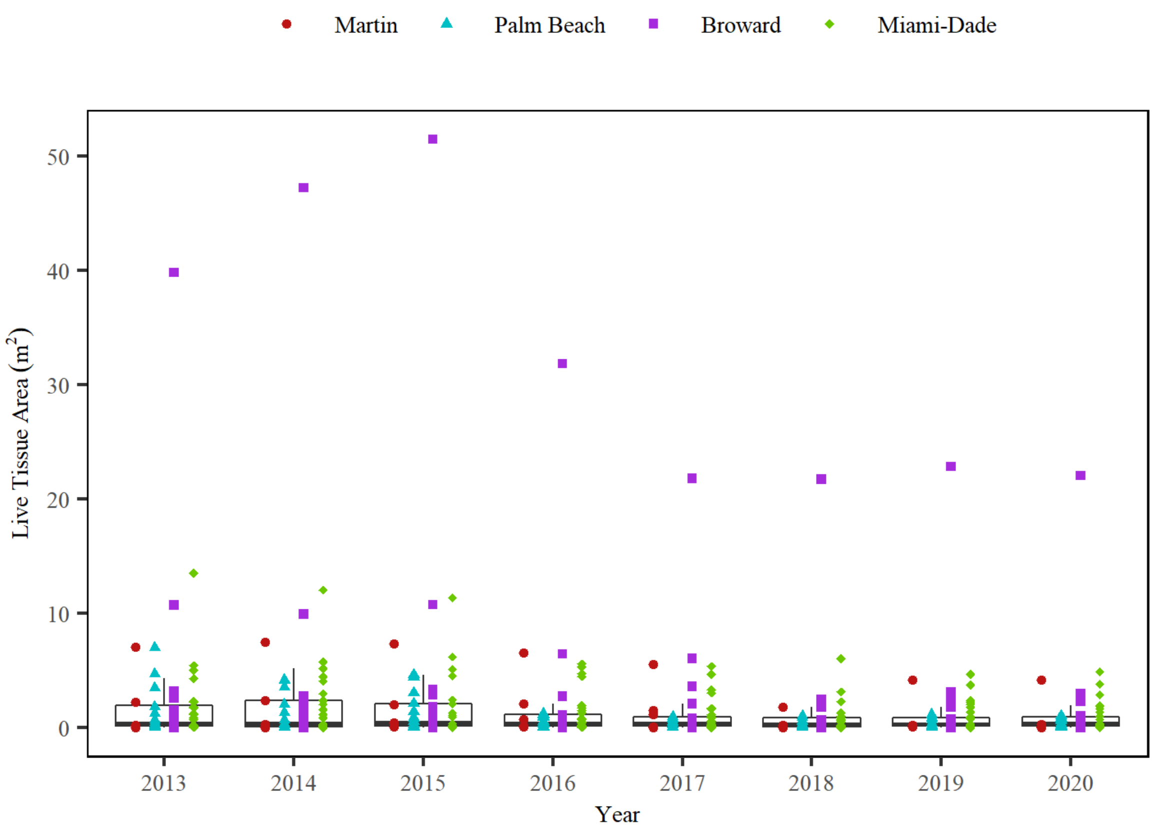

Figure 7. Live tissue area (LTA) for all stony corals summed by site (2013 – 2020). Each point is the LTA at a site colored by county. The middle bar in the boxplot is the median LTA for the region, the areas above and below the median, hinges, represent the 1st and 3rd quartiles, respectively. The whiskers, upper and lower, extend from the hinge to the largest value no greater than 1.5*IQR, where IQR is the inter-quartile range (distance between 1st and 3rd quartiles). Points lying beyond the whiskers are considered outliers. There was a significant LTA decrease in 2017, 2018, 2019, and 2020 compared to 2013, 2014 and 2015 (Tukey post-hoc: $p < 0.05$; see Appendix 4 for region-wide and site mean values and Appendix 6 for regional statistical p-values).

When comparing LTA between different groups of SCTLD susceptibility, only those species in the Intermediately-High Susceptibility group had a significant change in regional LTA (linear mixed-effects model ANOVA: $p < 0.05$; see Appendix 5 for region-wide mean values and Appendix 6 for regional statistical p-values). Regional LTA for Intermediately-High Susceptibility was significantly lower in 2017 (2.47 ± 1.00 m^2), 2018 (1.85 ± 0.98 m^2), 2019 (1.93 ± 1.02 m^2), and 2020 (1.94 ± 0.98 m^2) than it was in 2013 (5.26 ± 1.80 m^2), 2014 (5.37 ± 2.10 m^2), and 2015 (5.66 ± 2.39 m^2) (Figure 8, linear mixed-effects model ANOVA: $p > 0.05$; see Appendix 5 for region-wide mean values and Appendix 6 for regional statistical p-values). For both the Presumed Susceptible and Low Susceptible species group, no significant change in regional LTA was identified across the study years (Figure 9, Figure 10, linear mixed-effects model ANOVA: $p > 0.05$; see Appendix 5 for region-wide mean values and Appendix 6 for regional statistical p-values).

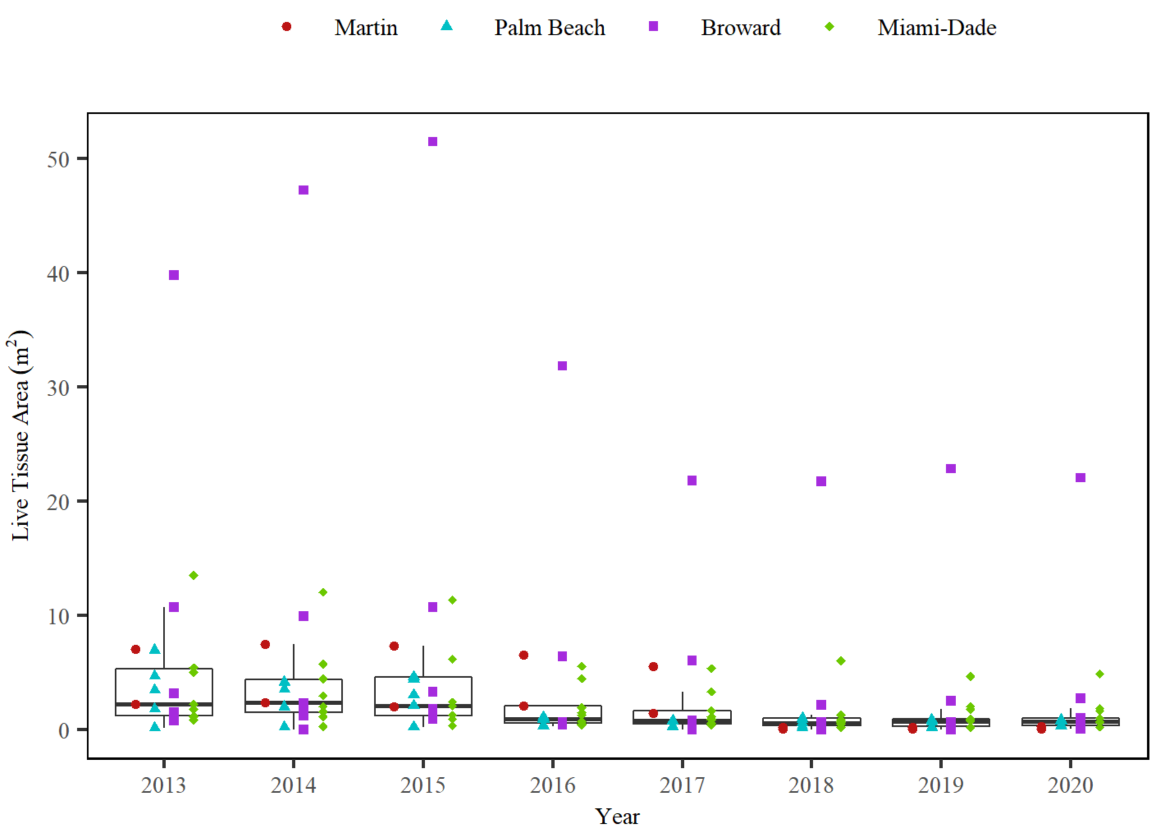

Figure 8. Intermediately-High SCTLD susceptible species regional LTA (2013 to 2020). Each point is the sum of the LTA at a site colored by county. For an explanation of the box and whisker components, see the caption for Figure 7. Only sites that contain the species were included. There was a significant LTA decrease in 2017, 2018, 2019, and 2020 compared to 2013, 2014 and 2015 (Tukey post-hoc: $p < 0.05$; see Appendix 5 for species mean LTA values and Appendix 6 for statistical values).

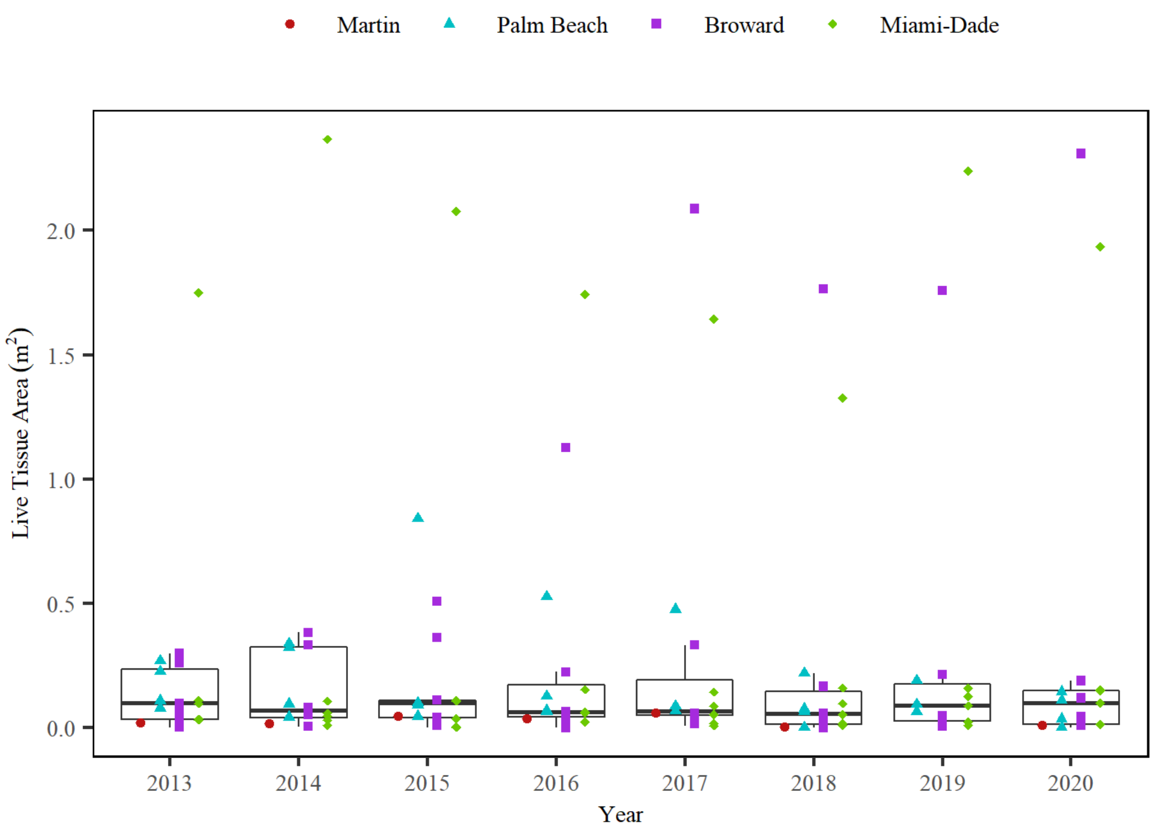

Figure 9. Presumed SCTLD susceptible species regional live tissue area from 2013 to 2020. Each point is the sum of the LTA at a site colored by county. For an explanation of the box and whisker components, see the caption for Figure 7. Only sites that contain the species were included. No significant change in LTA occurred across the study years (Tukey post-hoc: $p > 0.05$; see Appendix 5 for species mean LTA values and Appendix 6 for statistical values).

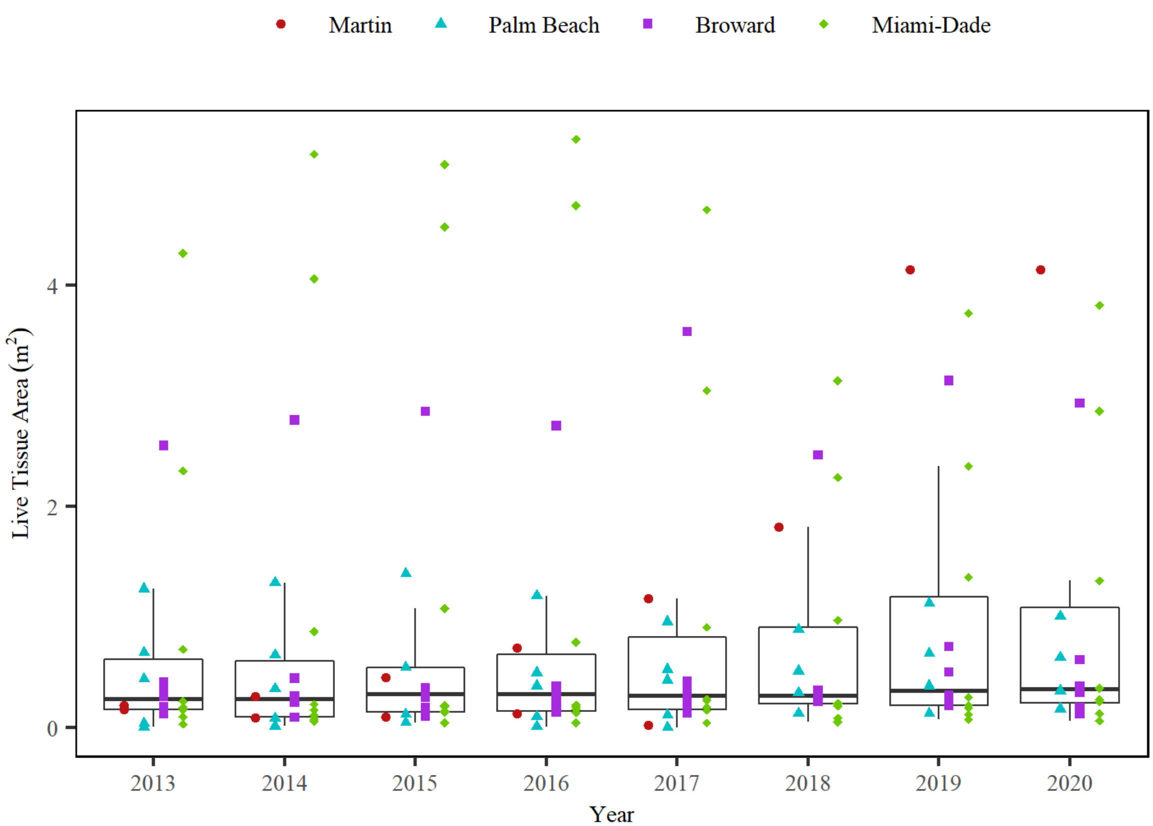

Figure 10. Low SCTLD susceptible species regional LTA from 2013 to 2020. Each point is the sum of the LTA at a site colored by county. For an explanation of the box and whisker components, see the caption for Figure 7. Only sites that contain the species were included. No significant change in LTA occurred across the study years (Tukey post-hoc: $p > 0.05$; see Appendix 5 for species mean LTA values and Appendix 6 for statistical values).

Figure 11 illustrates the site distribution of colony densities across the region for 2013-2020 (22 sites). The 2020 regional mean (±SE) stony colony density was 1.74 ± 0.32 colonies/m², the highest recorded density across study years and significantly higher than density in 2013 (1.21 ± 0.16 colonies/m²), 2014 (1.26 ± 0.18 colonies/m²), and 2016 (1.07 ± 0.17 colonies/m²) (repeated measure ANOVA: $p < 0.5$; see Appendix 7 for region and sites mean density values and Appendix 8 for statistical values). Density in 2020 ranged from a high of 4.95 ± 1.44 colonies/m² at site BCA to a low of 0.32 ± 0.10 colonies/m² at site MC2 (see Appendix 7). While 14 sites had their lowest density in 2016, 2017 or 2018, 10 sites had their highest density recorded in 2020 (Appendix 7).

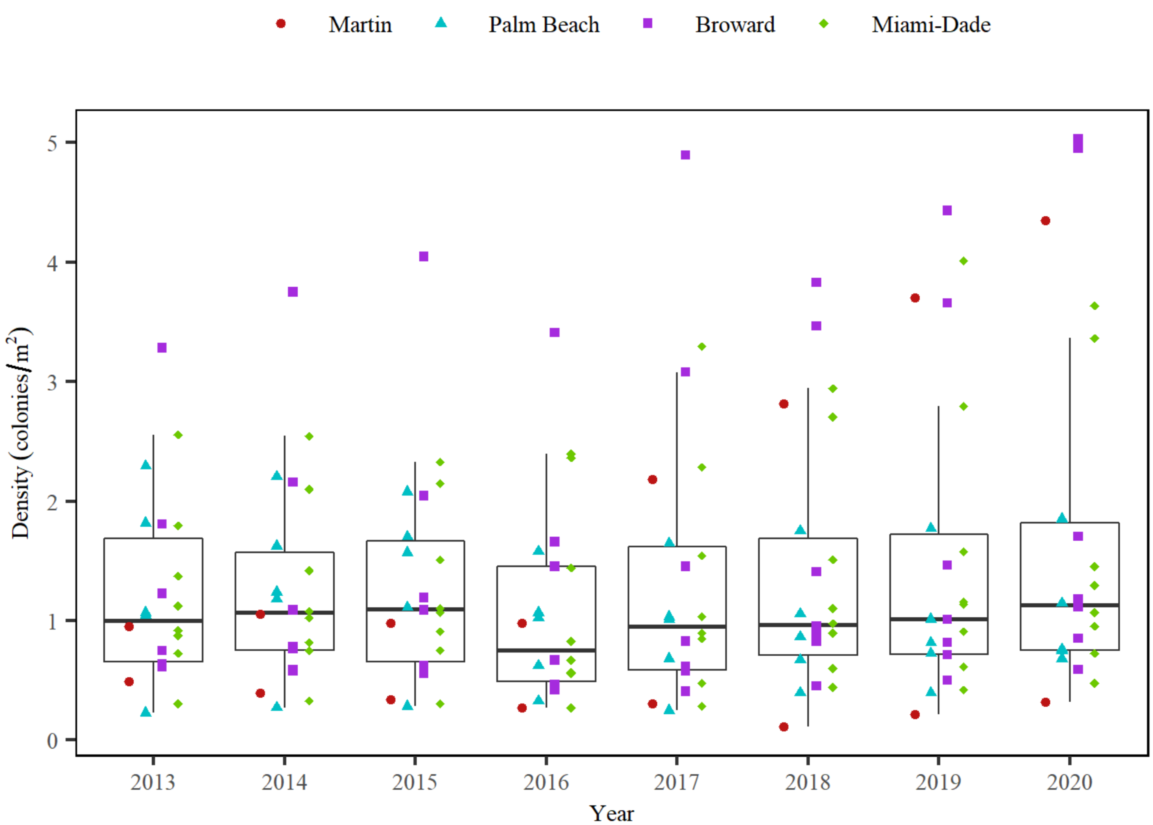

Figure 11. Region-wide stony coral density (colonies ≥ 4 cm) summed by site (2013 – 2020). Each point is the density at a site colored by county. See the caption for Figure 7 for explanation of the box and whisker components. Density in 2019 was significantly greater than in 2016, and density in 2020 was significantly greater than in 2013, 2014 and 2016 (Linear mixed-effects model: $p < 0.05$; see Appendix 7 for region and sites mean density values and Appendix 8 for statistical values).

Region-wide disease prevalence increased every year from 2013 to 2016 (Table 2). The greatest prevalence increase occurred from 2015 (1.4%) to 2016 (3.7%). Disease prevalence then dropped every year from 2017-2020, where it reached a low across the years surveyed of 0.2% (Table 2). At the site level, 12 sites had their highest recorded disease prevalence in 2016, while four sites had their highest in 2015. By 2019, only three sites were recorded with active disease. In 2020, five sites were recorded with disease, but prevalence at all sites was < 1% (Table 2). This increase in disease prevalence was driven primarily by an increase in SCTLD (Figure 12). When only diseases other than SCTLD are included, no significant change in disease prevalence was observed (Figure 12). Other diseases recorded included black band disease, yellow band disease, dark spot disease, white band disease (for acroporids) and rapid tissue loss (for acroporids). Prevalence of SCTLD was significantly higher in 2016 than in all other years see (Figure 12, see Appendix 9 for statistical values).

Table 2. Stony coral disease prevalence (%). Values are the percent of total colonies identified with disease in each site and for the region values are the total number of diseased colonies for all sites combined divided by the total number of coral colonies for all sites.

Site	2013 (%)	2014 (%)	2015 (%)	2016 (%)	2017 (%)	2018 (%)	2019 (%)	2020 (%)
DC1	0.0	0.5	0.6	13.7	10.2	6.5	6.2	0.7
DC2	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0
DC3	0.0	1.5	0.0	2.7	0.0	0.0	0.0	0.0
DC4	0.0	0.9	0.6	1.7	0.5	0.6	0.0	0.5
DC5	0.0	4.2	0.0	0.0	0.0	0.0	2.2	0.0
DC6	0.0	15.4	0.0	10.5	0.0	0.0	0.0	0.0
DC7	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.5
DC8	1.2	1.6	4.8	8.7	3.0	1.7	0.0	0.7
BCA	0.0	0.0	1.1	8.2	0.0	0.0	0.0	0.0
BC1	1.3	0.0	0.0	4.2	0.0	0.0	0.0	0.0
BC2	0.0	3.0	4.5	0.0	0.0	0.0	0.0	0.0
BC3	1.5	2.2	2.4	0.9	0.0	0.8	0.0	0.3
BC4	2.1	1.6	0.8	4.7	1.5	0.8	0.0	0.0
BC5	0.9	0.0	0.0	0.0	1.3	0.0	0.0	0.0
BC6	0.0	0.0	8.8	0.0	0.0	0.0	0.0	0.0
PB1	0.0	0.0	4.7	0.0	0.0	0.0	0.3	0.0
PB2	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0
PB3	0.0	0.0	0.0	6.9	0.0	0.0	0.0	0.0
PB4	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0
PB5	0.0	0.0	1.0	1.8	1.7	0.0	0.0	0.0
MC1	0.0	0.0	0.7	2.2	0.0	0.0	0.0	0.0
MC2	4.7	0.5	0.0	5.8	2.1	0.6	0.0	0.0
Region	0.6	1.2	1.4	3.7	1.1	0.8	0.4	0.2

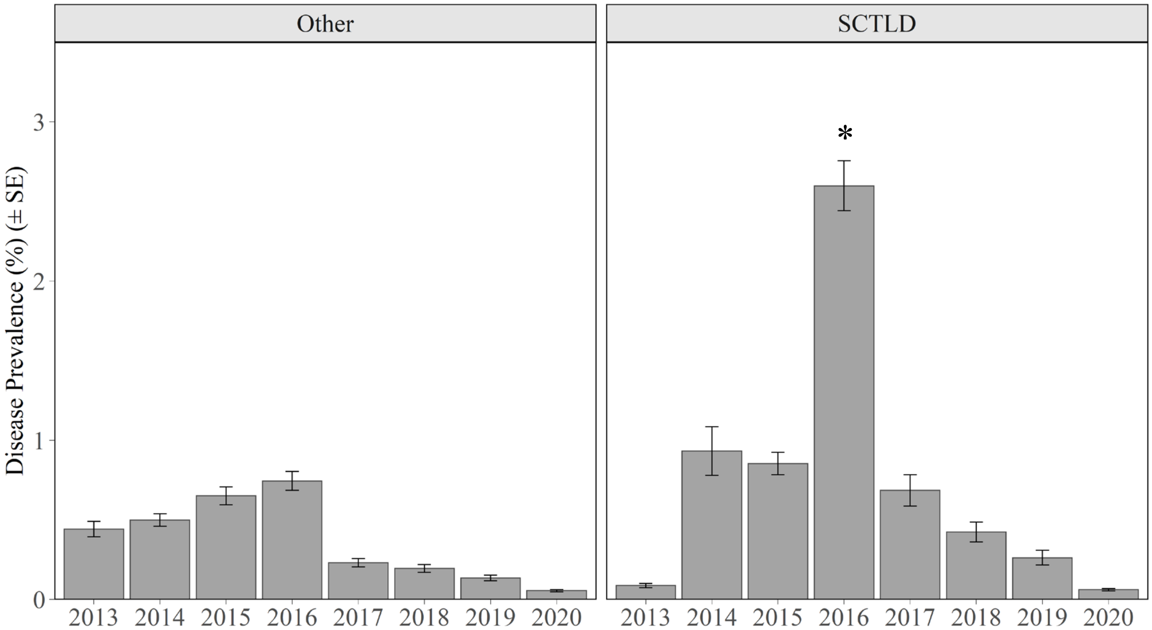

Figure 12. Mean (±SE) annual stony coral disease prevalence for other disease (black band disease, yellow band disease, dark spot disease, white band disease (for acroporids) and rapid tissue loss (for acroporids)) and SCTLD. There was no significant change in other disease prevalence; SCTLD prevalence in 2016 was significantly higher than all other years (Linear mixed-effects model: $p < 0.05$; see Appendix 9 for statistical values).

