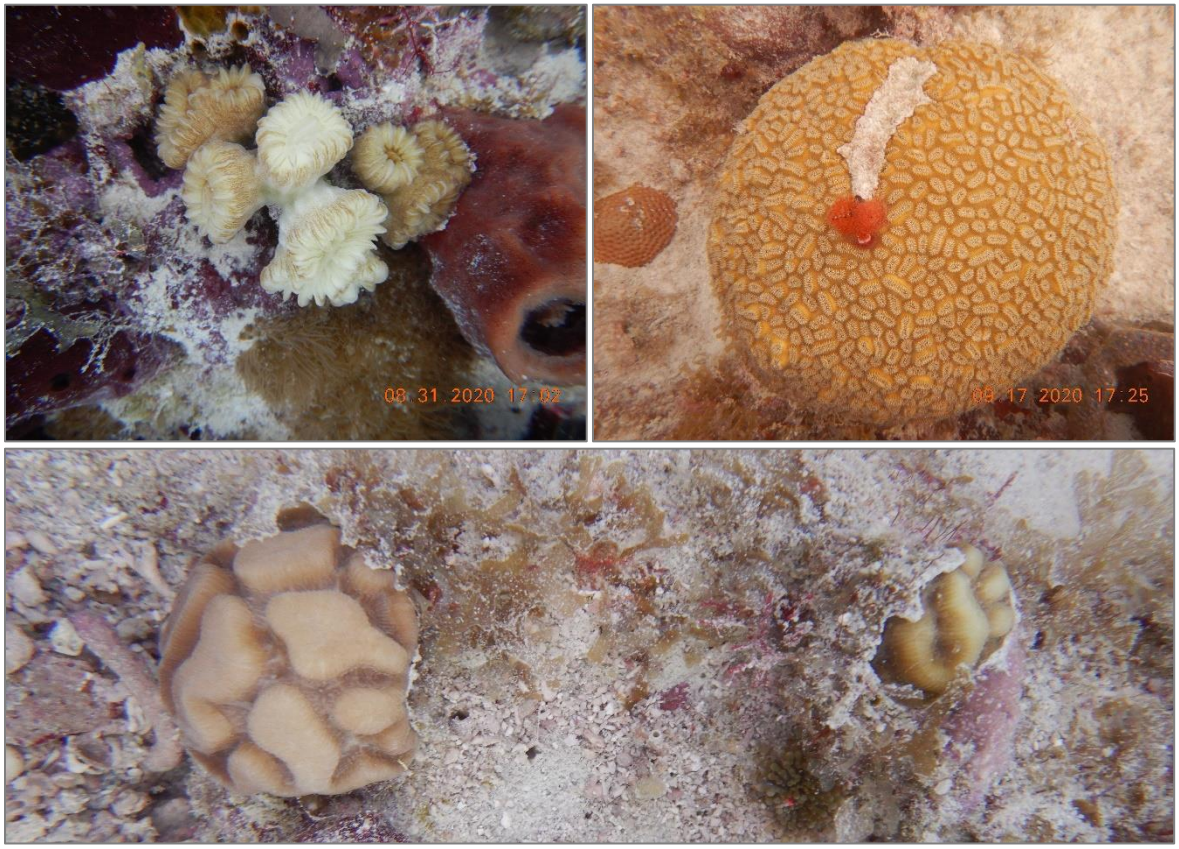
# Florida Reef Resilience Program
# Disturbance Response Monitoring
# 2020 Quick Look Report

May 2021




**Prepared by:**
**Jennifer Stein, Fish and Wildlife Research Institute**
Authors: Jennifer Stein and Rob Ruzicka

**This program is supported by the EPA's South Florida Initiative grant under the cooperative agreement number X7-01D00320-0.**

This report presents data collected during annual summer surveys conducted between August 5 and November 13 of 2020.

# Table of Contents

## INTRODUCTION

The Florida Reef Resilience Program (FRRP) is a collaborative effort among local, state, and federal environmental managers, scientists, conservation organizations, and reef users to develop resilience-based management strategies for anticipating and addressing climate change and other stressors on Florida's Coral Reef (FCR). Precipitated by the severe coral bleaching event in the Florida Keys in 2005, the FRRP developed the Disturbance Response Monitoring (DRM) program to assess reef condition annually during the months of peak thermal stress. Since 2005, the partners of the DRM program have conducted annual surveys to document the extent and severity of coral bleaching and disease along the reef tract.

The primary goals of the DRM program have always been to provide a condition report and the annual status of bleaching along the reef tract. This information is used to identify resilient areas of the reef, promote appropriate management or conservation strategies of reef areas based on resilience, and aid management in research and restoration decisions. In addition to the extensive dataset the DRM program provides, it offers the opportunity for partners from across the jurisdictions of FCR to work together under a unified effort. Collaborating across agencies, universities, and organizations allows for multiple sources of input and expertise and generates transparency across managers and researchers. This is becoming more important as the threats to the reef continually grow.

During its tenure, the DRM program has modified its experimental design to account for new disturbances and has specifically adapted its protocols in response to the outbreak of stony coral tissue loss disease (SCTLD). Now that the entire reef tract, aside from the Dry Tortugas, is endemic (i.e., has experienced the spread of SCTLD), the focus has changed to assessing the surviving population of corals that were most susceptible to SCTLD and identifying resilient reef areas that can support restoration and recovery. For the 2020 season, DRM instituted several changes to the survey design. First, it expanded the survey area at each site from two to four belt transects. The two additional transects were specifically designed to target the species most affected by SCTLD, increasing the effort on locating these now rare individuals. In addition, a juvenile census of the most SCTLD-susceptible coral families was completed along all four transects. These data will provide the first assessment of survivorship and/or post-SCTLD recruitment of these susceptible coral species and determine whether recovery will occur broadly or locally along the reef.

During the 2020 season, 389 sites were surveyed throughout FCR, including the second year of surveys within the Marquesas. This was possible due to the committed efforts of the 2020 partners, including Biscayne National Park, Broward County, Dry Tortugas National Park, Florida Department of Environmental Protection, Florida Fish and Wildlife Conservation Commission (FWC), John Pennekamp Coral Reef State Park, Keys Marine Laboratory, Miami-Dade County, Mote Marine Laboratory, National Oceanic and Atmospheric Administration (NOAA), Nova Southeastern University, Palm Beach Zoo, University of Miami's Rosenstiel School of Marine and Atmospheric Science, Shedd Aquarium, and The Nature Conservancy. Due to the Covid-19 pandemic, two partner organizations were not able to conduct surveys this past summer but are still listed due to their valuable insight and support of the program. In

addition, due to the restrictive guidelines to perform travel and safeguard against Covid-19 exposure during field operations, most partners worked under limited capacity and condensed schedules. Despite these hurdles, the 2020 season marked the largest DRM survey effort in the history of the program.

This summary report describes the prevalence of coral bleaching, paling, and disease in 2020 as traditionally assessed through the belt transect survey methodology employed by DRM. A temporal comparison of coral density and diameter for 10 SCTLD-susceptible coral species over an 11-year period was included to identify the timing and severity of potential impacts to these coral populations from the disease. A juvenile coral census of three SCTLD-susceptible (sub)families was incorporated into the DRM methods for the first time in 2020 to identify the potential recovery of these impacted populations. Those results are also presented in this report.

## METHODS

The DRM program surveys coral populations using a probabilistic sampling design based on how corals are distributed spatially within and across different regions, subregions, and zones of FCR. Regions include Southeast Florida, Florida Keys, Marquesas, and Dry Tortugas. Reef zones were classified by cross-shelf position, distance from shore, and depth, while subregions were stratified latitudinally. The Southeast Florida region includes the Martin, Palm Beach, and Broward-Miami subregions and the Florida Keys region includes the Biscayne, Upper Keys, Middle Keys, and Lower Keys subregions. Each year, new sites are randomly selected from this spatial framework. This sampling design is applied to all regions except the Marquesas, where, due to its remote location, detailed benthic habitat maps are not available, and a random site allocation is not possible. Instead, Marquesas sites in 2020 were selected in the same manner as 2019. They were a priori chosen based on known areas of hardbottom and reef habitat, where coral had been previously documented.

Surveys consisted of four independent 1x10 m belt transects that were haphazardly placed within a 50x50 m sample area. Transects are identified as Transect 1, 2, 3, and 4. Transects 1 and 2 included surveys of all stony coral species >4 cm while Transects 3 and 4 targeted a subset of 10 coral species (>4 cm) known to be highly susceptible to SCTLD, including: *Colpophyllia natans*, *Dichocoenia stokesii*, *Diploria labyrinthiformis*, *Meandrina meandrites*, *Mussa angulosa*, *Mycetophyllia aliciae*, *Mycetophyllia ferox*, *Mycetophyllia lamarckiana*, *Pseudodiploria clivosa*, and *Pseudodiploria strigosa*. Juvenile corals belonging to three target (sub)families (Faviinae, Mussinae, Meandrinidae) were tallied for each of Transects 1-4.

At all sites, stony corals >4 cm were measured for size (maximum diameter and height) and assessed for the condition indicators of bleaching (whole colony or partial colony areas of complete color loss), paling (a precursor to bleaching where coral color is lighter than normal), disease, and percent morality. Percent mortality was assigned as either old mortality, recent mortality due to disease, or recent mortality due to other factors (biotic or abiotic). If disease was the cause of recent mortality, surveyors described the rate of tissue loss spread and identified the disease using a three-letter identification code. The identification code for SCTLD was added to the DRM data entry system in 2019 as ‘STL’ (Stony Tissue Loss).

Prevalence values of bleaching, bleaching and paling combined, and disease were calculated by pooling coral data across Transects 1 and 2 at a site and by zone within each subregion. Prevalence values represent the percent of corals affected along Transects 1 and 2 within a site or zone population. Prevalence values were compared across zones and subregions to identify spatial differences in the severity of coral bleaching and paling, as well as identify spatial patterns of coral diseases.

Density values for the 10 target SCTLD-susceptible coral species and the three juvenile coral families were calculated per site by pooling abundances across all four transects. Mean density for each of the target adult coral species was calculated by region and then compared across the past 11 years of DRM summer survey data (excluding targeted survey efforts, e.g., post-Hurricane Irma or winter surveys). Mean maximum diameter for each of the target adult coral species was also calculated by region and then compared across the past 11 years of DRM summer survey data. Density values for each of the three target juvenile coral families was calculated per site by pooling abundances across all four transects. Mean density values of the target juvenile families were calculated by region. Mean density of the 10 adult target species and three juvenile families as well as mean maximum diameter of the 10 adult target species was also calculated for each subregion and is included in **Appendix I** of this report.

## RESULTS

A total of 389 sites were completed across nine subregions for the 2020 DRM season. Thirteen sites were completed in Martin County, 20 in Palm Beach, 83 in Broward-Miami, 10 in Biscayne, 38 in the Upper Keys, 32 in the Middle Keys, 83 in the Lower Keys, 49 in the Marquesas, and 61 in the Dry Tortugas.