A total of 3218 stony coral colonies < 4 cm in maximum diameter were recorded across the 22 sites (Table 3) in 2020, which was higher than the total number in 2018 (2071 colonies) and 2019 (1862 colonies). Across all years *Siderastrea siderea* was the most abundant of species < 4 cm, with 2020 (1926 colonies) having the highest number of *S. siderea* colonies < 4 cm compared to the other two years. The next two most abundant species across the three years surveyed are *Porites astreoides* and *Agaricia* spp. which in 2020 had 416 colonies and 375 colonies, respectively (Table 3). Of the colonies classified Intermediately-High SCTLD susceptible, only *Orbicella* spp. had no colonies < 4 cm identified region wide across all years. Other species did not have any colonies < 4 cm identified, however many of these species have very low abundance within sites. An increase in the abundance of colonies in the 4-10 cm diameter range can show successful growth of colonies < 4 cm into the larger size class. *Dichocoenia stokesii* and *Meandrina meandrites*, both highly susceptible SCTLD species, more than doubled the number of colonies 4-10 cm from 2018 to 2020 (Table 3).

Table 3. Count of stony coral colonies < 4 cm and 4-10 cm by year. The coral colonies are totaled by species and year, where identification occurred to the lowest taxonomic level possible.

Species or Genera	**Colonies < 4 cm**			Colonies 4-10 cm		
	2018	**2019**	**2020**	2018	2019	2020
Acropora cervicornis	**0**	**0**	**0**	1	0	1
Agaricia spp.	**162**	**325**	**375**	354	438	529
Colpophyllia natans	**1**	**0**	**1**	0	1	3
Dichocoenia stokesii	**33**	**21**	**27**	9	16	22
Diploria labyrinthiformis	**0**	**1**	**2**	1	3	1
Eusmilia fastigiata	**3**	**3**	**1**	5	4	8
Helioseris cucullata	**0**	**0**	**0**	1	1	1
Isophyllia spp.	**0**	**0**	**0**	2	0	2
Madracis arenterna	**16**	**5**	**3**	37	27	11
Madracis decactis	**7**	**6**	**5**	30	22	32
Meandrina meandrites	**14**	**12**	**8**	14	28	26
Montastraea cavernosa	**158**	**170**	**192**	144	144	171
Mycetophyllia spp.	**3**	**5**	**7**	4	5	5
Oculina spp.	**0**	**1**	**1**	1	1	0
Orbicella spp.	**0**	**0**	**0**	0	3	1
Phyllangia americana	**12**	**2**	**1**	1	0	1
Porites astreoides	**309**	**232**	**416**	553	605	636
Porites	**52**	**87**	**129**	111	148	169
Pseudodiploria spp.	**7**	**4**	**6**	5	6	8
Scolymia spp.	**1**	**8**	**5**	1	2	2
Siderastrea spp.	**1170**	**885**	**1926**	434	433	588
Solenastrea bournoni	**1**	**1**	**3**	7	6	5
Stephanocoenia intersepta	**122**	**94**	**110**	236	220	274
Total	**2071**	**1862**	**3218**	1951	2113	2496

Octocoral

Regionally, year to year analysis of octocoral cover showed a significant increase from 2019 to 2020 (two-way mixed model ANOVA: $p < 0.05$, see Appendix 1 for region wide and site mean values and Appendix 2 for statistical p-values). Seven sites (BC2, BC3, BC6, PB2, PB3, PB4, and PB5) had a significant increase in cover from 2019 to 2020, while three sites, all in Miami-Dade county, had a significant decrease in cover (DC4, D6, and DC8) (two-way mixed model ANOVA: $p < 0.05$, see Appendix 1 for region wide and site mean values and Appendix 2 for statistical p-values).

Octocoral cover generally decreased through time. For site group A, time interval I had the highest octocoral cover which was significantly higher than all following time intervals (13.12 ± 1.71; $P < 0.0001$ for all comparisons). Time interval II (10.60 ± 1.17) was not significantly different from the two following time intervals but was significantly greater than the final time intervals V and VI (9.16 ± 0.91 and 7.92 ± 0.81, $P = 0.0360$ and $P < 0.0001$, respectively). Time interval III (11.04 ± 1.30) was significantly greater than time intervals IV (9.33 ± 0.95, $P = 0.0015$), V (9.16 ± 0.91, $P = 0.0004$) and VI (7.92 ± 0.81, $P < 0.0001$). Time interval IV was significantly greater than time interval VI ($P = 0.062$) and the final two time intervals V and VI were not significantly different from each other though P was close to the threshold value $\alpha = 0.05$ ($P = 0.0588$). Site group C significantly decreased from each time interval to the next; from time interval III (19.46 ± 1.04) to time interval IV (16.12 ± 1.02, $P < 0.0001$), from time interval IV to time interval V (14.02 ± 0.90, $P = 0.0029$) and from time interval V to time interval VI (11.98 ± 0.0108). Site group D significantly decreased from time interval IV (9.77 ± 1.00) to time interval V (8.13 ± 0.89, $P < 0.0001$) and remained low in time interval VI (8.27 ± 1.33). No test was performed for site group B, the Martin County sites, because octocoral cover was near zero for all time periods. For site BCA, the first two time intervals (1.97 ± 0.23 for interval I and 1.79 ± 0.23 for interval II) were not significantly different from any other time interval; however, octocoral cover had slightly increased by time intervals III (2.31 ± 0.15) and IV (2.32 ± 0.26) which were both significantly greater than time interval V (1.30 ± 0.13; $P = 0.0006$ and $P = 0.0006$, respectively). Octocoral cover in the final time interval, interval VI, was significantly higher than interval V (2.14 ± 0.14, $P = 0.0215$), but was not significantly different than earlier time intervals I through IV.

The 2020 regional mean (±SEM) octocoral colony density was 14.05 ± 2.01 colonies/m^2 (Figure 14). Density in 2020 ranged from a high of 35.13 ± 3.57 colonies/m^2 at site PB5 to a low of 0 colonies/m^2 at site MC1 and MC2. Regional octocorals colony density increased every year from 2013 to 2017, peaking in 2017 at 12.58 ± 1.85 colonies/m^2, with the first regional decrease in density recorded in 2018 where density was 10.36 ± 1.50 colonies/m^2. A region-wide significant change in octocoral colony density was identified between years (Linear mixed-effects model: $p > 0.05$; see Appendix 7 for region and sites mean density values and Appendix 8 for statistical values). Following the linear mixed-effects model ANOVA, pairwise comparisons indicated 2015 (11.52 ± 1.76 colonies/m^2), 2016 (11.85 ± 1.83 colonies/m^2), 2017 (12.58 ± 1.85 colonies/m^2), 2019 (11.57 ± 1.61 colonies/m^2), and 2020 (14.05 ± 2.01 colonies/m^2) had significantly higher densities than 2013 (8.68 ± 1.34 colonies/m^2). Additionally, 2016, 2017 and 2020 had significantly higher densities than in 2014 (9.97 ± 1.55 colonies/m^2), and density in 2018 (10.41 ± 1.50 colonies/m^2) was significantly lower than in 2017. Density in 2020 was significantly higher than all other years (glht Tukey post-hoc: $p < 0.05$; see Appendix 8 for statistical p-values).

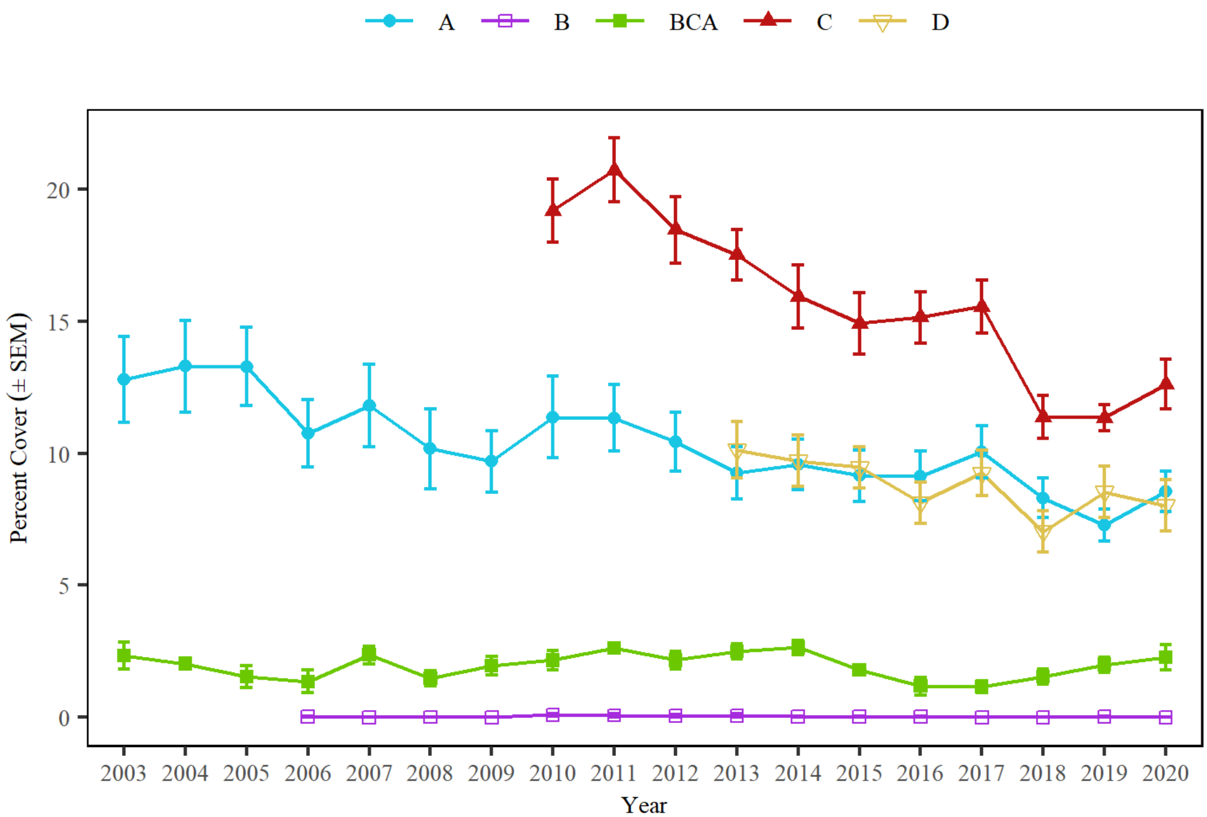

Figure 13. Mean octocoral percent cover (±SEM) for Group A, B, BCA, C and D.

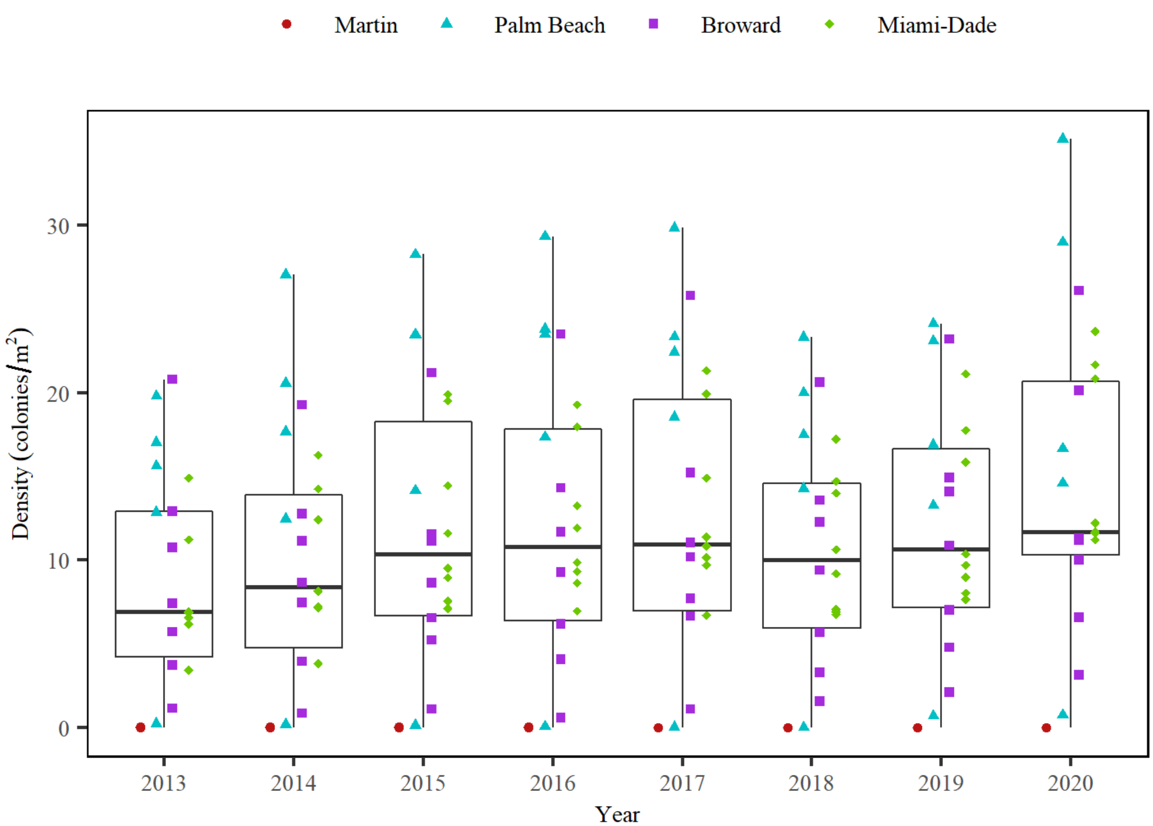

Figure 14. Region wide octocoral density (colonies/m²) distribution from 2013 to 2020. Each point is the density at a site colored by county. For an explanation of the box and whisker components, see the caption for Figure 7. Density in 2013 was significantly lower than 2015-2017, 2019, and 2020; density in 2014 was significantly lower than in 2016, 2017 and 2020. Density in 2017 was significantly higher than in 2018, density in 2020 was significantly higher than all other years (Tukey post-hoc: $p < 0.05$; see Appendix 8 for statistical p-values).

None of the three octocoral target species (*A. americana, E. flexuosa,* and *G. ventalina*) were identified at either of the Martin County sites (MC1 and MC2). In 2020, regional *Antillogorgia americana* density (2.54 ± 0.45 colonies/m^2) was the greatest of the three species followed by *E. flexuosa* (0.81 ± 0.25 colonies/m^2) and *G. ventalina* (0.35 ± 0.09 colonies/m^2) (Appendix 10). *Eunicea flexuosa* (Figure 15) density peaked in 2015; however, no years were found to be significantly different from each other (linear mixed-effects model ANOVA & glht Tukey post-hoc: $p > 0.05$; see Appendix 10 for octocoral mean density values and Appendix 11 statistical p-values). *Gorgonia ventalina* (Figure 16 Figure 16) had significantly higher colony density in 2020 (0.35 ± 0.09 colonies/m^2) than in 2013 (0.21 ± 0.05 colonies/m^2), with no other years having any significant differences other (linear mixed-effects model ANOVA & glht Tukey post-hoc: $p < 0.05$; see Appendix 10 for octocoral mean density values and Appendix 11 statistical p-values). *Antillogorgia americana* (Figure 17) had significantly higher colony density in 2020 (2.54 ± 0.45 colonies/m^2) than all other years. Additionally, density in 2019 (1.98 ± 0.37 colonies/m^2) was significantly higher than in 2013 (1.43 ± 0.24 colonies/m^2) and 2014 (1.36 ± 0.24 colonies/m^2) other (linear mixed-effects model ANOVA & glht Tukey post-hoc: $p < 0.05$; see Appendix 10 for octocoral mean density values and Appendix 11 statistical p-values).

No significant differences in colony height was identified between years for *G. ventalina* (Figure 18; linear mixed-effects model ANOVA: $p > 0.05$; see Appendix 12 for target species mean heights and Appendix 13 for statistical p-values). Colony height for *E. flexuosa* was significantly lower in 2015 (21.5 ± 0.6 cm) compared to 2013 (24.9 ± 0.6 cm), and 2014 (24.4 ± 0.7 cm); height in 2020 (20.3 ± 0.5 cm) was significantly lower than in 2013, 2014, 2017 (22.9 ± 0.5 cm), 2018 (23.1 ± 0.6), and 2019 (22.6 ± 0.5) (Figure 18; linear mixed-effects model ANOVA: $p < 0.05$; see Appendix 12 for target species mean heights and Appendix 13 for statistical p-values). *Antillogorgia americana* colony height was significantly higher in 2013 (27.1 ± 0.5 cm) compared to all other years; height in 2014 (25.1 ± 0.5 cm) and 2016 (23.8 ±0.4 cm) was significantly higher than in 2018 (21.8 ± 0.5 cm), 2019 (19.1 ± 0.4 cm), and 2020 (17.9 ± 0.3 cm); height in 2015 (23.2 ± 0.5 cm), 2017 (23.3 ± 0.4 cm) and 2018 was significantly higher than in 2019 and 2020 (Figure 18; linear mixed-effects model ANOVA: $p < 0.05$; see Appendix 12 for target species mean heights and Appendix 13 for statistical p-values).

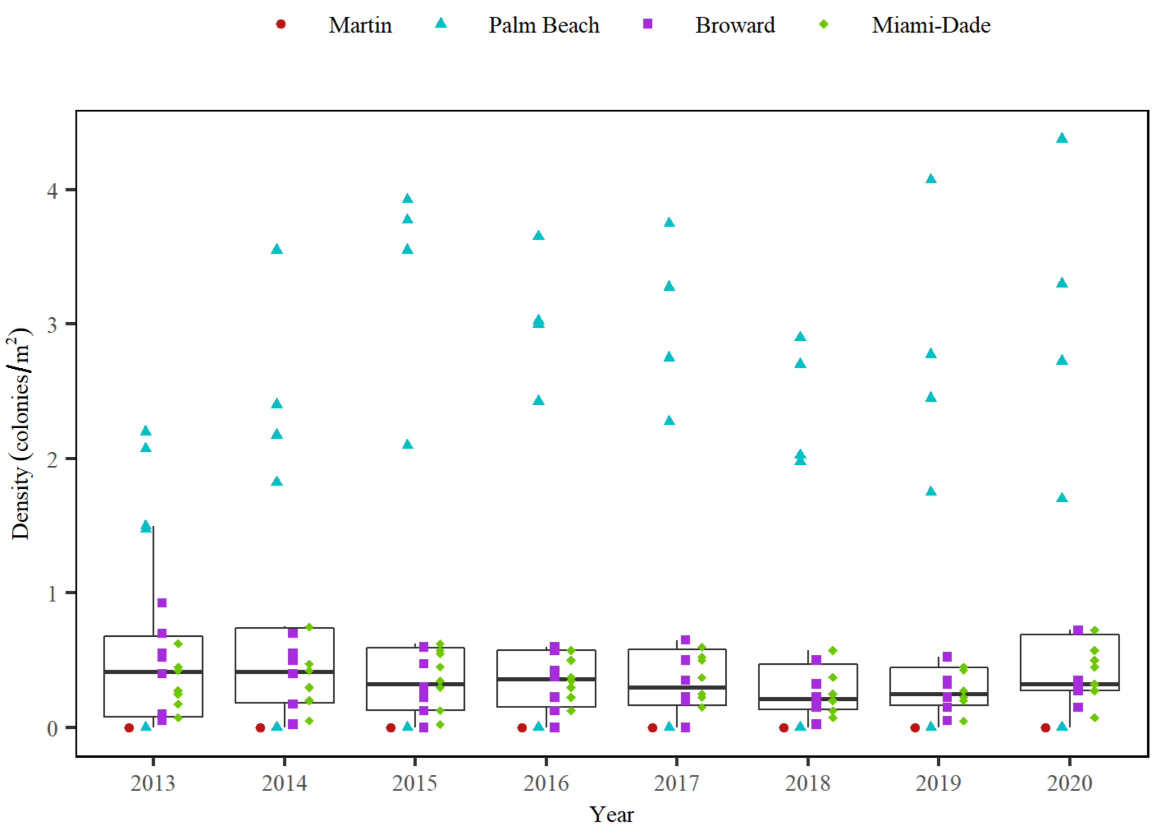

Figure 15. *Eunicea flexuosa* regional density (colonies/m^2) distribution from 2013 to 2020. Each point is the density at a site colored by county. For an explanation of the box and whisker components see the caption for Figure 7. An overall significant difference in density was identified, however there was no significant difference between years (Tukey post-hoc: $p < 0.05$; see Appendix 11 for statistical p-values).

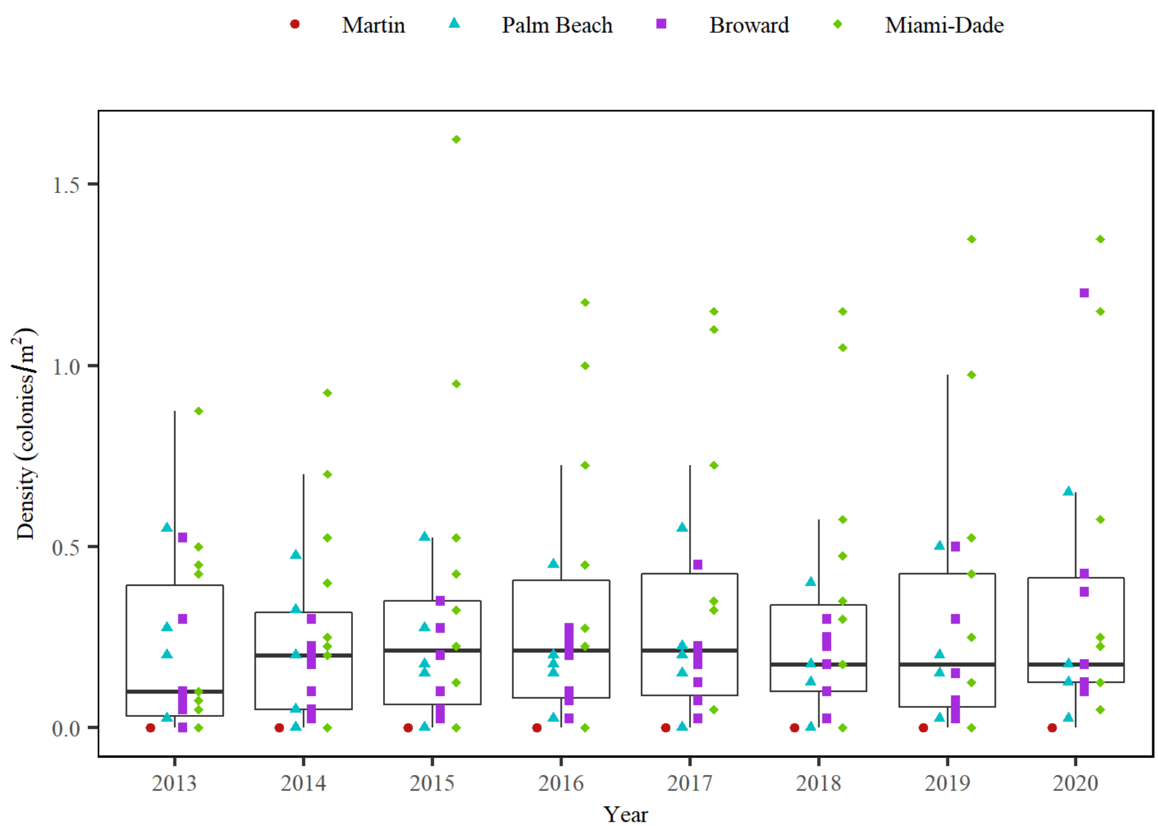

Figure 16. *Gorgonia ventalina* regional density (colonies/m^2) distribution 2013 to 2020. Each point is the density at a site colored by county. For an explanation of the box and whisker components, see the caption for Figure 7. Density in 2020 was significantly higher than in 2013 (Tukey post-hoc: $p < 0.05$; see Appendix 11 for statistical p-values).