The prevalence of colonies along Transects 1 and 2 exhibiting signs of bleaching, and/or bleaching and paling combined was pooled by zones (**Figures 1** and **2**) and by sites (**Tables 1** and **2**) within each subregion. Prevalence values were broken into three categories: mild (0-20%), moderate (21-50%), and severe (>50%). First, the prevalence of bleached and partially bleached corals (excluding pale colonies), pooled by zone, was mild across all subregion-zones with the exception of the Martin County Inshore zone, which had moderate bleaching (**Figure 1**). The bleaching prevalence in the Inshore zone was mostly influenced by the species *Siderastrea radians*, which made up 71% of the surveyed population in Martin County and 88% of the bleached or partially bleached colonies recorded across the subregion. Pooled by site, two sites in the Martin County subregion had severe bleaching (**Table 1**) which again was influenced mostly by *S. radians*. Across the reef tract, 36 sites had moderate bleaching. The Broward-Miami subregion had the highest number of sites with moderate bleaching, mostly influenced by partially bleached *S. siderea* and *Stephanocoenia intersepta*.

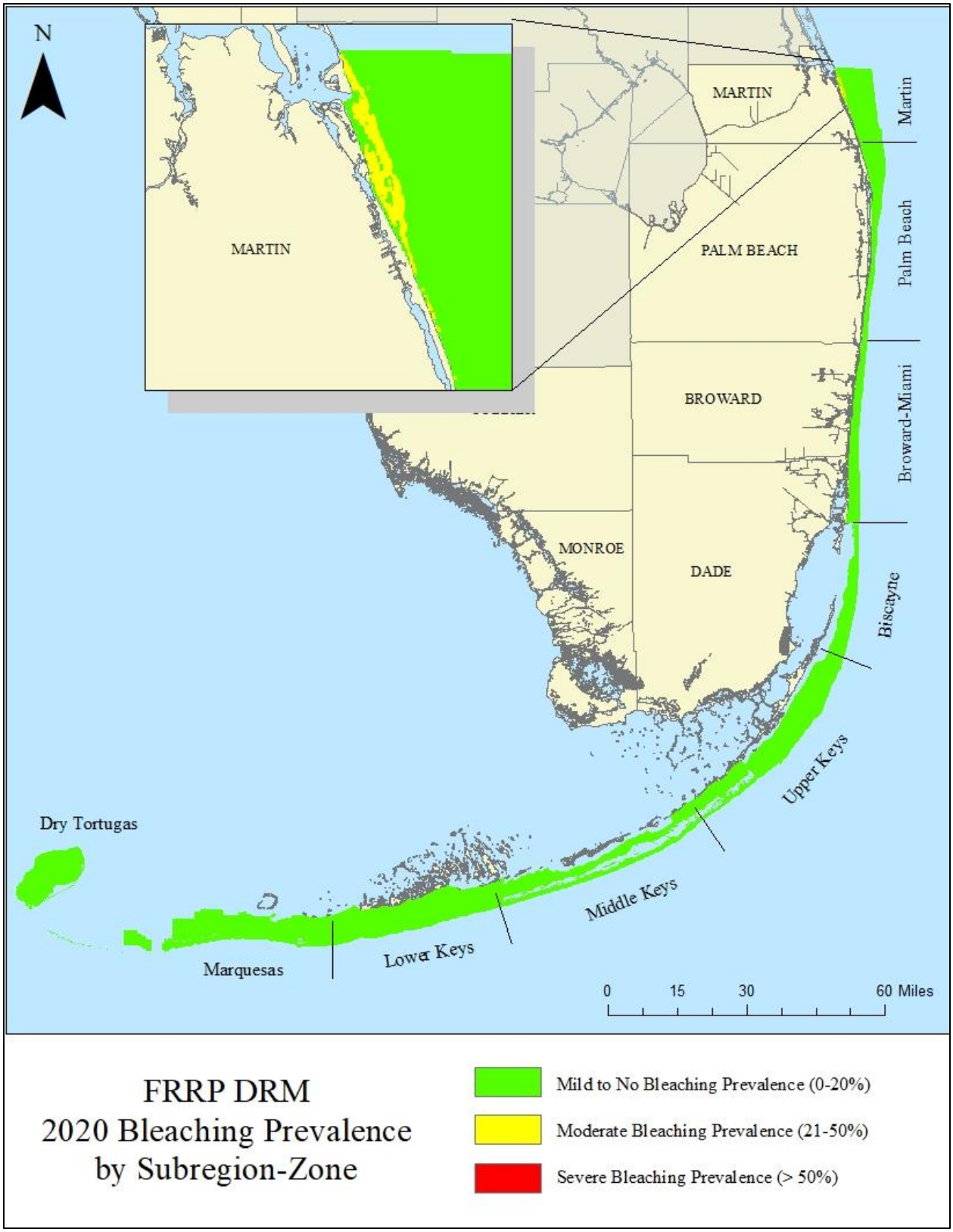



**Figure 1.** Bleaching prevalence of surveyed coral colonies by subregion-zone.

**Table 1.** Total number of sites within each subregion recorded with mild, moderate or severe bleaching prevalence of coral colonies.

| Subregion | Mild (0-20%) | Moderate (21-50%) | Severe (>50%) |
|---|---|---|---|
| Martin | 7 | 4 | 2 |
| Palm Beach | 16 | 4 | 0 |
| Broward-Miami | 72 | 11 | 0 |
| Biscayne | 9 | 1 | 0 |
| Upper Keys | 35 | 3 | 0 |
| Middle Keys | 29 | 3 | 0 |
| Lower Keys | 78 | 5 | 0 |
| Marquesas | 44 | 5 | 0 |
| Dry Tortugas | 61 | 0 | 0 |
| **Total Sites** | 351 | 36 | 2 |