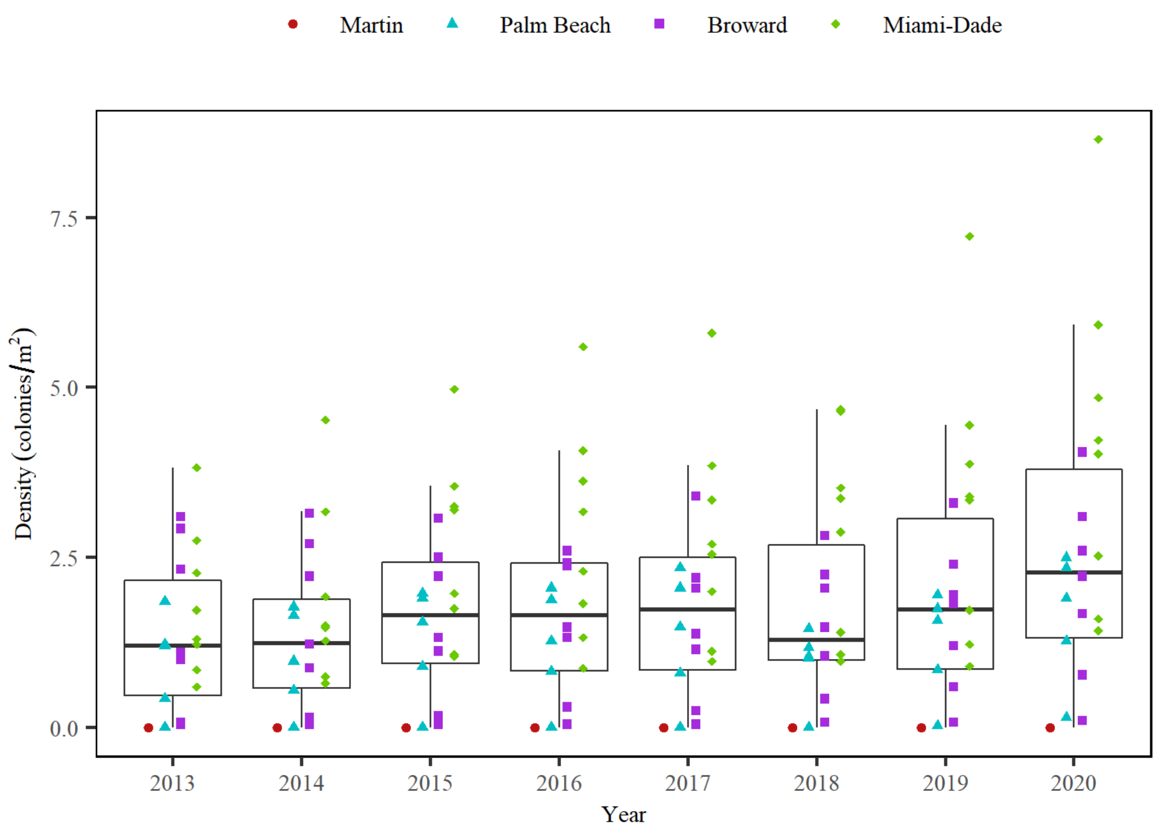

Figure 17. *Antillogorgia americana* regional density (colonies/m^2) distribution 2013 to 2020. Each point is the density at a site colored by county. For an explanation of the box and whisker components please see the caption for Figure 7. Density in 2019 was significantly higher than in 2013 and 2014, density in 2020 was significantly higher than all other years (2013-2019) (Tukey post-hoc: $p < 0.05$; see Appendix 11 for statistical p-values).

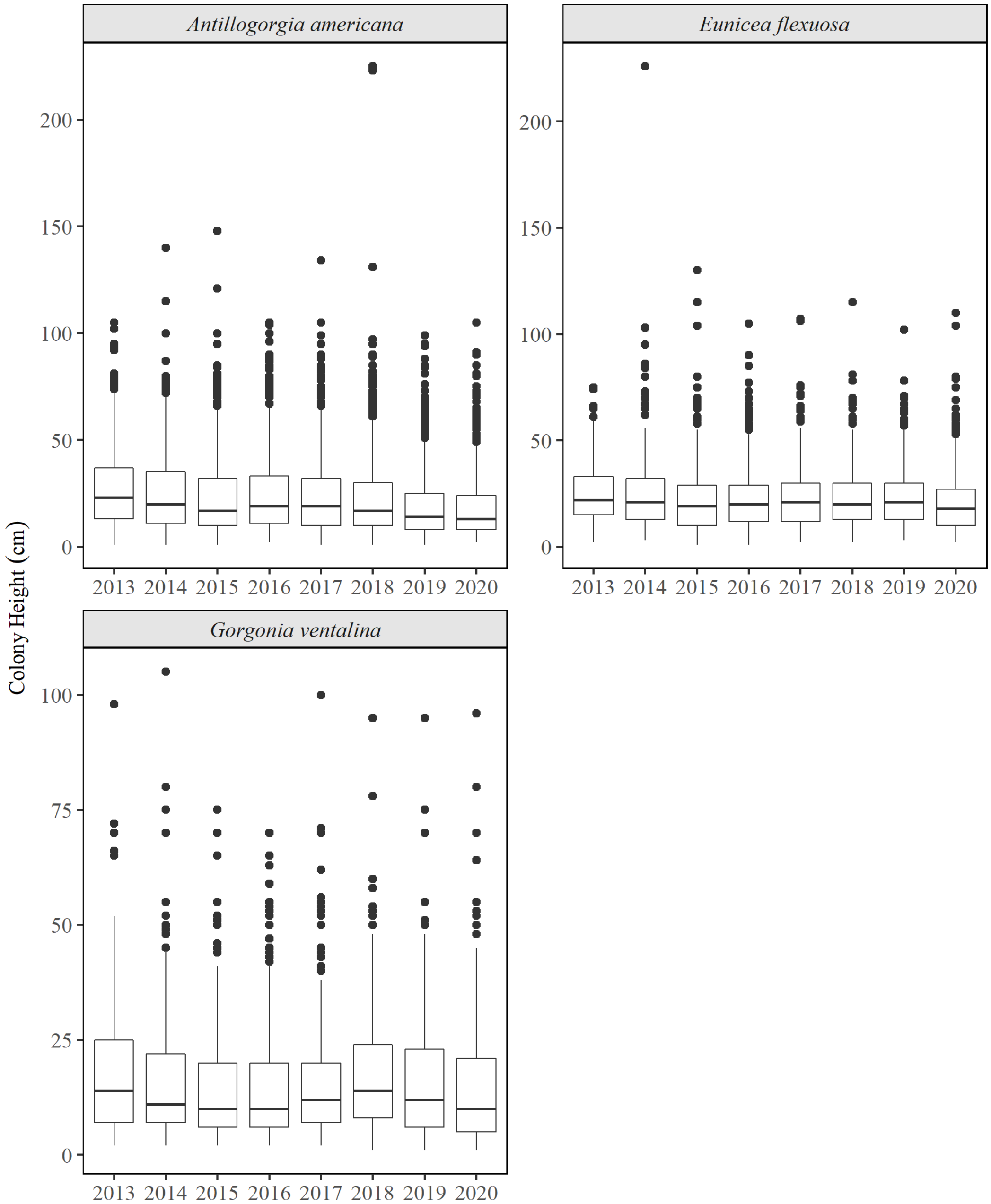

Figure 18. Octocoral target species colony height distribution 2013 to 2020. The middle bar in the boxplot is the median height for the region, the areas above and below the median, hinges, represent the 1st and 3rd quartiles, respectively. The whiskers, upper and lower, extend from the hinge to the largest value no greater than 1.5*IQR, where IQR in the inter-quartile range (distance between 1st and 3rd quartiles). Points lying beyond the whiskers are considered outliers. No significant difference between years was identified for *Gorgonia ventalina* (Linear mixed-effects model: $p > 0.05$; see Appendix 13 for statistical p-values). *Eunicea flexuosa* was significantly lower in 2015 than 2013 and 2014; and 2020 was significantly lower than 2013, 2014, 2017, 2018 and 2019. *Antillogorgia americana* height was significantly higher in 2013 than all other years; 2014 and 2016 were significantly higher than in 2018, 2019, and 2020; 2015, 2017, and 2018 were significantly higher than 2019 and 2020 (Tukey post-hoc: $p < 0.05$; see Appendix 13 for statistical p-values).

Barrel Sponge (*Xestospongia muta*)

A significant region-wide change in *X. muta* density (Figure 19) was identified, where 2013 (0.24 ± 0.05 sponges/m²) was significantly lower than 2015 (0.30 ± 0.06 sponges/m²), 2016 (0.31 ± 0.06 sponges/m²), 2017 (0.35 ± 0.06 sponges/m²), 2019 (0.32 ± 0.06 sponges/m²), and 2020 (0.32 ± 0.06 sponges/m²). Additionally, 2017 was significantly higher than 2014 (0.28 ± 0.06 sponges/m²) and 2018 (0.28 ± 0.05 sponges/m²) (Linear mixed-effects model ANOVA: $p < 0.05$; see Appendix 7 for region mean values and Appendix 8 for statistical p-values). *Xestospongia muta* were identified at all sites except those on the nearshore ridge complex habitat: MC1, MC2, BCA, and DC8. The three sites with the highest densities in 2020 were spread between three counties (PB5: 0.75 ± 0.10 sponges/m²; DC7: 0.72 ± 0.14 sponges/m²; and BC5: 0.69 ± 0.14 sponges/m²), and six sites had densities greater than 0.5 sponges/m² (see Appendix 7 for site mean values).

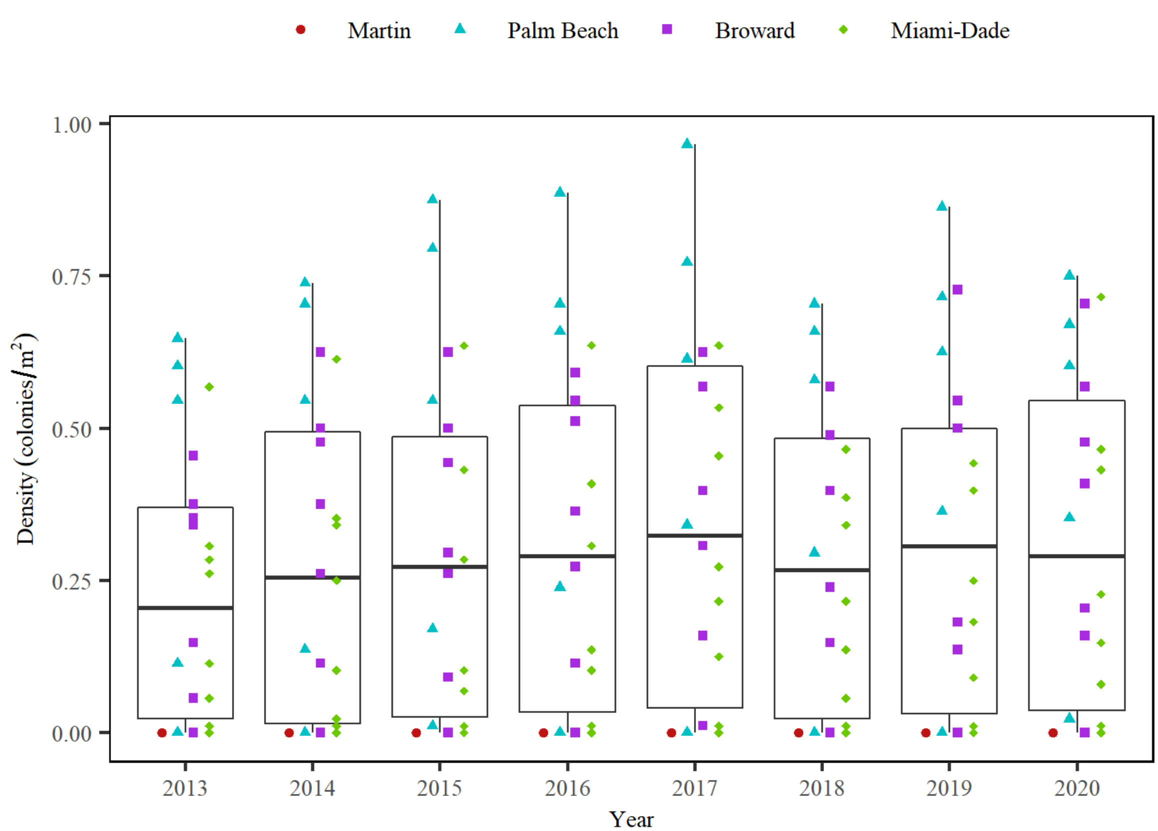

Figure 19. *Xestospongia muta* regional density (sponges/m²) distribution 2013 to 2020. Each point is the density at a site colored by county. For an explanation of the box and whisker components, see the caption for Figure 7. Density in 2013 was significantly lower than 2015, 2016, 2017, 2019 and 2020; 2017 was significantly higher than 2014 and 2018 (Tukey post-hoc: $p < 0.05$; see Appendix 7 for region mean values and Appendix 8 for statistical p-values).

Sponge and Macroalgae Percent Cover

Analysis of macroalgae cover from 2019 to 2020 showed a significant decrease in cover at the regional level (two-way mixed model ANOVA: $p < 0.05$, see Appendix 1 for region wide and site mean values and Appendix 2 for statistical p-values). At the site level, eight sites (DC2, DC3, BC2, BC3, PB2, PB3, PB5, and MC1) had a significant decrease from 2019 to 2020 while only one site (BC5) had a significant increase (two-way mixed model ANOVA: $p < 0.05$, see Appendix 1 for region wide and site mean values and Appendix 2 for statistical p-values).

Macroalgae cover was more variable than both stony coral and octocoral cover but generally increased across most site groups throughout the course of monitoring. This is especially apparent over the final two time intervals. For site group A, time interval I had the lowest macroalgae cover (4.74 ± 1.30) and cover was significantly less than all other time intervals (for intervals I to II P = 0.0007, for intervals I to III P = 0.0012, P < 0.0001 for all other comparisons) whereas time interval VI had the highest cover (21.19 ± 2.20) with cover significantly greater than time intervals I through IV (P < 0.0001 for all comparisons). Time interval V (21.00 ± 3.41) had macroalgae cover similar to time interval VI and was also significantly greater than all intervals I through IV (P < 0.0001 for all comparisons). Site group C (9.81 ± 3.00) significantly increased from intervals III to V (interval III to interval IV, 13.6 ± 2.31, P = 0.0110; interval IV to interval V, 21.97 ± 3.20, P = 0.0005). Macroalgae cover further increased in time interval VI (23.79 ± 2.45) though not significantly; interval VI was significantly greater than intervals III and IV (P < 0.0001 for both comparisons). Site group D also increased from time interval IV (18.76 ± 1.57) to time interval V (31.62 ± 2.75, P < 0.0001); however, macroalgae cover than decreased in time interval VI (24.97 ± 2.73, P = 0.0052). Macroalgae cover in the final time interval was still significantly greater than the first time interval VI for this site group, interval IV (P = 0.0011). Site BCA followed this trend of increasing macroalgae cover throughout the course of monitoring, with the lowest cover found in time interval I (0.92 ± 0.51) and the highest cover found in time interval VI (8.60 ± 1.07). Time intervals IV, V and VI were all greater than time interval I (P = 0.0180, P = 0.0010, P = 0.0001, respectively). Time interval VI was also significantly greater than time interval II (P = 0.0086). No other significant differences were found for site BCA though cover did increase in every time interval. Site group B, the Martin County sites, show a contrasting trend to all other site groups with macroalgae cover steadily decreasing across through 2018; with the highest cover found in the first-time interval, interval II (41.42 ± 2.76), and the lowest cover found in interval V (17.02 ± 3.45). Macroalgae cover in interval VI (33.59 ± 5.98) returned to values similar to the three earlier time intervals. No significant differences were found between time interval II, III, IV and VI while time interval V was significantly lower than all other intervals (P < 0.0001 for all comparisons except interval V to VI where P = 0.0010). Time intervals II, III and IV were not significantly different from each other but were all significantly greater than interval V, the final time interval (P < 0.0001 for all comparisons).

Year to year analysis of regional sponge cover showed a significant increase from 2019 to 2020 (two-way mixed model ANOVA: $p < 0.05$, see Appendix 1 for region wide and site mean values and Appendix 2 for statistical p-values). Eight sites (DC5, BC4, PB1 and PB3) had a significant increase in sponge cover; no sites had a significant decrease in cover (two-way mixed model ANOVA: $p < 0.05$, see Appendix 1 for region wide and site mean values and Appendix 2 for statistical p-values).

The percent cover of sponges was the most consistent through time of all taxa groups. In general, sponge cover was highest in time interval III (2010-2012) for all site groups. For site group A, time interval I had the lowest cover, 4.35 ± 0.59, which was significantly less than time interval III, IV, V and VI ($P < 0.0001$ for all comparisons). Time interval II, 4.82 ± 0.59, was not found to be different from interval I but was also significantly less than time intervals III, IV, V and VI ($P < 0.0001$, $P = 0.0001$, $P < 0.0001$, $P = 0.0008$, respectively). The highest sponge cover was found in time interval III (6.15 ± 0.66) though this value was not significantly greater than the following time intervals, IV, V and VI (5.53 ± 0.54, 5.75 ± 0.56, 5.70 ± 0.86, respectively). For site group C the final time interval VI (7.81 ± 0.88) had significantly lower sponge cover than the initial time interval III (9.37 ± 1.07, $P = 0.0176$) with no other significant differences between intervals. For site group D the final time interval VI (5.59 ± 0.72) had significantly higher sponge cover than the previous two intervals IV and V (4.78 ± 0.52 and 4.84 ± 0.48, $P = 0.0009$ and $P = 0.0049$, respectively). For site BCA, the highest sponge cover was found in time interval III (1.99 ± 0.54) and the lowest cover was found in time interval I (0.38 ± 0.06). Sponge cover did not significantly increase from time interval I to interval II (0.86 ± 0.12), but time intervals III, IV (1.73 ± 0.82), V (1.35 ± 0.36) and VI (1.51 ± 0.08) all had significantly higher sponge cover than interval I ($P = 0.0134$ or less for all comparisons). Time interval II was significantly less than interval III ($P = 0.0407$) but was not significantly different from other time intervals. Martin county sites, site group B, followed the same general trend as all other site groups with the lowest value occurring in the first time interval, interval II (1.96 ± 0.29), and cover significantly increasing to its the highest value in time interval III (3.31 ± 0.55, $P = 0.0009$). Sponge cover through time intervals IV, V and VI ranged from 2.41 ± 0.25 to 2.57 ± 0.32 and was not significantly different from interval II or interval III.

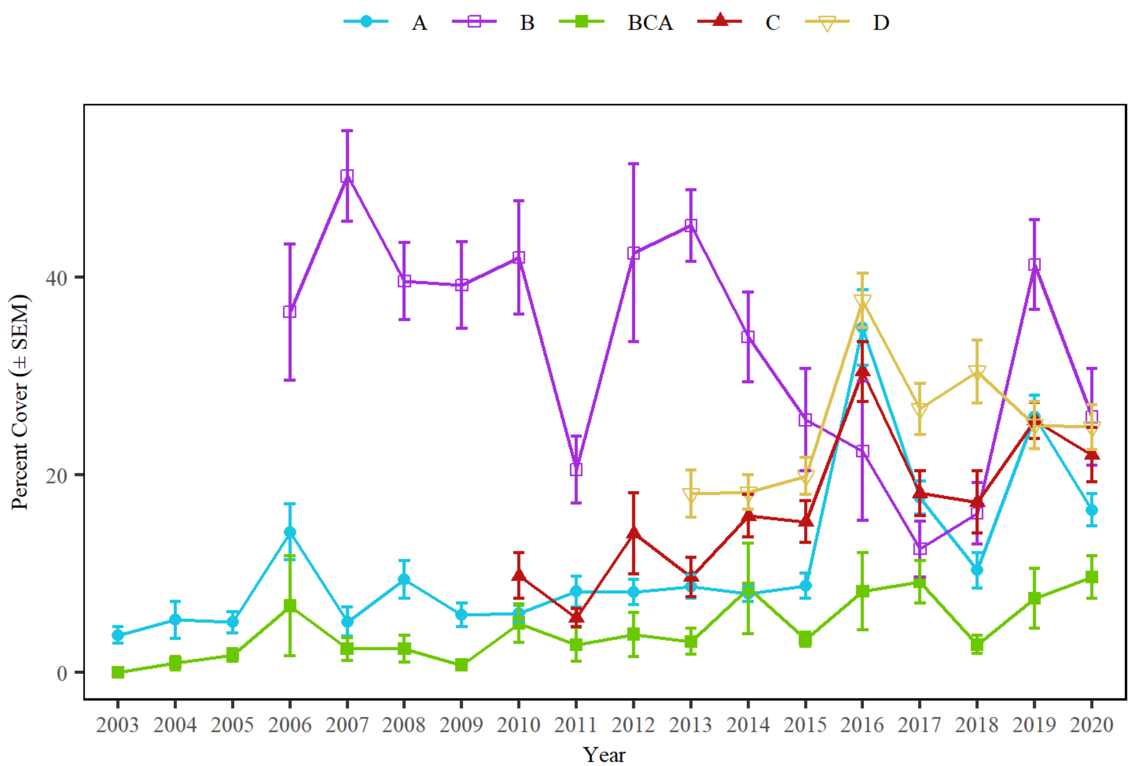

Figure 20. Mean macroalgae percent cover (±SEM) for Group A, B, BCA, C and D

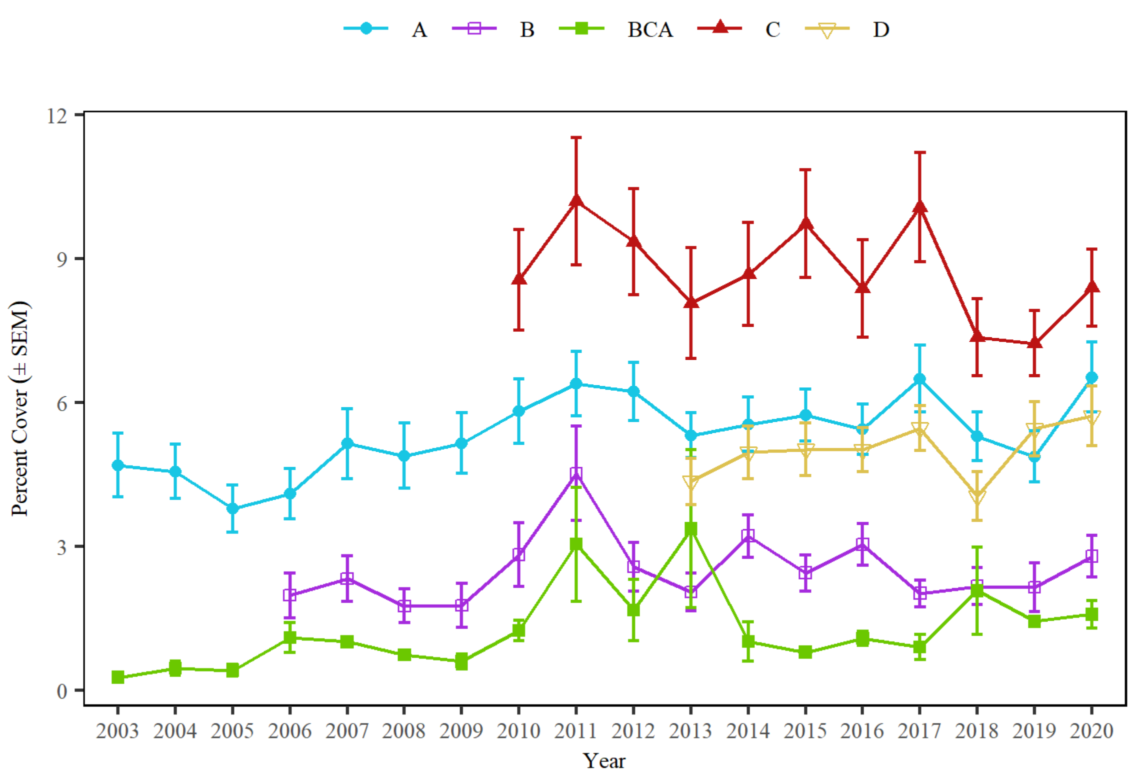

Figure 21. Mean porifera percent cover (±SEM) for Group A, B, BCA, C and D.