When paling was included within the bleaching analysis, prevalence values rose to moderate (21-50%) and severe (>50%) in all subregion-zones in Southeast Florida and Dry Tortugas and five of the 13 subregion-zones in the Florida Keys (**Figure 2**). The Martin County Inshore zone and Broward-Miami Undetermined zone were the only two subregion-zones with severe bleaching and paling. The Broward-Miami Undetermined zone was represented by one site, where only 5 corals were recorded across Transects 1 and 2. The Undetermined zone is an area that lacks appropriate mapping data or does not configure to the defined cross-shelf zonation but often contains reef habitat. Overall, when pooled by subregion-zone, the Keys had less bleaching and paling when compared to Southeast Florida and Dry Tortugas. Pooled by site, 26 of the 389 sites were recorded with severe bleaching and paling (**Table 2**). The Broward-Miami subregion had the highest number of sites with severe bleaching and paling.

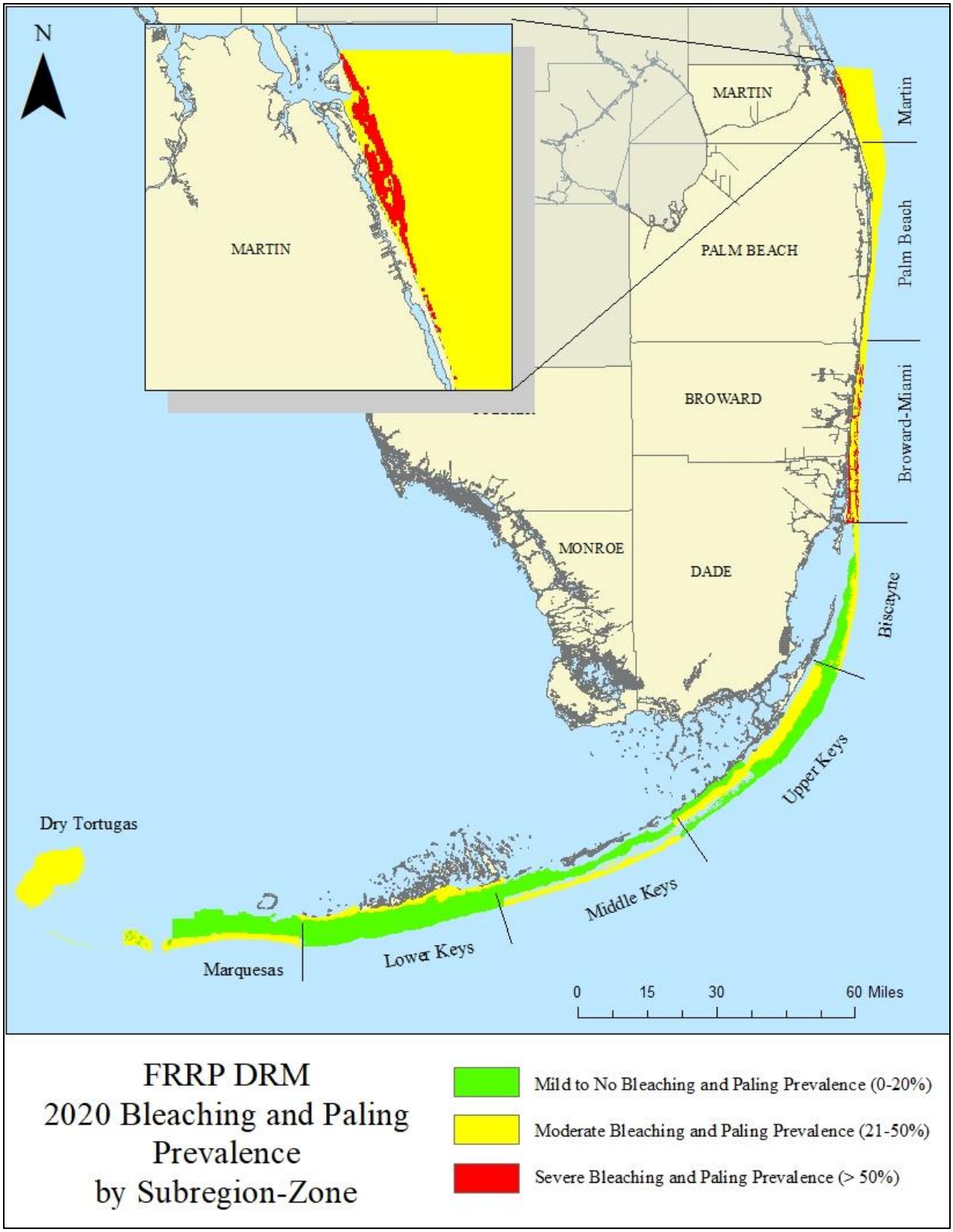



**Figure 2.** Bleaching and paling prevalence of surveyed coral colonies by subregion-zone.

**Table 2.** Total number of sites within each subregion recorded with mild, moderate or severe bleaching and paling prevalence.

| Subregion | Mild (0-20%) | Moderate (21-50%) | Severe (>50%) |
|---|---|---|---|
| Martin | 2 | 6 | 5 |
| Palm Beach | 8 | 10 | 2 |
| Broward-Miami | 37 | 35 | 11 |
| Biscayne | 6 | 4 | 0 |
| Upper Keys | 22 | 14 | 2 |
| Middle Keys | 15 | 16 | 1 |
| Lower Keys | 56 | 25 | 2 |
| Marquesas | 26 | 23 | 0 |
| Dry Tortugas | 23 | 35 | 3 |
| **Total Sites** | 195 | 168 | 26 |

Paling is included within the prevalence analysis because any visible loss of color indicates significant stress on a coral colony. It is advised, however, that paling results be interpreted with caution, due to the subjectivity inherent in how surveyors across the wide range of DRM partners interpret variations in coral color in the field.

The prevalence of disease along Transects 1 and 2 was pooled by zones (**Figure 3**) and by sites (**Table 3**) within each subregion. Prevalence values were broken into three categories: low (0-5%), medium (6-10%), and high (>10%). All disease prevalence values were calculated from diseases that result in tissue loss and do not include Dark Spot Syndrome or other discoloration conditions. Pooled by zone within each subregion, all prevalence values for diseases resulting in tissue loss were low, with the exception of the Marquesas. Medium disease prevalence was recorded at the Mid Channel and Offshore Patch Reef zones in the Marquesas subregion. The disease prevalence was heavily influenced by SCTLD, with 168 colonies recorded with the disease across all sites in the Marquesas (**Table 4**). Of the corals recorded with SCTLD in the Marquesas, 60% were *M. cavernosa* and 20% were *S. siderea*. Other highly susceptible species recorded with the disease in the Marquesas subregion were *C. natans, D. labyrinthiformis, D. stokesii, Eusmilia fastigiata, M. aliciae, M. meandrites, Orbicella faveolata, O. franksi,* and *P. strigosa* (**Figure 4**).

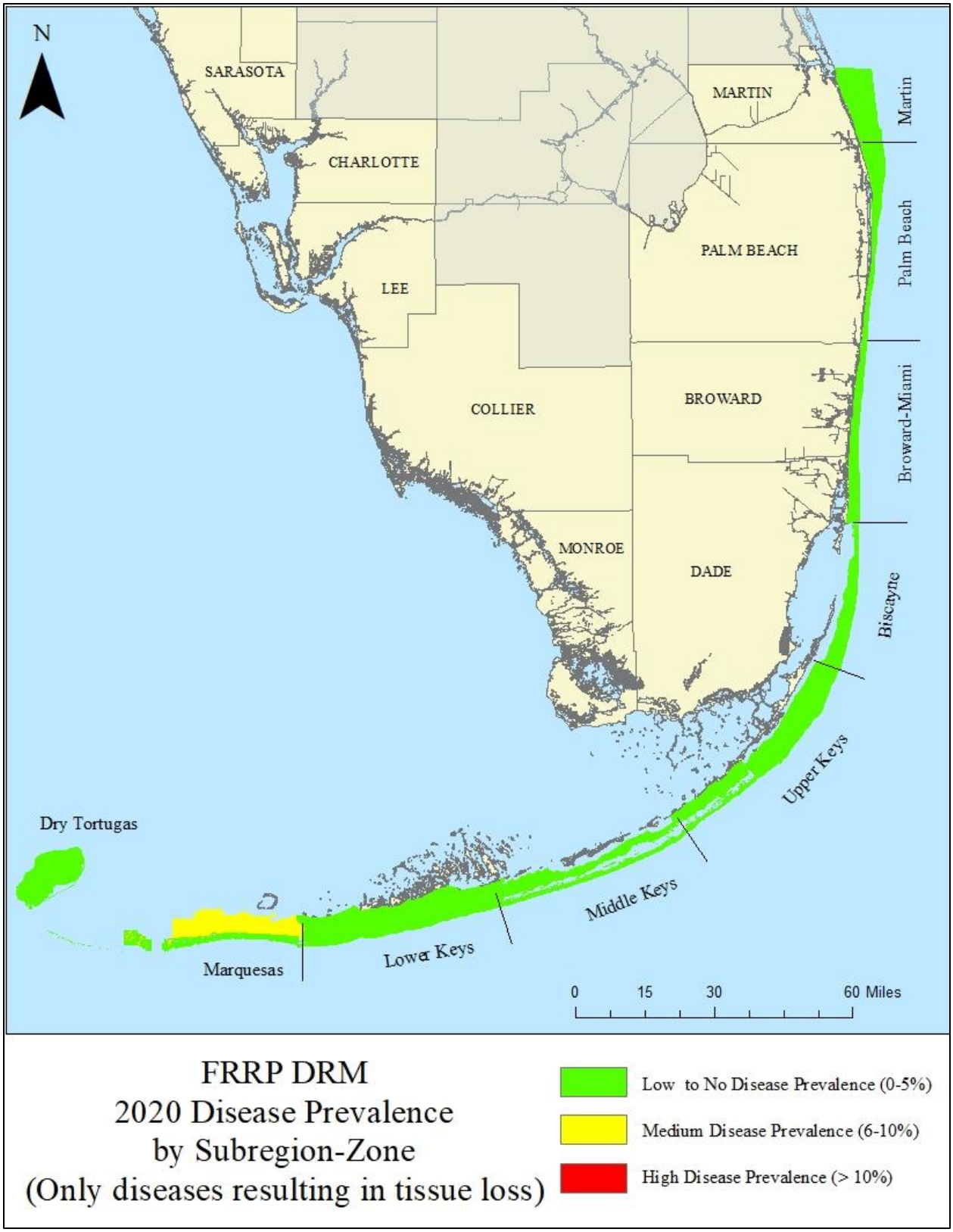



**Figure 3.** Tissue loss disease prevalence of surveyed coral colonies by subregion-zone.

**Table 3.** Total number of sites within each subregion recorded with low, medium or high disease prevalence.

| Subregion | Low (0-5%) | Medium (6-10%) | High (>10%) |
|---|---|---|---|
| Martin | 13 | 0 | 0 |
| Palm Beach | 15 | 4 | 1 |
| Broward-Miami | 77 | 5 | 1 |
| Biscayne | 10 | 0 | 0 |
| Upper Keys | 37 | 0 | 1 |
| Middle Keys | 32 | 0 | 0 |
| Lower Keys | 81 | 2 | 0 |
| Marquesas | 36 | 10 | 3 |
| Dry Tortugas | 61 | 0 | 0 |
| **Total Sites** | 362 | 21 | 6 |