Site Benthic Temperature

During the 2020 sites visits, all but five temperature loggers were successfully recovered. All sites however had at least one logger left in 2020 and data were downloaded for all 22 sites. The 2020 sample dates shown in Table 1 were the same dates that temperature loggers were collected and redeployed at each of the 22 sites. Table 4 presents the dates and maximum and minimum temperatures (°C) for each site from late winter 2007 into spring 2020. For 18 sites, the maximum temperature on record was recorded in August 2014 (all ≥ 30.9°C) with one additional site in September 2014 (MC1: 30.6°C) (Table 4). One site (DC8: 32.4 °C) had the maximum temperature recorded in August 2017. No maximum temperatures for sites were recorded in 2018, 2019 or 2020. Three sites had minimum recorded temperatures in January and February of 2018 (DC6, DC7, BC4) (Table 4). In 2019, more sites had temperatures recorded over 30.5°C than in 2016, 2017 and 2018 (Table 5; 2020 was not included because a full year of temperature data was not collected at the time each site was sampled). Ten sites had temperatures recorded over 30.5°C in 2019, where 7 of those sites were in Miami-Dade. Site DC8 consistently has the most days over 30.5°C 2018 (Table 5).

Table 4. Maximum and minimum water temperatures (°C) and dates for the 22 sites with temperature loggers recording winter 2007 through May 2020.

	Maximum		**Minimum**	
Site	**Temp**	**Date**	**Temp**	**Date**
DC1	31.9	21 Aug 14	19.7	23 Jan 09
DC2	31.2	25 Aug 14	20.1	4 Mar 10
DC3	31.3	24 Aug 14	20.4	1 Feb 11
DC4	31.2	24 Aug 14	20.3	31 Jan 11
DC5	31.4	24 Aug 14	20.3	31 Jan 11
DC6	31.7	22 Aug 14	21.0	19 Jan 18
DC7	31.2	25 Aug 14	22.1	1 Feb 18
DC8	32.4	18 Aug 17	21.0	22 Feb 15
BCA	31.6	24 Aug 14	19.0	6 Feb 09
BC1	31.6	25 Aug 14	19.6	5 Mar 10
BC2	31.2	25 Aug 14	20.4	5 Mar 10
BC3	30.9	25 Aug 14	20.0	22 Feb 11
BC4	31.4	24 Aug 14	21.9	21 Jan 18
BC5	30.9	25 Aug 14	22.3	23 Mar 14
BC6	30.8	26 Aug 14	22.1	23 Mar 14
PB1	30.9	30 Aug 14	19.5	6 Mar 10
PB2	30.8	29 Aug 14	18.5	5 Apr 11
PB3	30.6	29 Aug 14	19.7	7 Mar 10
PB4	30.8	22 Aug 11	19.6	5 Apr 11
PB5	30.8	25 Aug 11	19.7	22 Feb 11
MC1	30.6	1 Sept 14	13.4	11 Jan 10
MC2	30.7	11 Aug 09	13.8	11 Jan 10

Table 5. Number of days per year with water temperature ≥ 30.5°C for the 22 sites with temperature loggers recording winter 2007 through 2019 (NA = sites not established) (2020 is not included because a full year of temperature data was not collected at the time each site was sampled).

Site	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
DC1	11	0	7	5	18	0	0	29	33	13	9	7	15
DC2	0	0	0	0	6	0	0	8	20	0	0	0	1
DC3	1	0	0	0	1	0	0	7	5	0	0	0	1
DC4	0	0	0	0	1	0	0	9	12	0	0	0	2
DC5	0	0	0	2	8	0	0	18	15	1	11	1	14
DC6	NA	NA	NA	NA	NA	NA	0	18	49	11	11	7	11
DC7	NA	NA	NA	NA	NA	NA	0	6	5	0	0	0	0
DC8	NA	NA	NA	NA	NA	NA	0	41	64	30	50	45	43
BCA	21	0	7	0	0	0	0	22	36	4	11	6	12
BC1	8	0	6	0	13	0	0	19	30	3	6	1	10
BC2	0	0	0	0	1	0	0	7	3	0	0	0	0
BC3	0	0	0	0	2	0	0	4	1	0	0	0	0
BC4	NA	NA	NA	NA	NA	NA	0	12	13	0	0	0	2
BC5	NA	NA	NA	NA	NA	NA	0	6	3	0	0	0	0
BC6	NA	NA	NA	NA	NA	NA	0	4	0	0	0	0	0
PB1	0	0	0	0	0	6	0	4	3	0	0	0	0
PB2	0	0	0	0	0	2	0	3	0	0	0	0	0
PB3	0	0	0	0	0	0	0	1	0	0	0	0	0
PB4	0	0	0	0	0	5	0	1	0	0	0	0	0
PB5	0	0	0	0	0	7	0	4	1	0	0	0	0
MC1	0	0	1	0	0	0	0	3	0	0	0	0	0
MC2	0	0	2	0	0	0	0	3	0	0	0	0	0

Discussion

The coral reef ecosystem within the Southeast Florida Coral Reef Ecosystem Conservation Area (Coral ECA) is the northern extension of Florida's Coral Reef (FCR) and is a high-latitude system near the environmental threshold for significant coral reef growth. Coral ECA reefs generally have similar stony coral species richness, but reduced stony coral cover compared to the Florida Keys and Dry Tortugas (southern portions of Florida's Coral Reef) (Ruzicka et al. 2010; Ruzicka et al. 2012, Jones et al. 2020). Benthic cover by octocorals and macroalgae is similar throughout FCR, while sponges appear to contribute more to cover in the Coral ECA than in the Florida Keys or Dry Tortugas (Ruzicka et al. 2010; Ruzicka et al. 2012; Ruzicka et al. 2013).

The Coral ECA experienced significant stony coral assemblage declines across the study period, with significant losses determined for all stony coral metrics examined (cover, LTA, and density). These losses were predominately driven by a significant increase in Stony Coral Tissue Loss Disease (SCTLD) that is known to affect more than 22 species of stony corals (SCTLD Case Definition 2018). Prevalence of SCTLD peaked in 2016, and subsequently has dropped every year since, reaching the lowest prevalence recorded in 2020. As regional disease prevalence has dropped to < 1% in 2018, 2019, and 2020, total loss from this event can begin to be quantified, and recovery can start to be addressed.

Regionally, the year-to-year analysis found no significant change in stony coral cover from 2019 to 2020. Previously, stony coral cover decreased every year from 2014 to 2018, where cover in 2018 was significantly lower than cover in 2017 (Gilliam et al. 2019). From 2014 to 2018 there was an estimated 64% loss of regional stony coral cover. For the first time since 2013, regional stony coral cover increased from 2019 to 2020, although this increase was not significant, and primarily driven by an increase in 'weedy' species. Only two sites had significant change in cover from 2019 to 2020; site BCA had a significant decrease in cover, while site MC1 had a significant increase in cover. Site BCA is a targeted *Acropora cervicornis* patch and has been experiencing long term significant declines in cover across all time periods. Stony coral live tissue areas (LTA) were estimated to provide an additional and perhaps more sensitive metric for describing changes to the amount of live tissue in the region. Regional LTA from 2017-2020 was significantly lower than the LTA in 2013, 2014, and 2015. From 2015 to 2018 there was an estimated 58% loss in regional LTA. Although no significant recovery has been recorded, regional LTA has increased each year since 2018, where LTA in 2020 increased by 14% compared to 2018. Regional stony coral density significantly increased for the first time across the study period, where density in 2020 was significantly higher than the density in 2013, 2014, and 2016.

Differences between LTA loss across the SCTLD susceptibility groups was observed. Of the three groupings tested, only the Intermediately-High SCTLD susceptible species had a significant change in LTA. For Intermediately-High, regional LTA in 2017-2020 was significantly lower than LTA in 2013-2015. No significant change in LTA was observed for Low susceptible or Presumed susceptible species groups. The maximum mean regional LTA, for both Presumed and Low, was recorded in 2019 and 2020, respectively. The loss of the species in the Intermediately-High SCTLD susceptibility category demonstrates that the regional loss in LTA was driven almost entirely by the loss of SCTLD susceptible species. These species include vital reef building species such as *Montastrea cavernosa* and

Orbicella spp. Loss of *Montastraea cavernosa* is of particular concern because the species contributes greatly to stony coral benthic cover and LTA, and this species is present in all four Southeast Florida counties and reef habitats. *Montastraea cavernosa* is also one of the more common large (~>50 cm diameter) colony forming species and has commonly been described as a 'robust' species capable of surviving in variable habitats and conditions. This is in contrast to Low susceptible species, which includes small weedier species such as *Porites astreoides* and *P. porites* which are now contributing greater to the stony coral tissue remaining within the Coral ECA. The only site to have a significant increase in cover from 2019 to 2020 was MC1, which is comprised almost entirely of *P. astreoides*.

Declines in the stony coral community were not confined to any one area and this regional scale loss is of great concern. Stony coral cover, density and LTA declines were observed in Martin, Palm Beach, Broward and Miami-Dade counties. These losses were also observed in all habitats, which range in depth from 3 to 21 meters. The rate of decline is also of concern as significant losses have been observed over relatively short time periods. However, no species were completely lost from the project, and many of the species most susceptible to SCTLD had an increasing number of colonies < 4 cm in diameter and 4-10 cm in diameter from 2018 to 2020. *Dichocoenia stokesii, Meandrina meandrites* and *M. cavernosa* all saw increases in the number of colonies 4-10 cm within the sample sites from 2018 to 2020, in addition to having colonies in the < 4 cm size class. The only SCTLD susceptible species within the dataset that did not have any colonies < 4 cm were the *Orbicella* species. The greatest contributors to the < 4 cm size class include: *Siderastrea* spp., *P. astreoides*, and *Agaricia* spp. In 2020, these three species alone contributed to > 84 % of all colonies < 4 cm. Both *P. astreoides*, and *Agaricia* spp. are rapidly growing, lower relief species that have not had any significant decline in any metric across the study years.

There is no clear relationship between the changes documented in the stony coral community and the octocoral or sponge communities. Octocoral cover has generally decreased through time, and for site Groups A, C, and D the last time interval (2019-2020) had significantly lower cover than previous years. In contrast, region-wide octocoral density in 2020 was significantly higher than all other years, and density in 2019 was significantly higher than in 2013. Significant changes were identified for all three target species, and *G. ventalina* and *A. americana* both had significant increases in density in 2020, and both species had the highest recorded density across study years in 2020. There are likely a number of factors contributing to the contrast between the cover results and colony density. Benthic cover estimates derived from transect images in this project include octocoral canopy; therefore, larger-taller colonies will contribute greatly to percent cover estimates. All colonies with living tissue regardless of size contribute equally to colony density estimates. *Antillogorgia americana* mean colony height reached its minimum in 2020, and was significantly smaller than in 2013-2018, however colony density was significantly higher in 2020 than all other years. These results indicate that the region experienced a decline in colony size and/or an increase in partial mortality in the larger size classes, both of which would contribute to reduced cover, and likely an increase in smaller colony abundance.

Xestospongia muta, the giant barrel sponge, density region-wide has generally increased with mean density in 2020 significantly greater than in 2013. Although there was a dip in density in 2018 due to the passing of Hurricane Irma late in 2017, density has generally been increasing each year. The percent cover of sponges was the most temporally consistent across the taxa examined, and there were no region-wide consistent temporal trends identified among the site groups. The conditions driving the changes to the stony coral community and macroalgae cover do not appear to be, at the current level of examination, impacting the sponge communities.

Macroalgae cover was more variable than both stony coral and octocorals cover but generally increased across most site groups, with the last time interval (2019-2020) having significantly higher macroalgae cover than certain previous time intervals. Martin County, which previously had a decreasing trend across time intervals, had a significant increase in macroalgae cover from time interval 2016-2018 to time interval 2019-2020. Interpreting temporal changes in macroalgae cover through annual visits is challenging as macroalgae cover can change significantly in short time periods. These data do indicate that region-wide conditions appear to be more favorable to macroalgae growth. These changing conditions may include increased nutrients, water temperatures, substrate availability and a host of other factors not specifically addressed in this project.

SECREMP is an annual monitoring program and annual programs are designed to provide current status and long-term trend information. Capturing the processes that contribute to the changes in conditions and long-term trends is a challenge for annual sampling. Diseased individuals are a normal part of all populations, but unfortunately, disease outbreaks appear to be becoming a greater and more common threat. There have been a number of environmental factors reported that are potentially increasing the risk of disease and mortality above normal levels, including elevated water temperatures, various water quality parameters, and increased sedimentation and turbidity. However, all the factors and/or conditions that may be potentially contributing to the reported disease outbreak cannot be defined or evaluated. A combination of factors is most likely driving the disease event. Additionally, not all coral mortality documented in this report was caused by disease; other stressors, environmental and biological, most certainly contributed to some mortality across the region and/or at specific sites.

As disease prevalence has dropped to < 1% regionally, and with no further significant loss of stony coral LTA and density observed over the last three years, there is hope that natural recovery can begin. Stony coral density underwent the first significant increase in 2020 since the onset of the disease event. However, the species driving this increase include weedy, low relief species that do not provide the same structure to the reef as many of the larger species impacted by SCTLD. Additionally, the composition and diversity of stony coral species at sites has been significantly impacted and will affect what species are able to successfully sexually reproduce. Mitigation and intervention may be necessary to assist those species with the greatest losses from SCTLD in order to see any significant recovery.

The Southeast Florida reefs represent a significant economic resource to the region. Between June 2000 and May 2001, visitors spent 28 million person-days enjoying artificial and natural reefs in Southeast Florida. During the same period, reef-related expenditures and income amounted to over $5.7 billion and supported over 61,300 jobs in Miami-Dade, Broward, Palm Beach, and Martin Counties (Johns et al. 2001, 2004). Notably, Johns et al. (2001) indicated Southeast Florida reefs generate six times the sales, income, and jobs compared to reefs in the Florida Keys.

The chronic nature of disturbances to and the significant economic value of Southeast Florida reefs requires comprehensive, long-term monitoring to be conducted to define and quantify change and to help identify threats to the ecosystem. The region-wide information generated during the annual SECREMP site visits provide scientifically valid status and trend data designed to assist local resource managers in understanding the condition of the resources and possible implications of actions occurring in terrestrial and adjacent marine habitats. Both continual region-wide monitoring (SECREMP) and improved incident-specific monitoring are necessary if resource managers are to develop sound management plans for coral reefs that allow continued use and realization of the economic value of these fragile marine ecosystems.

The expansion of CREMP to include sites in Broward, Miami-Dade, Palm Beach, and Martin Counties through SECREMP, has insured that a suite of parameters is being monitored for much of Florida's Coral Reef. As a monitoring project under the NOAA Coral Reef Conservation Program Cooperative Agreement for the Southeast Florida coast, SECREMP will continue to provide valuable Southeast Florida coral reef status and long-term trend data. SECREMP provides resource managers with the critical information required to manage this valuable, yet increasingly threatened, natural resource.

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Appendices

Appendix 1. Mean cover (%) by site (R= region-wide comparison; BC = Broward County; DC = Miami-Dade County; PB = Palm Beach County; MC = Martin County). Region-wide values are calculated as an average of the sum of each site. Site level values are calculated as an average of the stations. For cover data for years prior to 2013 see Gilliam et al. (2013)

		2013	2014	2015	2016	2017	2018	2019	2020
Variable	Level	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Stony Coral	R (n=22)	2.54 ± 0.54	2.83 ± 0.61	2.54 ± 0.54	1.52 ± 0.32	1.46 ± 0.30	1.03 ± 0.29	1.24 ± 0.33	1.40 ± 0.37
	DC1	4.24 ± 0.92	5.44 ± 1.65	5.33 ± 2.54	2.70 ± 0.76	2.83 ± 0.35	2.50 ± 0.32	2.21 ± 0.70	2.18 ± 0.47
	DC2	0.95 ± 0.48	1.55 ± 0.40	1.22 ± 0.29	0.76 ± 0.20	0.73 ± 0.19	0.50 ± 0.05	0.51 ± 0.17	0.34 ± 0.08
	DC3	0.24 ± 0.07	0.40 ± 0.17	0.19 ± 0.09	0.22 ± 0.11	0.36 ± 0.13	0.24 ± 0.11	0.31 ± 0.15	0.38 ± 0.18
	DC4	1.52 ± 0.50	1.36 ± 0.56	1.32 ± 0.37	1.09 ± 0.12	1.01 ± 0.23	0.78 ± 0.15	1.04 ± 0.17	1.08 ± 0.27
	DC5	1.59 ± 0.28	2.94 ± 1.08	1.16 ± 0.29	0.70 ± 0.06	0.94 ± 0.12	0.40 ± 0.06	1.09 ± 0.30	1.20 ± 0.29
	DC6	2.50 ± 0.48	2.86 ± 0.80	3.24 ± 0.84	2.72 ± 0.69	2.22 ± 0.65	1.28 ± 0.42	1.60 ± 0.50	1.66 ± 0.72
	DC7	0.51 ± 0.09	0.50 ± 0.17	0.42 ± 0.04	0.16 ± 0.07	0.45 ± 0.07	0.34 ± 0.18	0.31 ± 0.16	0.29 ± 0.15
	DC8	1.51 ± 0.55	1.51 ± 0.34	1.18 ± 0.24	1.36 ± 0.51	1.04 ± 0.27	0.97 ± 0.40	1.04 ± 0.31	1.34 ± 0.56
	BC1	12.67 ± 1.93	12.27 ± 1.73	12.35 ± 1.17	7.28 ± 1.38	4.92 ± 0.86	6.43 ± 1.47	6.48 ± 0.89	6.56 ± 1.60
	BC2	0.73 ± 0.43	0.78 ± 0.21	0.89 ± 0.47	0.38 ± 0.10	0.35 ± 0.11	0.46 ± 0.17	0.38 ± 0.07	0.22 ± 0.12
	BC3	0.69 ± 0.32	0.61 ± 0.22	0.69 ± 0.32	0.41 ± 0.31	0.33 ± 0.12	0.24 ± 0.09	0.36 ± 0.15	0.66 ± 0.12
	BC4	4.04 ± 0.92	4.23 ± 0.88	4.38 ± 1.13	3.49 ± 0.67	3.82 ± 0.57	1.71 ± 0.36	2.65 ± 0.79	2.09 ± 0.46
	BC5	1.49 ± 0.30	1.08 ± 0.39	1.43 ± 0.20	0.16 ± 0.03	0.31 ± 0.12	0.23 ± 0.05	0.39 ± 0.17	0.43 ± 0.15
	BC6	0.76 ± 0.19	0.58 ± 0.23	0.60 ± 0.22	0.31 ± 0.09	0.53 ± 0.16	0.39 ± 0.10	0.36 ± 0.11	0.43 ± 0.18
	BCA	10.93 ± 1.67	13.85 ± 1.69	9.88 ± 2.06	4.75 ± 1.06	3.41 ± 0.90	2.44 ± 0.54	4.29 ± 0.87	6.11 ± 1.08
	PB1	0.11 ± 0.06	0.03 ± 0.03	0.10 ± 0.07	0.10 ± 0.07	0.06 ± 0.04	0.03 ± 0.03	0.10 ± 0.07	0.11 ± 0.06
	PB2	1.68 ± 0.38	2.09 ± 0.66	2.04 ± 0.42	0.87 ± 0.23	1.14 ± 0.31	1.00 ± 0.38	0.67 ± 0.23	1.08 ± 0.20
	PB3	1.49 ± 0.45	1.27 ± 0.43	1.04 ± 0.12	0.57 ± 0.10	0.59 ± 0.20	0.59 ± 0.17	0.47 ± 0.24	0.67 ± 0.28
	PB4	1.70 ± 0.42	1.73 ± 0.42	1.56 ± 0.54	0.40 ± 0.12	1.44 ± 1.15	0.48 ± 0.15	0.38 ± 0.11	0.36 ± 0.14
	PB5	1.94 ± 0.58	2.35 ± 0.37	2.04 ± 0.45	0.79 ± 0.24	0.60 ± 0.10	0.58 ± 0.31	0.70 ± 0.13	0.85 ± 0.23
	MC1	2.97 ± 1.47	3.60 ± 1.96	3.60 ± 1.67	2.98 ± 1.32	3.94 ± 1.14	0.89 ± 0.55	1.84 ± 1.14	2.65 ± 1.21
	MC2	1.52 ± 0.63	1.12 ± 0.39	1.31 ± 0.38	1.23 ± 0.56	1.13 ± 0.80	0.15 ± 0.15	0.03 ± 0.03	0.05 ± 0.05