**Table 4.** Total number of colonies for each species observed with SCTLD recorded in each subregion. Only those subregions where SCTLD was observed are listed.

| **Subregions** | ***Agaricia agaricites*** | ***Colpophyllia natans*** | ***Diploria labyrinthiformis*** | ***Dichocoenia stokesii*** | ***Eusmilia fastigiata*** | ***Mycetophyllia aliciae*** | ***Montastraea cavernosa*** | ***Meandrina meandrites*** | ***Oculina diffusa*** | ***Orbicella faveolata*** | ***Orbicella franksi*** | ***Pseudodiploria clivosa*** | ***Pseudodiploria strigosa*** | ***Stephanocoenia intersepta*** | ***Siderastrea siderea*** | **Total per subregion** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Palm Beach | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | **2** |
| Broward-Miami | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | **6** |
| Middle Keys | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 8 | **11** |
| Lower Keys | 1 | 0 | 1 | 0 | 1 | 0 | 4 | 0 | 0 | 8 | 0 | 0 | 0 | 2 | 12 | **29** |
| Marquesas | 0 | 5 | 2 | 2 | 7 | 2 | 98 | 2 | 1 | 6 | 3 | 0 | 7 | 4 | 29 | **168** |
| **Total per sp.** | **1** | **5** | **4** | **3** | **8** | **2** | **106** | **2** | **1** | **15** | **3** | **2** | **7** | **7** | **50** | **216** |

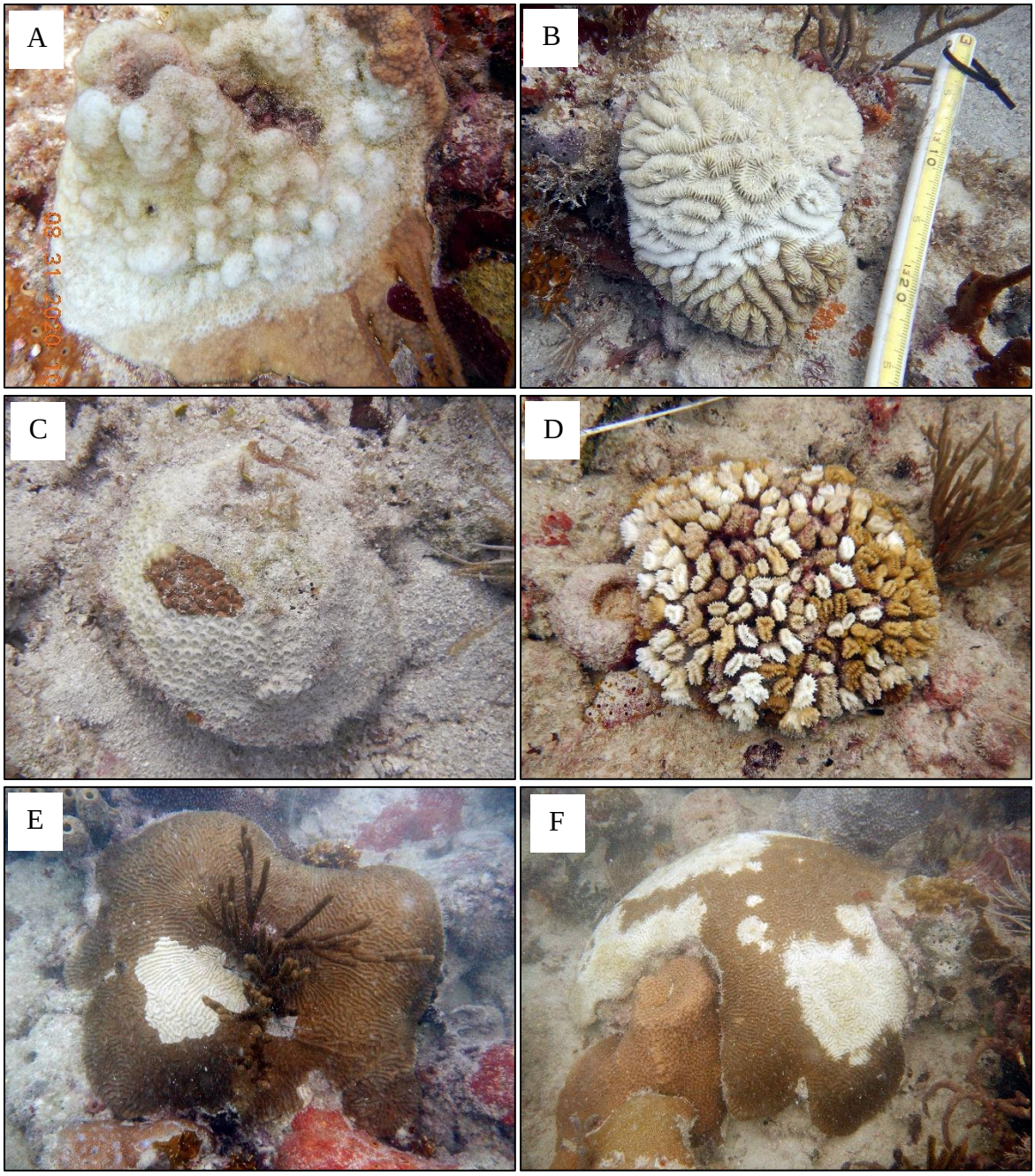



**Figure 4.** Images of SCTLD in the Marquesas subregion on colonies of A) *Orbicella* sp., B) *M. meandrites*, C) *M. cavernosa*, D) *E. fastigiata*, and E-F) *P. strigosa*, surveyed in August 2020.