Appendix 1. Continued

		2013	2014	2015	2016	2017	2018	2019	2020
Variable	Level	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Octocoral	R (n=22)	9.88 ± 1.07	9.60 ± 1.02	9.14 ± 0.97	8.76 ± 0.95	9.29 ± 1.19	7.46 ± 0.94	7.47 ± 0.94	8.08 ± 1.07
	DC1	8.34 ± 0.49	12.08 ± 1.49	9.45 ± 1.95	9.67 ± 0.72	9.37 ± 1.12	9.04 ± 1.29	6.51 ± 0.82	5.73 ± 0.57
	DC2	11.37 ± 0.47	12.04 ± 0.86	12.44 ± 0.79	8.49 ± 0.47	11.79 ± 1.54	7.06 ± 0.76	8.83 ± 0.65	8.76 ± 0.21
	DC3	8.38 ± 0.94	7.97 ± 1.42	9.19 ± 2.11	9.98 ± 0.48	11.50 ± 0.94	8.95 ± 0.45	7.84 ± 1.18	8.98 ± 0.52
	DC4	14.58 ± 1.36	12.15 ± 1.11	12.26 ± 0.78	12.34 ± 1.48	12.32 ± 0.64	9.92 ± 0.86	10.64 ± 0.65	8.54 ± 0.64
	DC5	16.74 ± 2.27	12.93 ± 1.42	12.67 ± 2.41	15.26 ± 1.17	15.39 ± 1.56	11.11 ± 2.08	9.83 ± 1.29	10.18 ± 0.43
	DC6	9.37 ± 1.47	7.04 ± 0.93	7.55 ± 0.92	6.87 ± 0.56	8.69 ± 0.68	4.94 ± 0.52	6.65 ± 0.55	5.37 ± 0.46
	DC7	8.09 ± 1.64	7.73 ± 0.33	11.79 ± 1.82	5.39 ± 0.70	6.65 ± 0.84	6.18 ± 1.28	6.50 ± 0.67	6.73 ± 0.38
	DC8	15.82 ± 1.84	14.11 ± 2.03	13.12 ± 0.62	12.23 ± 0.85	14.43 ± 1.40	11.56 ± 1.06	15.36 ± 0.86	9.18 ± 1.28
	BC1	7.36 ± 0.43	7.10 ± 0.56	5.74 ± 1.00	5.42 ± 0.74	6.32 ± 0.66	7.82 ± 0.44	9.93 ± 0.65	8.80 ± 0.82
	BC2	4.69 ± 0.87	7.98 ± 0.96	5.18 ± 0.45	5.01 ± 0.63	8.48 ± 1.19	7.25 ± 1.38	5.65 ± 0.84	8.94 ± 0.89
	BC3	13.12 ± 0.48	8.65 ± 1.68	9.28 ± 1.29	9.95 ± 0.90	9.38 ± 1.33	10.45 ± 1.49	7.83 ± 1.12	10.34 ± 1.25
	BC4	4.28 ± 0.58	4.20 ± 0.68	4.61 ± 0.51	5.03 ± 0.68	4.58 ± 0.76	2.14 ± 0.42	2.43 ± 0.74	3.01 ± 0.57
	BC5	6.76 ± 0.95	8.41 ± 0.76	6.51 ± 0.79	5.52 ± 0.48	7.05 ± 0.88	5.70 ± 0.41	6.81 ± 0.76	6.97 ± 0.30
	BC6	16.44 ± 1.40	16.79 ± 0.80	13.22 ± 0.49	13.69 ± 1.04	14.09 ± 1.16	11.64 ± 0.68	13.42 ± 0.90	16.86 ± 1.67
	BCA	2.96 ± 0.65	2.85 ± 0.40	2.25 ± 0.53	1.19 ± 0.23	1.13 ± 0.23	1.77 ± 0.22	2.00 ± 0.28	2.27 ± 0.49
	PB1	0.00 ± 0.00	0.00 ± 0.00	0.10 ± 0.07	0.00 ± 0.00	0.06 ± 0.06	0.00 ± 0.00	0.06 ± 0.06	0.03 ± 0.03
	PB2	17.12 ± 5.12	18.45 ± 4.22	18.61 ± 3.56	16.63 ± 3.29	18.80 ± 4.19	14.36 ± 3.14	8.93 ± 2.75	12.77 ± 3.91
	PB3	12.99 ± 1.89	11.91 ± 1.72	12.41 ± 1.36	17.03 ± 0.63	14.80 ± 1.71	9.80 ± 1.85	10.06 ± 0.91	12.60 ± 1.51
	PB4	18.93 ± 2.10	22.03 ± 2.11	20.71 ± 1.29	19.12 ± 2.36	15.40 ± 3.57	11.84 ± 2.18	12.31 ± 0.27	15.32 ± 0.92
	PB5	19.81 ± 1.27	16.62 ± 0.25	14.05 ± 1.95	13.88 ± 1.14	14.18 ± 1.21	12.62 ± 1.57	12.58 ± 1.03	16.41 ± 1.05
	MC1	0.12 ± 0.12	0.02 ± 0.02	0.05 ± 0.03	0.03 ± 0.03	0.00 ± 0.00	0.00 ± 0.00	0.03 ± 0.03	0.00 ± 0.00
	MC2	0.00 ± 0.00	0.03 ± 0.03	0.00 ± 0.00	0.03 ± 0.03	0.00 ± 0.00	0.00 ± 0.00	0.03 ± 0.03	0.00 ± 0.00

Appendix 1. Continued

		2013	2014	2015	2016	2017	2018	2019	2020
Variable	Level	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Sponge	R (n=22)	5.18 ± 0.54	5.52 ± 0.58	5.75 ± 0.61	5.43 ± 0.54	6.09 ± 0.76	4.90 ± 0.58	5.06 ± 0.61	6.08 ± 0.76
	DC1	2.64 ± 0.48	2.66 ± 0.33	3.34 ± 0.38	3.17 ± 0.18	2.88 ± 0.35	3.37 ± 0.51	3.07 ± 0.40	3.93 ± 1.11
	DC2	4.93 ± 0.35	4.97 ± 0.52	5.69 ± 0.33	5.88 ± 0.70	6.38 ± 1.21	4.59 ± 1.04	3.57 ± 0.23	5.74 ± 0.28
	DC3	5.47 ± 0.91	3.59 ± 0.90	3.19 ± 0.84	4.86 ± 1.45	4.55 ± 1.14	4.00 ± 0.67	3.85 ± 0.54	6.44 ± 1.65
	DC4	7.50 ± 1.54	7.34 ± 1.44	8.64 ± 1.39	7.74 ± 1.57	8.14 ± 0.26	6.64 ± 0.46	5.93 ± 0.83	7.78 ± 0.59
	DC5	3.50 ± 0.57	4.22 ± 0.95	5.72 ± 1.08	5.02 ± 1.38	5.72 ± 1.23	3.36 ± 0.52	4.72 ± 0.68	4.96 ± 1.07
	DC6	2.28 ± 0.38	2.14 ± 0.37	1.75 ± 0.24	2.42 ± 0.19	3.02 ± 0.29	1.84 ± 0.52	2.93 ± 0.68	2.67 ± 0.36
	DC7	7.52 ± 1.10	7.47 ± 1.48	8.60 ± 0.60	7.82 ± 0.66	7.73 ± 1.01	6.18 ± 1.40	7.99 ± 1.77	9.75 ± 1.54
	DC8	2.58 ± 0.28	3.19 ± 0.43	3.60 ± 0.27	3.78 ± 0.70	3.48 ± 0.30	3.07 ± 0.60	3.87 ± 0.34	4.01 ± 0.88
	BC1	3.25 ± 0.30	3.72 ± 0.57	3.70 ± 0.82	3.17 ± 0.73	3.29 ± 0.11	3.63 ± 0.57	3.22 ± 0.48	3.21 ± 0.61
	BC2	5.22 ± 0.50	5.67 ± 0.63	6.55 ± 0.90	4.45 ± 0.58	6.79 ± 0.71	5.74 ± 0.96	5.29 ± 0.60	6.49 ± 0.37
	BC3	6.42 ± 0.50	5.09 ± 0.55	5.84 ± 0.39	4.48 ± 0.51	6.00 ± 0.82	6.37 ± 0.44	5.01 ± 0.21	5.62 ± 0.46
	BC4	3.01 ± 0.35	3.93 ± 0.48	3.90 ± 0.93	3.52 ± 0.53	4.59 ± 0.07	2.47 ± 0.54	3.50 ± 0.82	3.49 ± 0.73
	BC5	6.92 ± 0.51	7.11 ± 1.14	7.30 ± 1.05	7.00 ± 0.86	8.08 ± 1.07	6.29 ± 0.91	8.63 ± 0.73	7.74 ± 0.96
	BC6	3.80 ± 0.70	5.92 ± 1.34	4.96 ± 0.89	5.53 ± 0.42	5.89 ± 0.59	4.46 ± 1.40	5.80 ± 0.23	6.65 ± 0.83
	BCA	3.58 ± 1.59	0.72 ± 0.35	0.87 ± 0.17	0.75 ± 0.29	0.82 ± 0.33	2.05 ± 0.77	1.43 ± 0.08	1.58 ± 0.29
	PB1	1.82 ± 1.02	3.47 ± 1.87	3.01 ± 1.29	3.98 ± 2.10	5.65 ± 3.11	2.40 ± 1.36	2.41 ± 1.43	2.75 ± 1.43
	PB2	7.44 ± 0.45	8.47 ± 0.71	7.92 ± 0.87	7.24 ± 0.48	8.13 ± 1.15	6.31 ± 0.92	4.81 ± 0.16	8.06 ± 1.02
	PB3	10.65 ± 0.88	12.26 ± 1.59	12.39 ± 1.22	11.80 ± 0.93	14.78 ± 1.37	11.24 ± 1.60	12.63 ± 1.11	16.55 ± 1.33
	PB4	12.69 ± 2.79	13.34 ± 2.17	14.76 ± 2.44	13.24 ± 1.88	13.23 ± 4.10	10.48 ± 0.71	9.98 ± 0.99	11.73 ± 1.56
	PB5	8.60 ± 1.28	9.79 ± 0.75	9.78 ± 1.40	7.49 ± 0.86	10.73 ± 1.04	8.94 ± 1.59	8.28 ± 1.25	9.08 ± 1.01
	MC1	1.54 ± 0.33	2.72 ± 0.43	1.88 ± 0.47	2.72 ± 0.17	2.14 ± 0.21	2.59 ± 0.59	2.65 ± 0.89	2.66 ± 0.34
	MC2	2.56 ± 0.64	3.72 ± 0.75	3.01 ± 0.48	3.36 ± 0.87	1.90 ± 0.55	1.75 ± 0.48	1.64 ± 0.48	2.93 ± 0.88

Appendix 1. Continued

		2013	2014	2015	2016	2017	2018	2019	2020
Variable	Level	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Macroalgae	R (n=22)	9.15 ± 1.89	10.27 ± 1.51	11.16 ± 1.65	26.90 ± 3.02	13.11 ± 1.63	13.98 ± 2.46	23.09 ± 2.13	18.37 ± 1.99
	DC1	15.26 ± 3.42	3.60 ± 0.62	2.88 ± 1.09	17.85 ± 2.70	2.30 ± 0.34	20.91 ± 3.72	25.21 ± 8.80	31.22 ± 0.78
	DC2	5.73 ± 2.70	5.59 ± 1.84	4.28 ± 1.60	67.44 ± 3.03	9.46 ± 2.74	23.70 ± 4.23	38.27 ± 2.81	24.55 ± 2.10
	DC3	1.13 ± 0.37	6.49 ± 0.94	3.57 ± 0.61	67.34 ± 3.52	15.03 ± 5.94	2.23 ± 1.77	30.11 ± 11.62	9.96 ± 4.90
	DC4	2.22 ± 0.68	8.38 ± 2.02	5.21 ± 1.76	21.26 ± 7.35	7.75 ± 1.70	11.52 ± 2.54	21.67 ± 2.81	28.50 ± 5.14
	DC5	7.06 ± 2.81	25.18 ± 2.48	25.72 ± 2.95	27.62 ± 4.12	22.37 ± 4.30	36.29 ± 2.57	24.02 ± 3.96	28.32 ± 3.42
	DC6	10.02 ± 0.80	9.80 ± 0.74	12.66 ± 2.70	31.97 ± 1.76	6.35 ± 2.07	40.39 ± 3.18	27.26 ± 3.54	32.65 ± 4.29
	DC7	2.53 ± 0.85	6.44 ± 1.41	8.91 ± 2.96	42.23 ± 3.74	12.39 ± 2.87	30.15 ± 6.36	32.28 ± 2.30	24.30 ± 2.74
	DC8	6.28 ± 0.91	7.79 ± 2.43	15.44 ± 4.11	26.53 ± 6.43	16.04 ± 4.62	14.23 ± 0.91	23.25 ± 2.00	24.22 ± 3.74
	BC1	7.04 ± 1.37	7.81 ± 1.07	15.21 ± 3.76	32.24 ± 6.36	27.00 ± 2.79	14.34 ± 3.40	23.12 ± 1.88	13.20 ± 1.32
	BC2	3.21 ± 0.80	6.13 ± 1.61	7.42 ± 2.80	25.62 ± 4.39	9.71 ± 1.68	0.90 ± 0.25	23.45 ± 2.74	9.43 ± 4.13
	BC3	1.88 ± 0.45	12.20 ± 2.59	11.55 ± 9.45	37.08 ± 8.75	21.96 ± 3.41	1.38 ± 0.74	24.22 ± 4.56	12.93 ± 4.84
	BC4	26.08 ± 3.20	18.87 ± 2.12	22.91 ± 1.84	40.16 ± 3.74	28.11 ± 1.89	21.40 ± 3.12	23.69 ± 2.70	22.94 ± 4.53
	BC5	10.92 ± 3.37	7.31 ± 0.58	18.71 ± 5.42	27.21 ± 4.90	10.10 ± 0.70	11.43 ± 3.99	9.71 ± 0.96	21.96 ± 3.96
	BC6	4.36 ± 1.21	4.39 ± 0.55	4.63 ± 0.70	9.67 ± 2.53	19.75 ± 4.45	17.50 ± 6.10	13.06 ± 2.55	10.57 ± 4.87
	BCA	2.69 ± 1.70	6.66 ± 4.37	2.54 ± 0.51	8.01 ± 3.32	6.05 ± 1.88	2.21 ± 0.79	6.03 ± 2.05	7.40 ± 0.85
	PB1	0.28 ± 0.16	1.75 ± 1.45	3.66 ± 0.94	1.43 ± 0.89	2.98 ± 1.13	2.40 ± 0.56	10.90 ± 3.16	16.85 ± 4.72
	PB2	0.60 ± 0.31	1.19 ± 0.38	3.38 ± 1.38	9.87 ± 3.19	3.49 ± 1.75	2.38 ± 0.98	19.47 ± 5.48	5.62 ± 2.69
	PB3	5.12 ± 0.89	7.21 ± 1.30	9.46 ± 2.56	16.10 ± 3.32	13.93 ± 3.33	8.24 ± 1.76	16.09 ± 2.31	4.90 ± 1.54
	PB4	3.22 ± 0.65	2.22 ± 0.47	6.07 ± 3.16	8.39 ± 0.83	7.75 ± 2.17	4.04 ± 1.25	6.82 ± 2.45	12.06 ± 2.90
	PB5	11.91 ± 1.80	15.19 ± 1.38	10.72 ± 1.41	30.30 ± 4.52	21.73 ± 2.79	9.89 ± 1.20	27.20 ± 3.07	11.26 ± 2.18
	MC1	23.38 ± 6.52	23.05 ± 2.77	26.35 ± 8.89	12.21 ± 7.54	10.09 ± 3.72	9.81 ± 3.31	39.04 ± 5.97	15.77 ± 2.44
	MC2	50.38 ± 3.07	38.72 ± 4.63	24.18 ± 7.20	31.35 ± 10.52	14.02 ± 4.83	22.21 ± 2.71	43.02 ± 7.55	35.48 ± 6.54

Appendix 2. Year to year model estimation of change in stony coral, octocoral, sponge, and macroalgae percent cover per year by region and by site from 2019 to 2020. Significant trends in cover are bolded and indicated as increasing (↑), decreasing (↓), or no significant change (-) (R= region-wide comparison).

Variable	Level	DF	t	p	Significant Change
Stony Coral	R	66	2.92	0.0923	-
	DC1	66	0.27	0.9158	-
	DC2	66	0.39	0.4581	-
	DC3	66	0.28	0.7386	-
	DC4	66	0.33	0.9854	-
	DC5	66	2.93	0.6723	-
	DC6	66	3.26	0.7642	-
	DC7	66	0.92	0.9201	-
	DC8	66	0.12	0.4926	-
	BC1	66	0.03	0.8574	-
	BC2	66	2.14	0.1483	-
	BC3	66	2.61	0.1109	-
	BC4	66	1.12	0.294	-
	BC5	66	0.43	0.5163	-
	BC6	66	0.02	0.9013	-
	BCA	**66**	**7.02**	**0.0101**	↑
	PB1	66	0.19	0.9339	-
	PB2	66	0.2	0.1139	-
	PB3	66	0	0.1877	-
	PB4	66	2.04	0.8611	-
	PB5	66	0.12	0.6536	-
	MC1	**66**	**35.8**	**0.0418**	↑
	MC2	66	10.29	0.8714	-
Octocoral	**R**	**66**	**10.44**	**0.0019**	↑
	DC1	66	1.45	0.2334	-
	DC2	66	0	0.9657	-
	DC3	66	2.91	0.0926	-
	DC4	**66**	**7.29**	**0.0088**	↓
	DC5	66	0.32	0.5752	-
	DC6	**66**	**4.28**	**0.0426**	↓
	DC7	66	0.17	0.6859	-
	DC8	**66**	**51.07**	**<.0001**	↓
	BC1	66	2.25	0.1387	-
	BC2	**66**	**23.94**	**<.0001**	↑
	BC3	**66**	**11.05**	**0.0014**	↑
	BC4	66	2.75	0.1018	-
	BC5	66	0.11	0.746	-
	BC6	**66**	**11.65**	**0.0011**	↑
	BCA	66	0.37	0.5447	-
	PB1	66	0.12	0.7314	-
	PB2	**66**	**20.11**	**<.0001**	↑
	PB3	**66**	**8.47**	**0.0049**	↑
	PB4	**66**	**9.99**	**0.0024**	↑
	PB5	**66**	**15.98**	**0.0002**	↑
	MC1	66	0.42	0.5208	-
	MC2	66	0.42	0.5174	-

Appendix 2. Continued

Variable	Level	DF	t	p	Significant Change
Sponge	**R**	**66**	**48.29**	**<0.0001**	↑
	DC1	66	1.64	0.205	-
	DC2	**66**	**12.71**	**0.0007**	↑
	DC3	**66**	**13.66**	**0.0004**	↑
	DC4	**66**	**6.68**	**0.012**	↑
	DC5	66	0.06	0.8138	-
	DC6	66	0.16	0.692	-
	DC7	**66**	**4.93**	**0.0299**	↑
	DC8	66	0.00	0.9548	-
	BC1	66	0.00	0.9496	-
	BC2	66	3.22	0.0774	-
	BC3	66	0.83	0.3666	-
	BC4	66	0.00	0.9589	-
	BC5	66	1.32	0.2549	-
	BC6	66	1.22	0.2739	-
	BCA	66	0.10	0.7529	-
	PB1	**66**	**4.32**	**0.0414**	↑
	PB2	**66**	**19.8**	**<.0001**	↑
	PB3	**66**	**13.16**	**0.0006**	↑
	PB4	66	3.26	0.0754	-
	PB5	66	1.04	0.3108	-
	MC1	66	0.24	0.6263	-
	MC2	**66**	**8.50**	**0.0048**	↑
Macroalgae	**R**	**66**	**18.33**	**<.0001**	↓
	DC1	66	1.55	0.2173	-
	DC2	**66**	**4.13**	**0.0462**	↓
	DC3	**66**	**14.37**	**0.0003**	↓
	DC4	66	1.14	0.2905	-
	DC5	66	0.53	0.4684	-
	DC6	66	0.64	0.4253	-
	DC7	66	1.58	0.2128	-
	DC8	66	0.01	0.9044	-
	BC1	66	3.78	0.0561	-
	BC2	**66**	**10.06**	**0.0023**	↓
	BC3	**66**	**5.6**	**0.0209**	↓
	BC4	66	0.04	0.8373	-
	BC5	**66**	**6.28**	**0.0147**	↑
	BC6	66	0.86	0.3565	-
	BCA	66	0.33	0.5652	-
	PB1	66	1.71	0.1960	-
	PB2	**66**	**11.67**	**0.0011**	↓
	PB3	**66**	**9.29**	**0.0033**	↓
	PB4	66	2.5	0.1183	-
	PB5	**66**	**9.74**	**0.0027**	↓
	MC1	**66**	**13.92**	**0.0004**	↓
	MC2	66	1.01	0.3175	-

Appendix 3. Long term model estimation of change in stony coral, octocoral, sponge, and macroalgae percent cover across time intervals (±SEM). Each group of survey sites was analyzed separately with the groups delineated based on their initial survey years. Group A consists of nine original survey sites. The tenth original site, BCA, was analyzed on its own due to the special nature of the *Acropora cervicornis* patch at this location. Group B consists of the two Martin County sites first surveyed in 2006, Group C consists of the four sites added in 2010 and Group D consists of the six sites added in 2013.

Stony Coral						
Site Group A (PB1, PB2, PB3, BC1, BC2, BC 3, DC1, DC2, DC3) IV > I & II > V & VI; III > V & VI						
Time interval	Time interval	Est.	SE	DF	t	P
I (2004-2006)	II (2007-2009)	-0.00148	0.003431	567	-0.43	0.9981
I (2004-2006)	III (2010-2012)	-0.00697	0.003668	567	-1.9	0.4026
I (2004-2006)	**IV (2013-2015)**	**-0.01683**	**0.003668**	**567**	**-4.59**	**<.0001**
I (2004-2006)	**V (2016-2018)**	**0.01722**	**0.003668**	**567**	**4.69**	**<.0001**
I (2004-2006)	**VI (2019-2020)**	**0.02**	**0.0041**	**567**	**4.88**	**<.0001**
II (2007-2009)	III (2010-2012)	-0.00549	0.003431	567	-1.6	0.5992
II (2007-2009)	**IV (2013-2015)**	**-0.01535**	**0.003431**	**567**	**-4.47**	**0.0001**
II (2007-2009)	**V (2016-2018)**	**0.0187**	**0.003431**	**567**	**5.45**	**<.0001**
II (2007-2009)	**VI (2019-2020)**	**0.02149**	**0.00389**	**567**	**5.52**	**<.0001**
III (2010-2012)	IV (2013-2015)	-0.00986	0.003668	567	-2.69	0.0792
III (2010-2012)	**V (2016-2018)**	**0.02419**	**0.003668**	**567**	**6.6**	**<.0001**
III (2010-2012)	**VI (2019-2020)**	**0.02697**	**0.0041**	**567**	**6.58**	**<.0001**
IV (2013-2015)	**V (2016-2018)**	**0.03405**	**0.003668**	**567**	**9.28**	**<.0001**
IV (2013-2015)	**VI (2019-2020)**	**0.03683**	**0.0041**	**567**	**8.98**	**<.0001**
V (2016-2018)	VI (2019-2020)	0.002782	0.0041	567	0.68	0.9843

Site Group B (MC1, MC2) II, III & IV > VI						
Time interval	Time interval	Est.	SE	DF	t	P
II (2007-2009)	III (2010-2012)	0.002956	0.01336	104	0.22	0.9995
II (2007-2009)	IV (2013-2015)	-0.01025	0.01336	104	-0.77	0.9394
II (2007-2009)	V (2016-2018)	0.02128	0.01336	104	1.59	0.5056
II (2007-2009)	**VI (2019-2020)**	**0.05241**	**0.01515**	**104**	**3.46**	**0.0069**
III (2010-2012)	IV (2013-2015)	-0.01321	0.01429	104	-0.92	0.8868
III (2010-2012)	V (2016-2018)	0.01833	0.01429	104	1.28	0.7024
III (2010-2012)	**VI (2019-2020)**	**0.04945**	**0.01597**	**104**	**3.1**	**0.0208**
IV (2013-2015)	V (2016-2018)	0.03154	0.01429	104	2.21	0.1852
IV (2013-2015)	**VI (2019-2020)**	**0.06266**	**0.01597**	**104**	**3.92**	**0.0015**
V (2016-2018)	VI (2019-2020)	0.03113	0.01597	104	1.95	0.2987

Appendix 3. Continued

Stony Coral cont.						
Site Group C (PB4, PB5, DC4, DC5) III & IV > V & VI						
Time interval	Time interval	Est.	SE	DF	t	P
III (2010-2012)	IV (2013-2015)	-0.0065	0.005341	148	-1.22	0.6167
III (2010-2012)	**V (2016-2018)**	**0.0424**	**0.005341**	**148**	**7.94**	**<.0001**
III (2010-2012)	**VI (2019-2020)**	**0.0339**	**0.005972**	**148**	**5.68**	**<.0001**
IV (2013-2015)	**V (2016-2018)**	**0.0489**	**0.005341**	**148**	**9.16**	**<.0001**
IV (2013-2015)	**VI (2019-2020)**	**0.0404**	**0.005972**	**148**	**6.77**	**<.0001**
V (2016-2018)	VI (2019-2020)	-0.0085	0.005972	148	-1.42	0.4869

Site Group D (BC4, BC5, BC6, DC6, DC7, DC8) IV > V & VI						
Time interval	Time interval	Est.	SE	DF	t	P
IV (2013-2015)	**V (2016-2018)**	**0.02926**	**0.004359**	**156**	**6.71**	**<.0001**
IV (2013-2015)	**VI (2019-2020)**	**0.03332**	**0.004874**	**156**	**6.84**	**<.0001**
V (2016-2018)	VI (2019-2020)	0.004066	0.004874	156	0.83	0.6824