Only six of the 389 sites had high disease prevalence and 21 had medium disease prevalence (**Table 3**). The Marquesas subregion had the highest number of sites with high and medium disease prevalence.

Across the reef tract, 216 corals were recorded with SCTLD (**Table 4**). Fifty percent of those corals were *M. cavernosa* and 23% were *S. siderea*. Both species have been identified as

intermediately susceptible species for which the rate of tissue loss is slower and symptoms typically manifest at a later onset than other highly susceptible species. All other species recorded with SCTLD had less than 10 total colonies observed with the disease, except for *O. faveolata*, which had 15 observations. The low prevalence of SCTLD on these other highly susceptible species may reflect the subsidence of the disease across most of the reef tract and/or be the result of fewer susceptible colonies remaining in the wake of the disease.

During the 2020 survey event, SCTLD was not observed within the boundaries of Dry Tortugas National Park. Using the traditional stratified random sampling design, 50 sites were allocated across the park. Eleven additional sites were pre-selected that targeted three areas of the park that are most vulnerable to the ongoing spread of SCTLD and were known to have several of the highly susceptible species. Those areas of the park are 1) the northeast region around Pulaski Shoal, 2) the eastern boundary where most vessel traffic from Key West enters the park, and 3) the southeast region where the reef is most exposed to offshore currents and other vessel access. The purpose of these additional targeted sites was to enhance the probability of detecting SCTLD at earliest arrival if it had spread into the park. Although no SCTLD was observed during the 2020 DRM survey effort, regular continued reconnaissance is needed to closely monitor for the potential introduction of the disease into the park.

## ADULT TARGET CORAL SPECIES

Now that the majority of the reef tract is classified as endemic, it is important to assess the population status of the coral species that were most susceptible to SCTLD. Density values for each target species were calculated by site pooled across all four transects. The total survey area at each site is $40m^2$ ($10m^2$ per transect). Mean density values were calculated by region (Southeast Florida, Florida Keys, Marquesas, and Dry Tortugas) and subregion. The results provided below are pooled by region (**Figures 5-11**). Results by subregion are included in **Appendix I** of this report. Mean maximum diameter was also calculated by region for each of the target species. Mean maximum diameter by subregion for each target species is also included in **Appendix I** of this report.

Comparing the 2020 density values by region for the target species, nearly all species are more abundant in the Dry Tortugas than in the Marquesas, Florida Keys or Southeast Florida, with the exception of *M. lamarckiana* which was found at similar abundances in the Dry Tortugas, Marquesas, and Florida Keys. The mean density of *M. meandrites* in Southeast Florida was higher than the mean density found in the Keys (**Table 5**) and similar to densities found in the Marquesas. The mean maximum diameter, however, was lowest in Southeast Florida, suggesting that smaller colonies made up a greater proportion of the surveyed population. The mean density of *P. clivosa* was lowest in the Marquesas region in 2020. However, this is likely due to the small number of sites that were surveyed in nearshore habitat of the Marquesas, where *P. clivosa* is most commonly found.

**Table 5.** Mean (±SE) density of the 10 target SCTLD-susceptible species in each region in 2020.

| Target Species | Southeast Florida | Florida Keys | Marquesas | Dry Tortugas |
|---|---|---|---|---|
| *Colpophyllia natans* | 0.003 ± 0.001 | 0.02 ± 0.005 | 0.016 ± 0.004 | 0.055 ± 0.008 |
| *Diploria labyrinthiformis* | 0.003 ± 0.001 | 0.009 ± 0.001 | 0.009 ± 0.002 | 0.018 ± 0.003 |
| *Dichocoenia stokesii* | 0.014 ± 0.003 | 0.032 ± 0.003 | 0.028 ± 0.004 | 0.04 ± 0.005 |
| *Meandrina meandrites* | 0.012 ± 0.002 | 0.003 ± 0.001 | 0.012 ± 0.003 | 0.054 ± 0.008 |
| *Mussa angulosa* | 0 ± 0 | 0.002 ± 0.001 | 0.004 ± 0.002 | 0.005 ± 0.001 |
| *Mycetophyllia aliciae* | 0.001 ± 0 | 0.004 ± 0.001 | 0.014 ± 0.004 | 0.015 ± 0.003 |
| *Mycetophyllia ferox* | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0.002 ± 0.001 |
| *Mycetophyllia lamarckiana* | 0 ± 0 | 0.002 ± 0.001 | 0.002 ± 0.001 | 0.002 ± 0.001 |
| *Pseudodiploria clivosa* | 0.003 ± 0.001 | 0.004 ± 0.001 | 0.001 ± 0.001 | 0.006 ± 0.002 |
| *Pseudodiploria strigosa* | 0.004 ± 0.001 | 0.014 ± 0.002 | 0.032 ± 0.006 | 0.061 ± 0.011 |
| **Total Sites Surveyed in 2020** | **104** | **163** | **49** | **61** |