Site BCA I > II > III > IV > V & VI						
Time interval	Time interval	Est.	SE	DF	t	P
I (2004-2006)	**II (2007-2009)**	**0.07764**	**0.01536**	**63**	**5.06**	**<.0001**
I (2004-2006)	**III (2010-2012)**	**0.2035**	**0.01642**	**63**	**12.4**	**<.0001**
I (2004-2006)	**IV (2013-2015)**	**0.2719**	**0.01642**	**63**	**16.56**	**<.0001**
I (2004-2006)	**V (2016-2018)**	**0.4229**	**0.01642**	**63**	**25.76**	**<.0001**
I (2004-2006)	**VI (2019-2020)**	**0.3832**	**0.01835**	**63**	**20.88**	**<.0001**
II (2007-2009)	**III (2010-2012)**	**0.1259**	**0.01536**	**63**	**8.2**	**<.0001**
II (2007-2009)	**IV (2013-2015)**	**0.1943**	**0.01536**	**63**	**12.65**	**<.0001**
II (2007-2009)	**V (2016-2018)**	**0.3452**	**0.01536**	**63**	**22.48**	**<.0001**
II (2007-2009)	**VI (2019-2020)**	**0.3055**	**0.01741**	**63**	**17.55**	**<.0001**
III (2010-2012)	**IV (2013-2015)**	**0.06837**	**0.01642**	**63**	**4.16**	**0.0013**
III (2010-2012)	**V (2016-2018)**	**0.2194**	**0.01642**	**63**	**13.36**	**<.0001**
III (2010-2012)	**VI (2019-2020)**	**0.1796**	**0.01835**	**63**	**9.79**	**<.0001**
IV (2013-2015)	**V (2016-2018)**	**0.151**	**0.01642**	**63**	**9.2**	**<.0001**
IV (2013-2015)	**VI (2019-2020)**	**0.1113**	**0.01835**	**63**	**6.06**	**<.0001**
V (2016-2018)	VI (2019-2020)	-0.03972	0.01835	63	-2.16	0.2692

Appendix 3. Continued

Octocoral						
Site Group A (PB1, PB2, PB3, BC1, BC2, BC 3, DC1, DC2, DC3) I > II, III, IV, V & VI; II > V & VI; III > IV, V & VI; IV > VI						
Time interval	Time interval	Est.	SE	DF	t	P
I (2004-2006)	**II (2007-2009)**	**0.04008**	**0.005232**	**567**	**7.66**	**<.0001**
I (2004-2006)	**III (2010-2012)**	**0.0321**	**0.005593**	**567**	**5.74**	**<.0001**
I (2004-2006)	**IV (2013-2015)**	**0.05389**	**0.005593**	**567**	**9.64**	**<.0001**
I (2004-2006)	**V (2016-2018)**	**0.05565**	**0.005593**	**567**	**9.95**	**<.0001**
I (2004-2006)	**VI (2019-2020)**	**0.07316**	**0.006253**	**567**	**11.7**	**<.0001**
II (2007-2009)	III (2010-2012)	-0.00798	0.005232	567	-1.53	0.6475
II (2007-2009)	IV (2013-2015)	0.01381	0.005232	567	2.64	0.0895
II (2007-2009)	**V (2016-2018)**	**0.01556**	**0.005232**	**567**	**2.97**	**0.036**
II (2007-2009)	**VI (2019-2020)**	**0.03307**	**0.005932**	**567**	**5.58**	**<.0001**
III (2010-2012)	**IV (2013-2015)**	**0.0218**	**0.005593**	**567**	**3.9**	**0.0015**
III (2010-2012)	**V (2016-2018)**	**0.02355**	**0.005593**	**567**	**4.21**	**0.0004**
III (2010-2012)	**VI (2019-2020)**	**0.04106**	**0.006253**	**567**	**6.57**	**<.0001**
IV (2013-2015)	V (2016-2018)	0.001752	0.005593	567	0.31	0.9996
IV (2013-2015)	**VI (2019-2020)**	**0.01926**	**0.006253**	**567**	**3.08**	**0.0262**
V (2016-2018)	VI (2019-2020)	0.01751	0.006253	567	2.8	0.0588

Site Group B (MC1, MC2) No Test - all values near zero

Site Group C (PB4, PB5, DC4, DC5) III > IV > V > VI						
Time interval	Time interval	Est.	SE	DF	t	P
III (2010-2012)	**IV (2013-2015)**	**0.0399**	**0.007681**	**148**	**5.19**	**<.0001**
III (2010-2012)	**V (2016-2018)**	**0.06712**	**0.007681**	**148**	**8.74**	**<.0001**
III (2010-2012)	**VI (2019-2020)**	**0.09412**	**0.008588**	**148**	**10.96**	**<.0001**
IV (2013-2015)	**V (2016-2018)**	**0.02723**	**0.007681**	**148**	**3.54**	**0.0029**
IV (2013-2015)	**VI (2019-2020)**	**0.05422**	**0.008588**	**148**	**6.31**	**<.0001**
V (2016-2018)	**VI (2019-2020)**	**0.027**	**0.008588**	**148**	**3.14**	**0.0108**

Appendix 3. Continued

Octocoral cont.						
Site Group D (BC4, BC5, BC6, DC6, DC7, DC8) IV > V & VI						
Time interval	Time interval	Est.	SE	DF	t	P
IV (2013-2015)	**V (2016-2018)**	**0.02749**	**0.005358**	**156**	**5.13**	**<.0001**
IV (2013-2015)	**VI (2019-2020)**	**0.02779**	**0.00599**	**156**	**4.64**	**<.0001**
V (2016-2018)	VI (2019-2020)	0.000302	0.00599	156	0.05	0.9986

Site BCA III & IV > V; VI > V						
Time interval	Time interval	Est.	SE	DF	t	P
I (2004-2006)	II (2007-2009)	0.007321	0.008376	63	0.87	0.9513
I (2004-2006)	III (2010-2012)	-0.01333	0.008954	63	-1.49	0.6724
I (2004-2006)	IV (2013-2015)	-0.01335	0.008954	63	-1.49	0.671
I (2004-2006)	V (2016-2018)	0.02595	0.008954	63	2.9	0.0554
I (2004-2006)	VI (2019-2020)	-0.00664	0.01001	63	-0.66	0.9852
II (2007-2009)	III (2010-2012)	-0.02065	0.008376	63	-2.47	0.1501
II (2007-2009)	IV (2013-2015)	-0.02067	0.008376	63	-2.47	0.1494
II (2007-2009)	V (2016-2018)	0.01863	0.008376	63	2.22	0.2415
II (2007-2009)	VI (2019-2020)	-0.01397	0.009497	63	-1.47	0.6839
III (2010-2012)	IV (2013-2015)	-0.00002	0.008954	63	0	1
III (2010-2012)	**V (2016-2018)**	**0.03928**	**0.008954**	**63**	**4.39**	**0.0006**
III (2010-2012)	VI (2019-2020)	0.006688	0.01001	63	0.67	0.9848
IV (2013-2015)	**V (2016-2018)**	**0.0393**	**0.008954**	**63**	**4.39**	**0.0006**
IV (2013-2015)	VI (2019-2020)	0.006708	0.01001	63	0.67	0.9846
V (2016-2018)	**VI (2019-2020)**	**-0.0326**	**0.01001**	**63**	**-3.26**	**0.0215**

Appendix 3. Continued

Macroalgae						
Site Group A (PB1, PB2, PB3, BC1, BC2, BC 3, DC1, DC2, DC3) I < II, III & IV < V & VI						
Time interval	Time interval	Est.	SE	DF	t	P
I (2004-2006)	**II (2007-2009)**	**-0.06884**	**0.01682**	**567**	**-4.09**	**0.0007**
I (2004-2006)	**III (2010-2012)**	**-0.07127**	**0.01798**	**567**	**-3.96**	**0.0012**
I (2004-2006)	**IV (2013-2015)**	**-0.1048**	**0.01798**	**567**	**-5.83**	**<.0001**
I (2004-2006)	**V (2016-2018)**	**-0.2438**	**0.01798**	**567**	**-13.56**	**<.0001**
I (2004-2006)	**VI (2019-2020)**	**-0.2746**	**0.02011**	**567**	**-13.66**	**<.0001**
II (2007-2009)	III (2010-2012)	-0.00244	0.01682	567	-0.14	1
II (2007-2009)	IV (2013-2015)	-0.036	0.01682	567	-2.14	0.2683
II (2007-2009)	**V (2016-2018)**	**-0.175**	**0.01682**	**567**	**-10.4**	**<.0001**
II (2007-2009)	**VI (2019-2020)**	**-0.2057**	**0.01907**	**567**	**-10.79**	**<.0001**
III (2010-2012)	IV (2013-2015)	-0.03356	0.01798	567	-1.87	0.4243
III (2010-2012)	**V (2016-2018)**	**-0.1725**	**0.01798**	**567**	**-9.59**	**<.0001**
III (2010-2012)	**VI (2019-2020)**	**-0.2033**	**0.02011**	**567**	**-10.11**	**<.0001**
IV (2013-2015)	**V (2016-2018)**	**-0.139**	**0.01798**	**567**	**-7.73**	**<.0001**
IV (2013-2015)	**VI (2019-2020)**	**-0.1697**	**0.02011**	**567**	**-8.44**	**<.0001**
V (2016-2018)	VI (2019-2020)	-0.03076	0.02011	567	-1.53	0.6452

Site Group B (MC1, MC2) V < II, III, IV & VI						
Time interval	Time interval	Est.	SE	DF	t	P
II (2007-2009)	III (2010-2012)	0.06365	0.03977	104	1.6	0.5004
II (2007-2009)	IV (2013-2015)	0.06037	0.03977	104	1.52	0.5532
II (2007-2009)	**V (2016-2018)**	**0.2609**	**0.03977**	**104**	**6.56**	**<.0001**
II (2007-2009)	VI (2019-2020)	0.06881	0.04509	104	1.53	0.5481
III (2010-2012)	IV (2013-2015)	-0.00328	0.04251	104	-0.08	1
III (2010-2012)	**V (2016-2018)**	**0.1972**	**0.04251**	**104**	**4.64**	**<.0001**
III (2010-2012)	VI (2019-2020)	0.005161	0.04753	104	0.11	1
IV (2013-2015)	**V (2016-2018)**	**0.2005**	**0.04251**	**104**	**4.72**	**<.0001**
IV (2013-2015)	VI (2019-2020)	0.008444	0.04753	104	0.18	0.9998
V (2016-2018)	**VI (2019-2020)**	**-0.1921**	**0.04753**	**104**	**-4.04**	**0.001**

Appendix 3. Continued

Macroalgae cont.						
Site Group C (PB4, PB5, DC4, DC5) III < IV < V & VI						
Time interval	Time interval	Est.	SE	DF	t	P
III (2010-2012)	**IV (2013-2015)**	**-0.07656**	**0.0244**	**148**	**-3.14**	**0.011**
III (2010-2012)	**V (2016-2018)**	**-0.1753**	**0.0244**	**148**	**-7.18**	**<.0001**
III (2010-2012)	**VI (2019-2020)**	**-0.2054**	**0.02728**	**148**	**-7.53**	**<.0001**
IV (2013-2015)	**V (2016-2018)**	**-0.09875**	**0.0244**	**148**	**-4.05**	**0.0005**
IV (2013-2015)	**VI (2019-2020)**	**-0.1288**	**0.02728**	**148**	**-4.72**	**<.0001**
V (2016-2018)	VI (2019-2020)	-0.03005	0.02728	148	-1.1	0.6892

Site Group D (BC4, BC5, BC6, DC6, DC7, DC8) IV < V & VI; V > VI						
Time interval	Time interval	Est.	SE	DF	t	P
IV (2013-2015)	**V (2016-2018)**	**-0.1276**	**0.01677**	**156**	**-7.61**	**<.0001**
IV (2013-2015)	**VI (2019-2020)**	**-0.06816**	**0.01875**	**156**	**-3.64**	**0.0011**
V (2016-2018)	**VI (2019-2020)**	**0.0594**	**0.01875**	**156**	**3.17**	**0.0052**

Site BCA I < IV, V & VI; II < VI						
Time interval	Time interval	Est.	SE	DF	t	P
I (2004-2006)	II (2007-2009)	-0.06252	0.03638	63	-1.72	0.5248
I (2004-2006)	III (2010-2012)	-0.1031	0.03889	63	-2.65	0.0999
I (2004-2006)	**IV (2013-2015)**	**-0.1291**	**0.03889**	**63**	**-3.32**	**0.018**
I (2004-2006)	**V (2016-2018)**	**-0.1646**	**0.03889**	**63**	**-4.23**	**0.001**
I (2004-2006)	**VI (2019-2020)**	**-0.2098**	**0.04348**	**63**	**-4.83**	**0.0001**
II (2007-2009)	III (2010-2012)	-0.04061	0.03638	63	-1.12	0.8728
II (2007-2009)	IV (2013-2015)	-0.06656	0.03638	63	-1.83	0.4546
II (2007-2009)	V (2016-2018)	-0.1021	0.03638	63	-2.81	0.0695
II (2007-2009)	**VI (2019-2020)**	**-0.1473**	**0.04125**	**63**	**-3.57**	**0.0086**
III (2010-2012)	IV (2013-2015)	-0.02594	0.03889	63	-0.67	0.9849
III (2010-2012)	V (2016-2018)	-0.06148	0.03889	63	-1.58	0.6139
III (2010-2012)	VI (2019-2020)	-0.1067	0.04348	63	-2.45	0.1538
IV (2013-2015)	V (2016-2018)	-0.03554	0.03889	63	-0.91	0.9415
IV (2013-2015)	VI (2019-2020)	-0.08076	0.04348	63	-1.86	0.4375
V (2016-2018)	VI (2019-2020)	-0.04522	0.04348	63	-1.04	0.9024

Appendix 3. Continued

Sponges						
Site Group A (PB1, PB2, PB3, BC1, BC2, BC 3, DC1, DC2, DC3) I & II < III, IV, V & VI						
Time interval	Time interval	Est.	SE	DF	t	P
I (2004-2006)	II (2007-2009)	-0.00862	0.005345	567	-1.61	0.5899
I (2004-2006)	**III (2010-2012)**	**-0.04177**	**0.005714**	**567**	**-7.31**	**<.0001**
I (2004-2006)	**IV (2013-2015)**	**-0.03274**	**0.005714**	**567**	**-5.73**	**<.0001**
I (2004-2006)	**V (2016-2018)**	**-0.03625**	**0.005714**	**567**	**-6.34**	**<.0001**
I (2004-2006)	**VI (2019-2020)**	**-0.03321**	**0.006388**	**567**	**-5.2**	**<.0001**
II (2007-2009)	**III (2010-2012)**	**-0.03315**	**0.005345**	**567**	**-6.2**	**<.0001**
II (2007-2009)	**IV (2013-2015)**	**-0.02412**	**0.005345**	**567**	**-4.51**	**0.0001**
II (2007-2009)	**V (2016-2018)**	**-0.02763**	**0.005345**	**567**	**-5.17**	**<.0001**
II (2007-2009)	**VI (2019-2020)**	**-0.02458**	**0.00606**	**567**	**-4.06**	**0.0008**
III (2010-2012)	IV (2013-2015)	0.009029	0.005714	567	1.58	0.612
III (2010-2012)	V (2016-2018)	0.005519	0.005714	567	0.97	0.9285
III (2010-2012)	VI (2019-2020)	0.008562	0.006388	567	1.34	0.7624
IV (2013-2015)	V (2016-2018)	-0.00351	0.005714	567	-0.61	0.99
IV (2013-2015)	VI (2019-2020)	-0.00047	0.006388	567	-0.07	1
V (2016-2018)	VI (2019-2020)	0.003043	0.006388	567	0.48	0.997

Site Group B (MC1, MC2) II < III						
Time interval	Time interval	Est.	SE	DF	t	P
II (2007-2009)	**III (2010-2012)**	**-0.03979**	**0.009792**	**104**	**-4.06**	**0.0009**
II (2007-2009)	IV (2013-2015)	-0.02271	0.009792	104	-2.32	0.147
II (2007-2009)	V (2016-2018)	-0.01747	0.009792	104	-1.78	0.3884
II (2007-2009)	VI (2019-2020)	-0.01845	0.0111	104	-1.66	0.462
III (2010-2012)	IV (2013-2015)	0.01708	0.01047	104	1.63	0.4808
III (2010-2012)	V (2016-2018)	0.02233	0.01047	104	2.13	0.2142
III (2010-2012)	VI (2019-2020)	0.02134	0.0117	104	1.82	0.3657
IV (2013-2015)	V (2016-2018)	0.005244	0.01047	104	0.5	0.9871
IV (2013-2015)	VI (2019-2020)	0.004262	0.0117	104	0.36	0.9962
V (2016-2018)	VI (2019-2020)	-0.00098	0.0117	104	-0.08	1

Appendix 3. Continued

Sponges cont.						
Site Group C (PB4, PB5, DC4, DC5) III > VI						
Time interval	Time interval	Est.	SE	DF	t	P
III (2010-2012)	IV (2013-2015)	0.00927	0.006871	148	1.35	0.5333
III (2010-2012)	V (2016-2018)	0.01204	0.006871	148	1.75	0.3007
III (2010-2012)	**VI (2019-2020)**	**0.02289**	**0.007682**	**148**	**2.98**	**0.0176**
IV (2013-2015)	V (2016-2018)	0.002769	0.006871	148	0.4	0.9778
IV (2013-2015)	VI (2019-2020)	0.01362	0.007682	148	1.77	0.2906
V (2016-2018)	VI (2019-2020)	0.01085	0.007682	148	1.41	0.4938

Site Group D (BC4, BC5, BC6, DC6, DC7, DC8) IV & V < VI						
Time interval	Time interval	Est.	SE	DF	t	P
IV (2013-2015)	V (2016-2018)	-0.00245	0.00432	156	-0.57	0.8381
IV (2013-2015)	**VI (2019-2020)**	**-0.01783**	**0.004829**	**156**	**-3.69**	**0.0009**
V (2016-2018)	**VI (2019-2020)**	**-0.01538**	**0.004829**	**156**	**-3.19**	**0.0049**

Site BCA I < III, IV, V & VI; II < III						
Time interval	Time interval	Est.	SE	DF	t	P
I (2004-2006)	II (2007-2009)	-0.03122	0.01394	63	-2.24	0.2348
I (2004-2006)	**III (2010-2012)**	**-0.0733**	**0.0149**	**63**	**-4.92**	**<.0001**
I (2004-2006)	**IV (2013-2015)**	**-0.05698**	**0.0149**	**63**	**-3.82**	**0.0039**
I (2004-2006)	**V (2016-2018)**	**-0.05099**	**0.0149**	**63**	**-3.42**	**0.0134**
I (2004-2006)	**VI (2019-2020)**	**-0.06242**	**0.01666**	**63**	**-3.75**	**0.005**
II (2007-2009)	**III (2010-2012)**	**-0.04208**	**0.01394**	**63**	**-3.02**	**0.0407**
II (2007-2009)	IV (2013-2015)	-0.02577	0.01394	63	-1.85	0.4429
II (2007-2009)	V (2016-2018)	-0.01977	0.01394	63	-1.42	0.7157
II (2007-2009)	VI (2019-2020)	-0.0312	0.0158	63	-1.97	0.3686
III (2010-2012)	IV (2013-2015)	0.01632	0.0149	63	1.1	0.8815
III (2010-2012)	V (2016-2018)	0.02231	0.0149	63	1.5	0.6672
III (2010-2012)	VI (2019-2020)	0.01088	0.01666	63	0.65	0.9862
IV (2013-2015)	V (2016-2018)	0.005993	0.0149	63	0.4	0.9986
IV (2013-2015)	VI (2019-2020)	-0.00543	0.01666	63	-0.33	0.9995
V (2016-2018)	VI (2019-2020)	-0.01143	0.01666	63	-0.69	0.9829

Appendix 4. Stony coral live tissue area (m^2) by region and site. For region-wide values the live tissue area of all colonies within a site were summed and the average of all sites taken. Site values are the sum of the live tissue area of all colonies within a station and the average of the stations.

	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Level	Mean ± SE (m^2)	Mean ± SE (m^2)	Mean ± SE (m^2)	Mean ± SE (m^2)	Mean ± SE (m^2)	Mean ± SE (m^2)	Mean ± SE (m^2)	Mean ± SE (m^2)
R	6.11 ± 1.87	6.38 ± 2.16	6.48 ± 2.38	4.20 ± 1.50	3.53 ± 1.09	2.72 ± 1.01	3.08 ± 1.08	3.11 ± 1.03
DC1	4.46 ± 0.97	4.32 ± 0.85	4.00 ± 1.01	2.73 ± 0.58	2.52 ± 0.26	2.31 ± 0.37	2.13 ± 0.27	2.21 ± 0.28
DC2	0.35 ± 0.09	0.42 ± 0.03	0.36 ± 0.07	0.36 ± 0.09	0.32 ± 0.08	0.22 ± 0.05	0.28 ± 0.07	0.22 ± 0.04
DC3	0.28 ± 0.10	0.13 ± 0.03	0.13 ± 0.05	0.15 ± 0.05	0.17 ± 0.05	0.11 ± 0.01	0.12 ± 0.02	0.15 ± 0.02
DC4	0.50 ± 0.11	0.57 ± 0.14	0.30 ± 0.08	0.23 ± 0.07	0.29 ± 0.08	0.30 ± 0.06	0.28 ± 0.04	0.35 ± 0.05
DC5	1.98 ± 0.63	2.25 ± 0.71	1.40 ± 0.21	1.00 ± 0.28	0.88 ± 0.14	0.70 ± 0.11	1.12 ± 0.14	0.99 ± 0.17
DC6	1.85 ± 0.36	2.14 ± 0.58	2.83 ± 0.95	2.32 ± 0.91	1.61 ± 0.36	0.90 ± 0.36	1.10 ± 0.26	1.18 ± 0.31
DC7	0.36 ± 0.07	0.34 ± 0.08	0.32 ± 0.05	0.21 ± 0.05	0.25 ± 0.05	0.25 ± 0.08	0.28 ± 0.07	0.28 ± 0.06
DC8	0.57 ± 0.15	0.76 ± 0.23	0.53 ± 0.18	0.50 ± 0.17	0.43 ± 0.15	0.33 ± 0.14	0.47 ± 0.15	0.43 ± 0.18
BC1	10.04 ± 1.65	11.88 ± 1.41	12.98 ± 2.06	8.06 ± 1.57	5.56 ± 1.06	5.51 ± 0.90	5.90 ± 1.15	5.64 ± 0.90
BC2	0.28 ± 0.10	0.40 ± 0.17	0.35 ± 0.15	0.22 ± 0.05	0.26 ± 0.08	0.23 ± 0.07	0.22 ± 0.07	0.35 ± 0.13
BC3	0.37 ± 0.07	0.38 ± 0.12	0.29 ± 0.05	0.21 ± 0.05	0.26 ± 0.09	0.18 ± 0.01	0.19 ± 0.01	0.18 ± 0.03
BC4	3.39 ± 0.49	3.26 ± 0.55	3.49 ± 0.35	2.35 ± 0.44	2.49 ± 0.53	1.20 ± 0.07	1.46 ± 0.24	1.47 ± 0.28
BC5	0.86 ± 0.29	0.65 ± 0.19	0.91 ± 0.26	0.19 ± 0.02	0.18 ± 0.04	0.18 ± 0.05	0.19 ± 0.06	0.20 ± 0.03
BC6	0.45 ± 0.18	0.49 ± 0.17	0.50 ± 0.22	0.20 ± 0.03	0.13 ± 0.03	0.19 ± 0.06	0.18 ± 0.04	0.20 ± 0.06
BCA	0.37 ± 0.09	0.21 ± 0.07	0.22 ± 0.09	0.37 ± 0.07	0.60 ± 0.25	0.53 ± 0.19	0.59 ± 0.21	0.74 ± 0.23
PB1	0.05 ± 0.03	0.06 ± 0.04	0.07 ± 0.04	0.08 ± 0.04	0.06 ± 0.04	0.04 ± 0.02	0.04 ± 0.01	0.07 ± 0.04
PB2	0.95 ± 0.25	1.00 ± 0.22	1.00 ± 0.22	0.39 ± 0.07	0.35 ± 0.06	0.35 ± 0.10	0.30 ± 0.10	0.28 ± 0.09
PB3	0.65 ± 0.12	0.69 ± 0.16	0.67 ± 0.13	0.23 ± 0.08	0.23 ± 0.07	0.23 ± 0.09	0.25 ± 0.08	0.28 ± 0.09
PB4	1.87 ± 0.72	1.14 ± 0.21	1.27 ± 0.15	0.35 ± 0.12	0.33 ± 0.12	0.23 ± 0.08	0.29 ± 0.07	0.29 ± 0.10
PB5	1.55 ± 0.27	1.45 ± 0.29	1.52 ± 0.27	0.61 ± 0.21	0.45 ± 0.12	0.46 ± 0.13	0.46 ± 0.11	0.45 ± 0.10
MC1	1.82 ± 0.72	1.94 ± 0.78	1.97 ± 0.80	1.83 ± 0.60	1.68 ± 0.57	0.50 ± 0.20	1.09 ± 0.49	1.11 ± 0.54
MC2	0.60 ± 0.14	0.61 ± 0.14	0.53 ± 0.12	0.55 ± 0.13	0.37 ± 0.17	0.02 ± 0.01	0.02 ± 0.01	0.02 ± 0.01

Appendix 5. Regional stony coral live tissue area of select species. Live tissue area was summed at each site and the regional live tissue area is the average of all sites.

	2013	2014	2015	2016	2017	2018	2019	2020
Susceptibility Group	Mean ± SE (m^2)	Mean ± SE (m^2)	Mean ± SE (m^2)	Mean ± SE (m^2)	Mean ± SE (m^2)	Mean ± SE (m^2)	Mean ± SE (m^2)	Mean ± SE (m^2)
Low	0.68 ± 0.23	0.81 ± 0.30	0.87 ± 0.30	0.87 ± 0.31	0.82 ± 0.27	0.75 ± 0.20	1.01 ± 0.29	1.01 ± 0.29
Intermediately-High	5.26 ± 1.80	5.37 ± 2.10	5.66 ± 2.39	3.29 ± 1.49	2.47 ± 1.00	1.85 ± 0.98	1.93 ± 1.02	1.94 ± 0.98
Presumed	0.22 ± 0.10	0.27 ± 0.14	0.27 ± 0.12	0.27 ± 0.12	0.33 ± 0.15	0.23 ± 0.12	0.34 ± 0.18	0.32 ± 0.17

Appendix 6. Stony coral live tissue area (LTA) statistics

Linear Mixed Effects Model ANOVA results

Variable	Level	Intercept	Year
Region	DF	1	7
	F	8.799211	7.274149
	P	0.0037	<.0001
Mod-High Susp. Spp.	DF	1	7
	F	5.669910	8.078571
	P	0.0186	<.0001
Presumed Susp. Spp.	DF	1	7
	F	4.682594	0.501056
	P	0.0328	0.8319
Low Susp. Spp.	DF	1	7
	F	10.624629	0.0014
	P	0.917031	0.4953

Appendix 6. Continued

Tukey post hoc Test

Variable	Years	Est.	SE	z	P > |z|	Variable	Years	Est.	SE	z	P > |z|
Region	2014 - 2013	0.27285	0.82692	0.33	0.99998	Intermediately-High Susp. Spp.	2014 - 2013	0.105777	0.823635	0.128	1
	2015 - 2013	0.37298	0.82692	0.451	0.99983		2015 - 2013	0.254083	0.834952	0.304	0.99999
	2016 - 2013	-1.90527	0.82692	-2.304	0.29134		2016 - 2013	-2.11514	0.834952	-2.533	0.18128
	2017 - 2013	-2.5719	0.82692	-3.11	0.03957		2017 - 2013	-2.78899	0.823635	-3.386	0.01618
	2018 - 2013	-3.38674	0.82692	-4.096	0.00125		2018 - 2013	-3.4086	0.823635	-4.138	< 0.001
	2019 - 2013	-3.02835	0.82692	-3.662	0.00614		2019 - 2013	-3.329162	0.823635	-4.042	0.00131
	2020 - 2013	-3.00047	0.82692	-3.628	0.00684		2020 - 2013	-3.321731	0.823635	-4.033	0.00142
	2015 - 2014	0.10012	0.82692	0.121	1		2015 - 2014	0.148306	0.834952	0.178	1
	2016 - 2014	-2.17813	0.82692	-2.634	0.14374		2016 - 2014	-2.220917	0.834952	-2.66	0.13504
	2017 - 2014	-2.84475	0.82692	-3.44	0.0135		2017 - 2014	-2.894767	0.823635	-3.515	0.01036
	2018 - 2014	-3.65959	0.82692	-4.426	< 0.001		2018 - 2014	-3.514377	0.823635	-4.267	< 0.001
	2019 - 2014	-3.3012	0.82692	-3.992	0.00167		2019 - 2014	-3.434939	0.823635	-4.17	< 0.001
	2020 - 2014	-3.27333	0.82692	-3.958	0.00182		2020 - 2014	-3.427508	0.823635	-4.161	< 0.001
	2016 - 2015	-2.27825	0.82692	-2.755	0.10683		2016 - 2015	-2.369222	0.843017	-2.81	0.0922
	2017 - 2015	-2.94487	0.82692	-3.561	0.00905		2017 - 2015	-3.043073	0.834952	-3.645	0.00656
	2018 - 2015	-3.75971	0.82692	-4.547	< 0.001		2018 - 2015	-3.662683	0.834952	-4.387	< 0.001
	2019 - 2015	-3.40132	0.82692	-4.113	< 0.001		2019 - 2015	-3.583245	0.834952	-4.292	< 0.001
	2020 - 2015	-3.37345	0.82692	-4.08	0.00122		2020 - 2015	-3.575814	0.834952	-4.283	< 0.001
	2017 - 2016	-0.66662	0.82692	-0.806	0.99284		2017 - 2016	-0.673851	0.834952	-0.807	0.99278
	2018 - 2016	-1.48146	0.82692	-1.792	0.62592		2018 - 2016	-1.293461	0.834952	-1.549	0.78049
	2019 - 2016	-1.12307	0.82692	-1.358	0.87627		2019 - 2016	-1.214022	0.834952	-1.454	0.83157
	2020 - 2016	-1.0952	0.82692	-1.324	0.88983		2020 - 2016	-1.206591	0.834952	-1.445	0.83606
	2018 - 2017	-0.81484	0.82692	-0.985	0.97661		2018 - 2017	-0.61961	0.823635	-0.752	0.99532
	2019 - 2017	-0.45645	0.82692	-0.552	0.99936		2019 - 2017	-0.540172	0.823635	-0.656	0.99803
	2020 - 2017	-0.42858	0.82692	-0.518	0.99957		2020 - 2017	-0.532741	0.823635	-0.647	0.9982
	2019 - 2018	0.35839	0.82692	0.433	0.99987		2019 - 2018	0.079438	0.823635	0.096	1
	2020 - 2018	0.38626	0.82692	0.467	0.99979		2020 - 2018	0.086869	0.823635	0.105	1
	2020 - 2019	0.02787	0.82692	0.034	1		2020 - 2019	0.007431	0.823635	0.009	1

Appendix 7. Stony coral, octocoral and *Xestospongia muta* density (colonies/m^2) data region and by site. Regional density was calculated as an average of all sites, where site is the sum of all four stations. Site level values were calculated as an average of the four stations.

		2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Variable	**Level**	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Stony	R	1.21 ± 0.16	1.26 ± 0.18	1.29 ± 0.19	1.07 ± 0.17	1.35 ± 0.25	1.40 ± 0.23	1.54 ± 1.54	1.74 ± 0.32
Coral	DC1	1.80 ± 0.15	2.10 ± 0.16	2.15 ± 0.03	2.36 ± 0.06	2.28 ± 0.13	2.70 ± 0.27	2.80 ± 0.11	3.36 ± 0.24
	DC2	0.88 ± 0.09	1.08 ± 0.14	1.07 ± 0.11	0.83 ± 0.09	1.03 ± 0.04	1.10 ± 0.10	1.16 ± 0.06	1.07 ± 0.11
	DC3	0.31 ± 0.09	0.33 ± 0.03	0.31 ± 0.06	0.27 ± 0.07	0.28 ± 0.01	0.44 ± 0.03	0.42 ± 0.01	0.48 ± 0.06
	DC4	0.73 ± 0.11	0.75 ± 0.12	0.75 ± 0.20	0.57 ± 0.14	0.90 ± 0.18	0.90 ± 0.10	0.91 ± 0.11	0.95 ± 0.08
	DC5	2.56 ± 0.24	2.55 ± 0.14	2.33 ± 0.26	2.40 ± 0.26	3.30 ± 0.35	2.94 ± 0.41	4.01 ± 0.57	3.64 ± 0.48
	DC6	1.38 ± 0.26	1.42 ± 0.25	1.51 ± 0.25	1.44 ± 0.33	1.55 ± 0.35	1.51 ± 0.25	1.58 ± 0.27	1.45 ± 0.18
	DC7	1.13 ± 0.05	1.02 ± 0.12	1.10 ± 0.14	0.67 ± 0.09	0.85 ± 0.08	0.98 ± 0.14	1.14 ± 0.10	1.30 ± 0.10
	DC8	0.92 ± 0.09	0.82 ± 0.06	0.91 ± 0.15	0.56 ± 0.07	0.48 ± 0.05	0.60 ± 0.03	0.61 ± 0.06	0.73 ± 0.05
	BC1	1.81 ± 0.35	2.16 ± 0.33	2.05 ± 0.34	1.66 ± 0.30	1.45 ± 0.34	1.41 ± 0.34	1.47 ± 0.33	1.70 ± 0.29
	BC2	0.64 ± 0.12	0.78 ± 0.12	0.78 ± 0.12	0.47 ± 0.10	0.05 ± 0.13	0.95 ± 0.19	0.82 ± 0.10	1.11 ± 0.12
	BC3	0.75 ± 0.11	0.76 ± 0.22	0.59 ± 0.08	0.09 ± 0.03	0.61 ± 0.04	0.83 ± 0.09	0.72 ± 0.03	0.85 ± 0.09
	BC4	3.28 ± 0.32	3.75 ± 0.22	4.05 ± 0.31	3.41 ± 0.12	4.90 ± 0.40	3.83 ± 0.18	4.43 ± 0.16	5.03 ± 0.23
	BC5	1.23 ± 0.19	1.09 ± 0.25	1.19 ± 0.22	0.67 ± 0.08	0.83 ± 0.14	0.90 ± 0.12	1.01 ± 0.26	1.18 ± 0.16
	BC6	0.64 ± 0.11	0.59 ± 0.07	0.56 ± 0.06	0.43 ± 0.05	0.41 ± 0.00	0.45 ± 0.12	0.50 ± 0.09	0.59 ± 0.13
	BCA	0.61 ± 0.18	0.58 ± 0.17	1.09 ± 0.40	1.45 ± 0.17	3.08 ± 1.10	3.47 ± 1.15	3.66 ± 1.28	4.95 ± 1.44
	PB1	0.23 ± 0.15	0.27 ± 0.17	0.28 ± 0.15	0.33 ± 0.14	0.25 ± 0.11	0.40 ± 0.15	0.40 ± 0.07	0.75 ± 0.18
	PB2	1.07 ± 0.15	1.24 ± 0.09	1.57 ± 0.31	1.07 ± 0.33	1.03 ± 0.42	0.86 ± 0.25	0.82 ± 0.14	0.68 ± 0.13
	PB3	1.05 ± 0.31	1.18 ± 0.34	1.11 ± 0.29	0.63 ± 0.22	0.68 ± 0.23	0.67 ± 0.19	0.73 ± 0.17	0.76 ± 0.24
	PB4	1.82 ± 0.38	1.63 ± 0.31	1.70 ± 0.29	1.02 ± 0.27	1.01 ± 0.23	1.06 ± 0.24	1.01 ± 0.22	1.15 ± 0.30
	PB5	2.30 ± 0.31	2.20 ± 0.29	2.08 ± 0.29	1.58 ± 0.25	1.65 ± 0.32	1.75 ± 0.40	1.77 ± 0.34	1.85 ± 0.27
	MC1	0.95 ± 0.09	1.06 ± 0.11	0.98 ± 0.18	0.98 ± 0.31	2.18 ± 0.66	2.82 ± 0.78	3.70 ± 1.20	4.35 ± 1.32
	MC2	0.49 ± 0.06	0.40 ± 0.05	0.34 ± 0.05	0.27 ± 0.05	0.31 ± 0.08	0.11 ± 0.05	0.22 ± 0.05	0.32 ± 0.10

Appendix 7. Continued

		2013	2014	2015	2016	2017	2018	2019	2020
Variable	**Level**	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Octocoral	R	8.68 ± 1.34	9.97 ± 1.55	11.52 ± 1.76	11.85 ± 1.83	12.58 ± 1.85	10.36 ± 1.50	11.57 ± 1.61	14.05 ± 2.01
	DC1	6.93 ± 1.42	8.18 ± 0.74	11.60 ± 1.52	13.25 ± 1.28	11.38 ± 1.19	10.63 ± 1.09	8.98 ± 0.91	11.70 ± 0.54
	DC2	6.88 ± 2.30	14.25 ± 1.80	19.50 ± 2.09	17.98 ± 1.44	19.93 ± 1.91	14.70 ± 1.77	17.75 ± 1.14	20.83 ± 1.42
	DC3	6.18 ± 1.43	7.23 ± 1.23	7.55 ± 1.36	9.33 ± 0.44	10.15 ± 1.19	9.20 ± 0.97	9.70 ± 1.12	12.23 ± 1.75
	DC4	11.23 ± 2.52	12.43 ± 3.18	14.45 ± 2.60	11.93 ± 1.00	14.90 ± 2.36	14.00 ± 2.03	15.85 ± 2.95	21.68 ± 2.93
	DC5	6.58 ± 1.19	7.15 ± 0.80	8.95 ± 0.91	8.63 ± 0.96	9.70 ± 0.58	7.08 ± 0.73	10.38 ± 1.10	11.23 ± 1.16
	DC6	6.90 ± 0.75	8.13 ± 0.97	9.53 ± 1.83	9.88 ± 1.65	10.85 ± 1.38	6.93 ± 0.99	7.65 ± 0.90	11.65 ± 0.82
	DC7	3.43 ± 0.26	3.83 ± 0.14	7.13 ± 0.47	6.95 ± 0.41	6.70 ± 0.54	6.75 ± 0.78	8.03 ± 0.91	11.60 ± 1.84
	DC8	14.90 ± 1.45	16.28 ± 1.70	19.90 ± 1.91	19.28 ± 1.41	21.33 ± 1.48	17.23 ± 2.84	21.13 ± 1.13	23.65 ± 2.98
	BC1	10.75 ± 0.79	11.15 ± 0.99	11.15 ± 0.96	11.68 ± 0.88	11.05 ± 1.30	13.58 ± 0.81	14.93 ± 1.86	20.13 ± 1.49
	BC2	7.40 ± 1.11	8.65 ± 1.30	8.63 ± 1.65	9.28 ± 1.99	10.18 ± 1.56	9.40 ± 1.70	10.88 ± 2.23	10.00 ± 1.79
	BC3	12.90 ± 1.06	12.75 ± 1.30	11.53 ± 1.40	14.30 ± 1.89	15.23 ± 1.30	12.28 ± 1.60	14.08 ± 1.11	11.20 ± 2.85
	BC4	3.73 ± 0.61	3.95 ± 0.97	5.23 ± 0.58	4.08 ± 0.68	6.65 ± 1.21	3.28 ± 0.85	4.78 ± 1.63	6.58 ± 2.04
	BC5	5.73 ± 0.53	7.45 ± 0.56	6.55 ± 0.63	6.18 ± 0.71	7.70 ± 1.37	5.68 ± 0.66	7.03 ± 0.96	11.30 ± 1.01
	BC6	20.78 ± 3.78	19.28 ± 1.91	21.18 ± 2.13	23.48 ± 0.88	25.80 ± 1.02	20.63 ± 2.76	23.20 ± 3.16	26.10 ± 1.78
	BCA	1.15 ± 0.51	0.85 ± 0.39	1.10 ± 0.54	0.58 ± 0.28	1.10 ± 0.46	1.58 ± 0.50	2.10 ± 0.41	3.15 ± 0.76
	PB1	0.23 ± 0.14	0.18 ± 0.09	0.13 ± 0.05	0.05 ± 0.03	0.03 ± 0.03	0.00 ± 0.00	0.70 ± 0.33	0.75 ± 0.40
	PB2	17.03 ± 3.85	20.55 ± 5.32	23.45 ± 5.59	23.48 ± 4.99	23.33 ± 4.55	17.48 ± 3.77	16.88 ± 5.68	16.65 ± 6.69
	PB3	12.85 ± 3.18	12.45 ± 2.56	14.15 ± 2.39	17.33 ± 3.14	18.55 ± 3.20	14.28 ± 2.32	13.25 ± 2.00	14.60 ± 1.65
	PB4	15.63 ± 2.31	17.65 ± 1.09	23.48 ± 2.48	23.80 ± 4.01	22.43 ± 2.93	20.00 ± 0.81	23.08 ± 0.87	28.98 ± 1.59
	PB5	19.80 ± 2.36	27.03 ± 4.61	28.25 ± 4.98	29.33 ± 3.83	29.83 ± 3.38	23.30 ± 2.11	24.13 ± 1.73	35.13 ± 3.57
	MC1	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
	MC2	0.03 ± 0.03	0.03 ± 0.03	0.03 ± 0.03	0.03 ± 0.03	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00

Appendix 7. Continued

		2013	2014	2015	2016	2017	2018	2019	2020
Variable	**Level**	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
X. muta	R	0.24 ± 0.05	0.28 ± 0.06	0.30 ± 0.06	0.31 ± 0.06	0.35 ± 0.06	0.28 ± 0.05	0.32 ± 0.06	0.32 ± 0.06
	DC1	0.06 ± 0.04	0.02 ± 0.02	0.07 ± 0.04	0.10 ± 0.04	0.13 ± 0.04	0.06 ± 0.01	0.09 ± 0.03	0.08 ± 0.02
	DC2	0.31 ± 0.02	0.35 ± 0.04	0.43 ± 0.04	0.41 ± 0.06	0.45 ± 0.06	0.34 ± 0.05	0.40 ± 0.04	0.47 ± 0.03
	DC3	0.26 ± 0.07	0.25 ± 0.07	0.28 ± 0.07	0.31 ± 0.11	0.27 ± 0.08	0.22 ± 0.08	0.25 ± 0.09	0.23 ± 0.10
	DC4	0.57 ± 0.04	0.61 ± 0.05	0.64 ± 0.03	0.64 ± 0.03	0.64 ± 0.03	0.47 ± 0.04	0.44 ± 0.05	0.43 ± 0.04
	DC5	0.15 ± 0.02	0.10 ± 0.03	0.10 ± 0.03	0.14 ± 0.06	0.22 ± 0.02	0.14 ± 0.04	0.18 ± 0.06	0.15 ± 0.06
	DC6	0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.01
	DC7	0.28 ± 0.05	0.34 ± 0.03	0.43 ± 0.04	0.41 ± 0.06	0.53 ± 0.02	0.39 ± 0.08	0.44 ± 0.08	0.72 ± 0.14
	DC8	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
	BC1	0.06 ± 0.04	0.11 ± 0.06	0.09 ± 0.04	0.11 ± 0.05	0.16 ± 0.07	0.15 ± 0.11	0.14 ± 0.09	0.16 ± 0.10
	BC2	0.35 ± 0.05	0.50 ± 0.05	0.05 ± 0.07	0.51 ± 0.08	0.57 ± 0.09	0.57 ± 0.08	0.52 ± 0.06	0.57 ± 0.06
	BC3	0.34 ± 0.04	0.63 ± 0.08	0.63 ± 0.11	0.55 ± 0.12	0.63 ± 0.14	0.49 ± 0.10	0.35 ± 0.11	0.41 ± 0.10
	BC4	0.15 ± 0.02	0.26 ± 0.04	0.26 ± 0.04	0.27 ± 0.06	0.31 ± 0.05	0.24 ± 0.06	0.18 ± 0.03	0.20 ± 0.04
	BC5	0.45 ± 0.11	0.49 ± 0.14	0.44 ± 0.11	0.59 ± 0.09	0.63 ± 0.08	0.57 ± 0.12	0.73 ± 0.16	0.69 ± 0.14
	BC6	0.38 ± 0.10	0.38 ± 0.11	0.25 ± 0.09	0.36 ± 0.11	0.40 ± 0.08	0.40 ± 0.07	0.50 ± 0.11	0.48 ± 0.12
	BCA	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.01 ± 0.01	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
	PB1	0.00 ± 0.00	0.00 ± 0.00	0.01 ± 0.01	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.02 ± 0.02
	PB2	0.11 ± 0.05	0.14 ± 0.04	0.17 ± 0.02	0.24 ± 0.05	0.34 ± 0.05	0.30 ± 0.07	0.36 ± 0.10	0.35 ± 0.12
	PB3	0.55 ± 0.10	0.55 ± 0.10	0.71 ± 0.13	0.66 ± 0.13	0.61 ± 0.11	0.58 ± 0.16	0.63 ± 0.13	0.60 ± 0.12
	PB4	0.60 ± 0.10	0.70 ± 0.07	0.64 ± 0.10	0.72 ± 0.09	0.77 ± 0.06	0.70 ± 0.06	0.72 ± 0.06	0.67 ± 0.08
	PB5	0.65 ± 0.05	0.74 ± 0.09	0.88 ± 0.07	0.88 ± 0.07	0.97 ± 0.11	0.66 ± 0.08	0.86 ± 0.12	0.75 ± 0.10
	MC1	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
	MC2	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00

Appendix 8. Stony coral, octocoral and *Xestospongia muta* density statistics.

Linear Mixed Effects Model ANOVA results.

Variable	**Level**	**Intercept**	**Year**
Stony Coral	DF	1	7
	F	44.03846	3.74342
	P	<.0001	.0009
Octocoral	DF	1	7
	F	47.19374	15.82358
	P	<.0001	<.0001
Xestospongia Muta	DF	1	7
	F	29.292451	6.568722
	P	<.0001	<.0001

Appendix 8. Continued.

Tukey post hoc Test.

Variable	**Years**	**Est.**	**SE**	**z**	**P > |z|**	**Variable**	**Years**	**Est.**	**SE**	**z**	**P > |z|**
Stony Coral	2014 - 2013	0.05579	0.15173	0.368	1	Octocoral	2014 - 2013	1.29205	0.58766	2.199	0.353
	2015 - 2013	0.08213	0.15173	0.541	0.9994		2015 - 2013	2.83864	0.58766	4.83	<0.01
	2016 - 2013	-0.13843	0.15173	-0.912	0.985		2016 - 2013	3.17159	0.58766	5.397	<0.01
	2017 - 2013	0.14153	0.15173	0.933	0.9829		2017 - 2013	3.9	0.58766	6.637	<0.01
	2018 - 2013	0.18905	0.15173	1.246	0.9181		2018 - 2013	1.68068	0.58766	2.86	0.0805
	2019 - 2013	0.33368	0.15173	2.199	0.3518		2019 - 2013	2.88523	0.58766	4.91	<0.01
	2020 - 2013	0.53357	0.15173	3.517	0.0105		2020 - 2013	5.36932	0.58766	9.137	<0.01
	2015 - 2014	0.02634	0.15173	0.174	1		2015 - 2014	1.54659	0.58766	2.632	0.1448
	2016 - 2014	-0.19421	0.15173	-1.28	0.9065		2016 - 2014	1.87955	0.58766	3.198	0.0303
	2017 - 2014	0.08574	0.15173	0.565	0.9992		2017 - 2014	2.60795	0.58766	4.438	<0.01
	2018 - 2014	0.13326	0.15173	0.878	0.988		2018 - 2014	0.38864	0.58766	0.661	0.9979
	2019 - 2014	0.27789	0.15173	1.831	0.5986		2019 - 2014	1.59318	0.58766	2.711	0.1189
	2020 - 2014	0.47779	0.15173	3.149	0.0351		2020 - 2014	4.07727	0.58766	6.938	<0.01
	2016 - 2015	-0.22056	0.15173	-1.454	0.8319		2016 - 2015	0.33295	0.58766	0.567	0.9992
	2017 - 2015	0.0594	0.15173	0.391	0.9999		2017 - 2015	1.06136	0.58766	1.806	0.6162
	2018 - 2015	0.10692	0.15173	0.705	0.9969		2018 - 2015	-1.15795	0.58766	-1.97	0.5021
	2019 - 2015	0.25155	0.15173	1.658	0.7143		2019 - 2015	0.04659	0.58766	0.079	1
	2020 - 2015	0.45145	0.15173	2.975	0.0585		2020 - 2015	2.53068	0.58766	4.306	<0.01
	2017 - 2016	0.27996	0.15173	1.845	0.5889		2017 - 2016	0.72841	0.58766	1.24	0.9202
	2018 - 2016	0.32748	0.15173	2.158	0.3774		2018 - 2016	-1.49091	0.58766	-2.537	0.1801
	2019 - 2016	0.47211	0.15173	3.111	0.039		2019 - 2016	-0.28636	0.58766	-0.487	0.9997
	2020 - 2016	0.672	0.15173	4.429	<0.01		2020 - 2016	2.19773	0.58766	3.74	<0.01
	2018 - 2017	0.04752	0.15173	0.313	1		2018 - 2017	-2.21932	0.58766	-3.777	<0.01
	2019 - 2017	0.19215	0.15173	1.266	0.9112		2019 - 2017	-1.01477	0.58766	-1.727	0.6697
	2020 - 2017	0.39205	0.15173	2.584	0.163		2020 - 2017	1.46932	0.58766	2.5	0.1954
	2019 - 2018	0.14463	0.15173	0.953	0.9807		2019 - 2018	1.20455	0.58766	2.05	0.4482
	2020 - 2018	0.34452	0.15173	2.271	0.3096		2020 - 2018	3.68864	0.58766	6.277	<0.01
	2020 - 2019	0.1999	0.15173	1.317	0.8926		2020 - 2019	2.48409	0.58766	4.227	<0.01

Appendix 8. Continued.

Tukey post hoc Test.

Variable	Years	Est.	SE	z	P > |z|
Xestospongia muta	2014 - 2013	0.042355	0.018031	2.349	0.26674
	2015 - 2013	0.06095	0.018031	3.38	0.01687
	2016 - 2013	0.075413	0.018031	4.182	< 0.001
	2017 - 2013	0.108988	0.018031	6.044	< 0.001
	2018 - 2013	0.046488	0.018031	2.578	0.16353
	2019 - 2013	0.079029	0.018031	4.383	< 0.001
	2020 - 2013	0.080062	0.018031	4.44	< 0.001
	2015 - 2014	0.018595	0.018031	1.031	0.96981
	2016 - 2014	0.033058	0.018031	1.833	0.5968
	2017 - 2014	0.066632	0.018031	3.695	0.00541
	2018 - 2014	0.004132	0.018031	0.229	1
	2019 - 2014	0.036674	0.018031	2.034	0.45866
	2020 - 2014	0.037707	0.018031	2.091	0.42017
	2016 - 2015	0.014463	0.018031	0.802	0.99305
	2017 - 2015	0.048037	0.018031	2.664	0.13337
	2018 - 2015	-0.014463	0.018031	-0.802	0.99305
	2019 - 2015	0.018079	0.018031	1.003	0.97419
	2020 - 2015	0.019112	0.018031	1.06	0.96486
	2017 - 2016	0.033574	0.018031	1.862	0.57717
	2018 - 2016	-0.028926	0.018031	-1.604	0.74806
	2019 - 2016	0.003616	0.018031	0.201	1
	2020 - 2016	0.004649	0.018031	0.258	1
	2018 - 2017	-0.0625	0.018031	-3.466	0.01245
	2019 - 2017	-0.029959	0.018031	-1.662	0.71245
	2020 - 2017	-0.028926	0.018031	-1.604	0.748
	2019 - 2018	0.032541	0.018031	1.805	0.61686
	2020 - 2018	0.033574	0.018031	1.862	0.57723
	2020 - 2019	0.001033	0.018031	0.057	1

Appendix 9. Stony coral disease statistics for other disease (black band disease, yellow band disease, dark spot disease, white band disease (for acroporids) and rapid tissue loss (for acroporids)) and SCTLD.

Linear Mixed Effects Model ANOVA results.

Variable	**Level**	**Intercept**	**Year**
Other Disease	DF	1	7
	F	25.473323	1.957024
	P	<.0001	0.0647
SCTLD	DF	1	7
	F	11.385117	4.182276
	P	9e-04	3e-04

Appendix 9 continued.

Variable	Years	Est.	SE	z	P > |z|
SCTLD	2014 - 2013	0.0084484	0.0056789	1.488	0.81434
	2015 - 2013	0.0076613	0.0056789	1.349	0.87995
	2016 - 2013	0.0251078	0.0056789	4.421	< 0.001
	2017 - 2013	0.0059756	0.0056789	1.052	0.96624
	2018 - 2013	0.0033596	0.0056789	0.592	0.99899
	2019 - 2013	0.0017492	0.0056789	0.308	0.99999
	2020 - 2013	-0.0002616	0.0056789	-0.046	1
	2015 - 2014	-0.0007872	0.0056789	-0.139	1
	2016 - 2014	0.0166594	0.0056789	2.934	0.06601
	2017 - 2014	-0.0024728	0.0056789	-0.435	0.99987
	2018 - 2014	-0.0050888	0.0056789	-0.896	0.9865
	2019 - 2014	-0.0066993	0.0056789	-1.18	0.93788
	2020 - 2014	-0.00871	0.0056789	-1.534	0.78924
	2016 - 2015	0.0174466	0.0056789	3.072	0.0437
	2017 - 2015	-0.0016856	0.0056789	-0.297	0.99999
	2018 - 2015	-0.0043016	0.0056789	-0.757	0.99511
	2019 - 2015	-0.0059121	0.0056789	-1.041	0.96815
	2020 - 2015	-0.0079228	0.0056789	-1.395	0.8599
	2017 - 2016	-0.0191322	0.0056789	-3.369	0.01726
	2018 - 2016	-0.0217482	0.0056789	-3.83	0.00322
	2019 - 2016	-0.0233587	0.0056789	-4.113	0.00113
	2020 - 2016	-0.0253694	0.0056789	-4.467	< 0.001
	2018 - 2017	-0.002616	0.0056789	-0.461	0.99981
	2019 - 2017	-0.0042265	0.0056789	-0.744	0.99562
	2020 - 2017	-0.0062372	0.0056789	-1.098	0.95735
	2019 - 2018	-0.0016105	0.0056789	-0.284	0.99999
	2020 - 2018	-0.0036212	0.0056789	-0.638	0.99835
	2020 - 2019	-0.0020107	0.0056789	-0.354	0.99997

Appendix 10. Octocoral target species mean density (colonies/m^2).

	2013	2014	2015	2016	2017	2018	2019	2020
Species	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
G. ventalina	0.21 ± 0.05	0.24 ± 0.05	0.30 ± 0.08	0.29 ± 0.07	0.33 ± 0.07	0.28 ± 0.07	0.29 ± 0.07	0.35 ± 0.09
A. americana	1.36 ± 0.24	1.39 ± 0.26	1.71 ± 0.28	1.79 ± 0.31	1.80 ± 0.31	1.70 ± 0.30	1.98 ± 0.37	2.54 ± 0.45
E. flexuosa	0.58 ± 0.14	0.73 ± 0.20	0.83 ± 0.27	0.78 ± 0.24	0.77 ± 0.24	0.60 ± 0.19	0.68 ± 0.23	0.81 ± 0.25

Appendix 11. Octocoral density statistics.

Linear Mixed Effects Model ANOVA results.

Variable	**Level**	**Intercept**	**Year**
G. ventalina	DF	1	7
	F	19.76099	2.65907
	P	<.0001	0.0128
A. americana	DF	1	7
	F	34.51523	10.12247
	P	<.0001	<.0001
E. flexuosa	DF	1	7
	F	11.338590	2.195481
	P	0.0010	0.0378

Appendix 11. Continued.

Tukey post hoc Test.

Variable	Years	Est.	SE	z	P > |z|	Variable	Years	Est.	SE	z	P > |z|
G. ventalina	2014 - 2013	0.029545	0.03711	0.796	0.99336	*A. americana*	2014 - 2013	0.035227	0.16507	0.213	1
	2015 - 2013	0.089773	0.03711	2.419	0.23185		2015 - 2013	0.354545	0.16507	2.148	0.3834
	2016 - 2013	0.079545	0.03711	2.144	0.38642		2016 - 2013	0.434091	0.16507	2.63	0.1451
	2017 - 2013	0.111364	0.03711	3.001	0.05443		2017 - 2013	0.439773	0.16507	2.664	0.1342
	2018 - 2013	0.064773	0.03711	1.746	0.65701		2018 - 2013	0.344318	0.16507	2.086	0.4245
	2019 - 2013	0.073864	0.03711	1.991	0.48817		2019 - 2013	0.628409	0.16507	3.807	<0.01
	2020 - 2013	0.134091	0.03711	3.614	0.00731		2020 - 2013	1.186364	0.16507	7.187	<0.01
	2015 - 2014	0.060227	0.03711	1.623	0.73629		2015 - 2014	0.319318	0.16507	1.934	0.527
	2016 - 2014	0.05	0.03711	1.348	0.88051		2016 - 2014	0.398864	0.16507	2.416	0.2341
	2017 - 2014	0.081818	0.03711	2.205	0.34848		2017 - 2014	0.404545	0.16507	2.451	0.2169
	2018 - 2014	0.035227	0.03711	0.949	0.98108		2018 - 2014	0.309091	0.16507	1.873	0.57
	2019 - 2014	0.044318	0.03711	1.194	0.93381		2019 - 2014	0.593182	0.16507	3.594	<0.01
	2020 - 2014	0.104545	0.03711	2.818	0.09068		2020 - 2014	1.151136	0.16507	6.974	<0.01
	2016 - 2015	-0.01023	0.03711	-0.276	0.99999		2016 - 2015	0.079545	0.16507	0.482	0.9997
	2017 - 2015	0.021591	0.03711	0.582	0.99909		2017 - 2015	0.085227	0.16507	0.516	0.9996
	2018 - 2015	-0.025	0.03711	-0.674	0.99766		2018 - 2015	-0.01023	0.16507	-0.062	1
	2019 - 2015	-0.01591	0.03711	-0.429	0.99988		2019 - 2015	0.273864	0.16507	1.659	0.7138
	2020 - 2015	0.044318	0.03711	1.194	0.93386		2020 - 2015	0.831818	0.16507	5.039	<0.01
	2017 - 2016	0.031818	0.03711	0.858	0.9896		2017 - 2016	0.005682	0.16507	0.034	1
	2018 - 2016	-0.01477	0.03711	-0.398	0.99993		2018 - 2016	-0.08977	0.16507	-0.544	0.9994
	2019 - 2016	-0.00568	0.03711	-0.153	1		2019 - 2016	0.194318	0.16507	1.177	0.9386
	2020 - 2016	0.054545	0.03711	1.47	0.8236		2020 - 2016	0.752273	0.16507	4.557	<0.01
	2018 - 2017	-0.04659	0.03711	-1.256	0.91485		2018 - 2017	-0.09546	0.16507	-0.578	0.9991
	2019 - 2017	-0.0375	0.03711	-1.011	0.97303		2019 - 2017	0.188636	0.16507	1.143	0.9474
	2020 - 2017	0.022727	0.03711	0.613	0.99873		2020 - 2017	0.746591	0.16507	4.523	<0.01
	2019 - 2018	0.009091	0.03711	0.245	1		2019 - 2018	0.284091	0.16507	1.721	0.6734
	2020 - 2018	0.069318	0.03711	1.868	0.57286		2020 - 2018	0.842045	0.16507	5.101	<0.01
	2020 - 2019	0.060227	0.03711	1.623	0.73631		2020 - 2019	0.557955	0.16507	3.38	0.0164

Appendix 11. Continued.

Tukey post hoc Test.

Variable	Years	Est.	SE	z	P > |z|
G. ventalina	2014 - 2013	0.14091	0.08901	1.583	0.7606
	2015 - 2013	0.25	0.08901	2.809	0.0926
	2016 - 2013	0.19886	0.08901	2.234	0.331
	2017 - 2013	0.1875	0.08901	2.106	0.4108
	2018 - 2013	0.01705	0.08901	0.191	1
	2019 - 2013	0.09886	0.08901	1.111	0.9547
	2020 - 2013	0.22159	0.08901	2.489	0.1997
	2015 - 2014	0.10909	0.08901	1.226	0.9245
	2016 - 2014	0.05795	0.08901	0.651	0.9981
	2017 - 2014	0.04659	0.08901	0.523	0.9995
	2018 - 2014	-0.12386	0.08901	-1.392	0.8615
	2019 - 2014	-0.04205	0.08901	-0.472	0.9998
	2020 - 2014	0.08068	0.08901	0.906	0.9856
	2016 - 2015	-0.05114	0.08901	-0.574	0.9992
	2017 - 2015	-0.0625	0.08901	-0.702	0.997
	2018 - 2015	-0.23295	0.08901	-2.617	0.1496
	2019 - 2015	-0.15114	0.08901	-1.698	0.6887
	2020 - 2015	-0.02841	0.08901	-0.319	1
	2017 - 2016	-0.01136	0.08901	-0.128	1
	2018 - 2016	-0.18182	0.08901	-2.043	0.4529
	2019 - 2016	-0.1	0.08901	-1.123	0.9519
	2020 - 2016	0.02273	0.08901	0.255	1
	2018 - 2017	-0.17045	0.08901	-1.915	0.5403
	2019 - 2017	-0.08864	0.08901	-0.996	0.9752
	2020 - 2017	0.03409	0.08901	0.383	0.9999
	2019 - 2018	0.08182	0.08901	0.919	0.9843
	2020 - 2018	0.20455	0.08901	2.298	0.2942
	2020 - 2019	0.12273	0.08901	1.379	0.8672

Appendix 12. Octocoral target species mean height (cm).

	2013	2014	2015	2016	2017	2018	2019	2020
Species	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
G. ventalina	18.26 ± 1.12	16.52 ± 1.02	14.82 ± 0.78	15.17 ± 0.83	16.43 ± 0.82	17.64 ± 0.88	16.70 ± 0.88	14.83 ± 0.79
A. americana	27.15 ± 0.52	25.09 ± 0.52	23.24 ± 0.46	23.76 ± 0.42	23.34 ± 0.44	21.80 ± 0.46	19.06 ± 0.36	17.89 ± 0.30
E. flexuosa	24.87 ± 0.59	24.43 ± 0.67	21.53 ± 0.55	22.34 ± 0.55	22.89 ± 0.54	23.07 ± 0.61	22.61 ± 0.55	20.28 ± 0.54

Appendix 13.Octocoral height statistics

Linear Mixed Effects Model ANOVA results.

Variable	**Level**	**Intercept**	**Year**
G. ventalina	DF	1	7
	F	66.30776	1.92903
	P	<.0001	0.0614
A. americana	DF	1	7
	F	659.9748	52.8952
	P	<.0001	<.0001
E. flexuosa	DF	1	7
	F	643.4177	6.2388
	P	<.0001	<.0001

Appendix 13. Continued.

Tukey post hoc Test.

Variable	**Years**	**Est.**	**SE**	**z**	**P > |z|**	**Variable**	**Years**	**Est.**	**SE**	**z**	**P > |z|**
E. flexuosa	2014 - 2013	-0.55	0.8474	-0.649	0.99814	*A. americana*	2014 - 2013	-2.1255	0.6693	-3.176	0.0321
	2015 - 2013	-3.2324	0.8263	-3.912	0.00244		2015 - 2013	-3.8458	0.6383	-6.025	<0.001
	2016 - 2013	-2.243	0.834	-2.69	0.12541		2016 - 2013	-3.2106	0.6324	-5.077	<0.001
	2017 - 2013	-1.7481	0.8382	-2.086	0.42342		2017 - 2013	-3.6298	0.6323	-5.74	<0.001
	2018 - 2013	-1.4559	0.8874	-1.641	0.72492		2018 - 2013	-5.0388	0.6409	-7.862	<0.001
	2019 - 2013	-2.0572	0.861	-2.389	0.24613		2019 - 2013	-7.9069	0.6211	-12.73	<0.001
	2020 - 2013	-4.4634	0.8338	-5.353	< 0.001		2020 - 2013	-9.1057	0.5927	-15.363	<0.001
	2015 - 2014	-2.6824	0.7735	-3.468	0.01237		2015 - 2014	-1.7202	0.6339	-2.714	0.1177
	2016 - 2014	-1.6929	0.7842	-2.159	0.37631		2016 - 2014	-1.085	0.6279	-1.728	0.6672
	2017 - 2014	-1.1981	0.7876	-1.521	0.79546		2017 - 2014	-1.5043	0.6276	-2.397	0.2411
	2018 - 2014	-0.9058	0.8392	-1.079	0.96103		2018 - 2014	-2.9132	0.6367	-4.575	<0.001
	2019 - 2014	-1.5071	0.8117	-1.857	0.58013		2019 - 2014	-5.7814	0.6161	-9.384	<0.001
	2020 - 2014	-3.9134	0.7816	-5.007	< 0.001		2020 - 2014	-6.9802	0.5875	-11.882	<0.001
	2016 - 2015	0.9895	0.7556	1.31	0.89515		2016 - 2015	0.6352	0.5927	1.072	0.9623
	2017 - 2015	1.4843	0.7581	1.958	0.50991		2017 - 2015	0.2159	0.5925	0.364	1
	2018 - 2015	1.7766	0.813	2.185	0.35993		2018 - 2015	-1.193	0.6012	-1.984	0.4904
	2019 - 2015	1.1753	0.7847	1.498	0.80845		2019 - 2015	-4.0611	0.58	-7.002	<0.001
	2020 - 2015	-1.231	0.7538	-1.633	0.72965		2020 - 2015	-5.2599	0.5495	-9.572	<0.001
	2017 - 2016	0.4949	0.7698	0.643	0.99826		2017 - 2016	-0.4193	0.5856	-0.716	0.9965
	2018 - 2016	0.7871	0.8234	0.956	0.98025		2018 - 2016	-1.8282	0.5941	-3.077	0.0432
	2019 - 2016	0.1858	0.7957	0.233	1		2019 - 2016	-4.6964	0.5728	-8.199	<0.001
	2020 - 2016	-2.2205	0.7653	-2.902	0.07175		2020 - 2016	-5.8952	0.5421	-10.874	<0.001
	2018 - 2017	0.2922	0.8254	0.354	0.99997		2018 - 2017	-1.4089	0.594	-2.372	0.2536
	2019 - 2017	-0.3091	0.7987	-0.387	0.99994		2019 - 2017	-4.2771	0.5725	-7.47	<0.001
	2020 - 2017	-2.7153	0.7678	-3.537	0.00968		2020 - 2017	-5.4759	0.5422	-10.099	<0.001
	2019 - 2018	-0.6013	0.8494	-0.708	0.99678		2019 - 2018	-2.8682	0.5804	-4.942	<0.001
	2020 - 2018	-3.0076	0.8197	-3.669	0.00593		2020 - 2018	-4.0669	0.5505	-7.387	<0.001
	2020 - 2019	-2.4063	0.791	-3.042	0.04848		2020 - 2019	-1.1988	0.5252	-2.283	0.3015

Appendix 14. Results of statistical analyses for each taxa and each site grouping (Group A = PB1, PB2, PB3, BC1, BC2, BC3, DC1, DC2, DC3, Group B = MC1, MC2, Group C = PB4, PB5, DC4, DC5, Group D = BC4, BC5, BC6, DC6, DC7, DC8). The mean ± SE is pooled for all sites within each site grouping and years for each time interval. Significant results are specified. Non-significant results are not included.

Stony Coral

	A (2003-2005)	B (2006-2009)	C (2010-2012)	D (2013-2015)	E (2016-2018)	F (2019-2020)	
GrpA	2.09 ± 0.65	2.19 ± 0.61	2.22 ± 0.63	2.63 ± 0.73	1.35 ± 0.37	1.32 ± 0.47	D > A & B > E & F; C > E & F
GrpB		1.96 ± 0.16	1.92 ± 0.42	2.35 ± 0.48	1.72 ± 0.58	1.14 ± 0.66	B, C & D > F
GrpC			1.56 ± 0.11	1.77 ± 0.14	0.67 ± 0.07	0.84 ± 0.12	C & D > E & F
GrpD				1.82 ± 0.32	1.19 ± 0.27	1.05 ± 0.23	D > E & F
BCA	37.07 ± 2.68	28.16 ± 1.45	16.54 ± 1.86	11.43 ± 1.43	3.58 ± 0.77	5.2 ± 0.91	A > B > C > D > E & F

Octocoral

	A (2003-2005)	B (2006-2009)	C (2010-2012)	D (2013-2015)	E (2016-2018)	F (2019-2020)	
GrpA	13.12 ± 1.71	10.6 ± 1.17	11.04 ± 1.30	9.33 ± 0.95	9.16 ± 0.91	7.92 ± 0.81	A > B, C, D, E & F; B > E & F; C > D, E & F D > F
GrpB		0.01 ± 0.01	0.07 ± 0.02	0.04 ± 0.02	0.01 ± 0.01	0.01 ± 0.01	No Test
GrpC			19.46 ± 1.04	16.12 ± 1.02	14.02 ± 0.90	11.98 ± 0.97	C > D > E > F
GrpD				9.77 ± 1.00	8.13 ± 0.89	8.27 ± 1.33	D > E & F
BCA	1.97 ± 0.23	1.79 ± 0.23	2.31 ± 0.15	2.32 ± 0.26	1.30 ± 0.13	2.14 ± 0.14	C & D > E; F > E

Appendix 14. continued

Macroalgae & Cyanobacteria

	A (2003-2005)	B (2006-2009)	C (2010-2012)	D (2013-2015)	E (2016-2018)	F (2019-2020)	
GrpA	4.74 ± 1.30	8.67 ± 1.37	7.45 ± 1.27	8.49 ± 0.81	21.00 ± 3.41	21.19 ± 2.20	A < B, C & D < E & F
GrpB		41.42 ± 2.76	35.03 ± 5.28	34.95 ± 4.66	17.02 ± 3.45	33.59 ± 5.98	E < B, C, D & F
GrpC			9.81 ± 3.00	13.60 ± 2.13	21.97 ± 3.20	23.79 ± 2.45	C < D < E & F
GrpD				18.76 ± 1.57	31.62 ± 2.75	24.97 ± 2.73	D < E & F; E > F
BCA	0.92 ± 0.51	3.09 ± 1.28	3.91 ± 0.62	5.03 ± 1.76	6.76 ± 1.98	8.60 ± 1.07	A < D, E & F; B < F

Sponges

	A (2003-2005)	B (2006-2009)	C (2010-2012)	D (2013-2015)	E (2016-2018)	F (2019-2020)	
GrpA	4.35 ± 0.59	4.82 ± 0.59	6.15 ± 0.66	5.53 ± 0.54	5.75 ± 0.56	5.70 ± 0.86	A & B < C, D, E & F
GrpB		1.96 ± 0.29	3.31 ± 0.55	2.57 ± 0.32	2.41 ± 0.25	2.47 ± 0.28	B < C
GrpC			9.37 ± 1.07	8.82 ± 1.01	8.60 ± 1.01	7.81 ± 0.88	C > F
GrpD				4.78 ± 0.52	4.84 ± 0.48	5.59 ± 0.72	D & E < F
BCA	0.38 ± 0.06	0.86 ± 0.12	1.99 ± 0.54	1.73 ± 0.82	1.35 ± 0.36	1.51 ± 0.08	A < C, D, E & F; B < C