To identify potential impacts from SCTLD for each target species, mean density values and mean maximum diameter were compared across 11 years (2010-2020) of DRM data within each region. However, due to the paucity of some species across all regions, low replication limited any meaningful interpretation of changes in abundance. If less than 10 total colonies of the target species were observed for most of the 11 survey years within a region, that species or species complex was omitted from the time series comparisons for that corresponding region. Abundance values of *M. angulosa* were too low across all regions and survey years and was therefore omitted for all regions. **Figures 5** through **11** plot the mean density (primary Y axis, columns) and mean maximum diameter (secondary Y axis, lines) for each of the target species across the survey years (X axis) with the exception of *M. angulosa*. *Mycetophyllia* spp. (*M. aliciae*, *M. ferox*, and *M. lamarckiana*) were pooled together in **Figure 9** due to the low total colony counts for each species in each region. Statistical tests to detect significance differences across survey years for each species or *Mycetophyllia* spp. was not calculated for the time series graphs. The graphs are only provided for general reference to aid in understanding the impacts of SCTLD.

There are limited data gaps in the long-term DRM dataset. In the Dry Tortugas, DRM data was not collected in 2010, 2011, and 2013. Due to the impacts from Hurricane Irma in the Florida Keys, the 2017 data collection did not employ the traditional stratified sampling design. Therefore, the 2017 data was omitted from the time series graphs in the Florida Keys region. Finally, DRM monitoring in the Marquesas began in 2019, providing only two years of data.

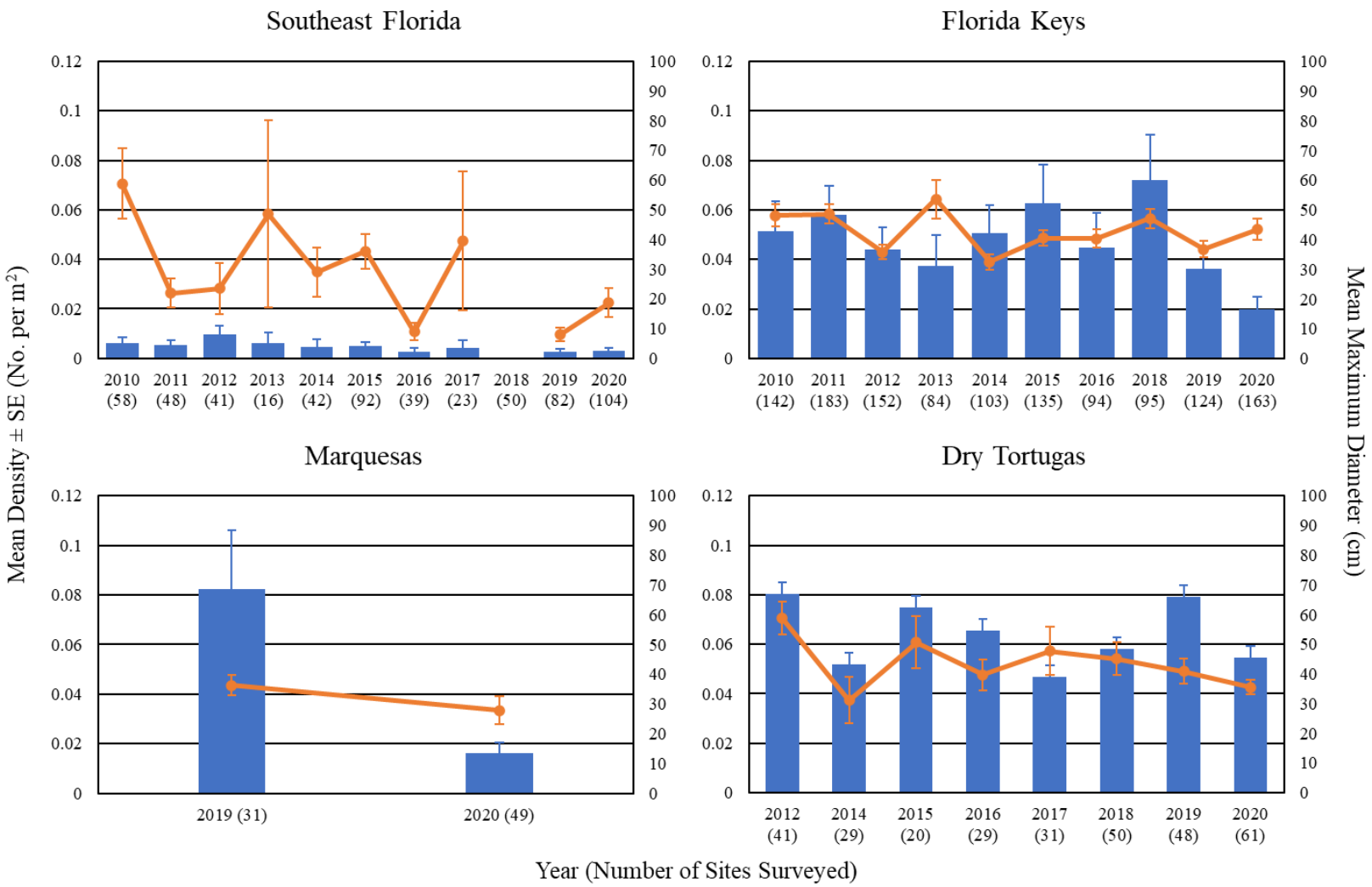



**Figure 5.** Density (blue columns, primary Y axis) and mean maximum diameter (orange lines, secondary Y axis) of target species *Colpophyllia natans* across the four regions for each survey year.

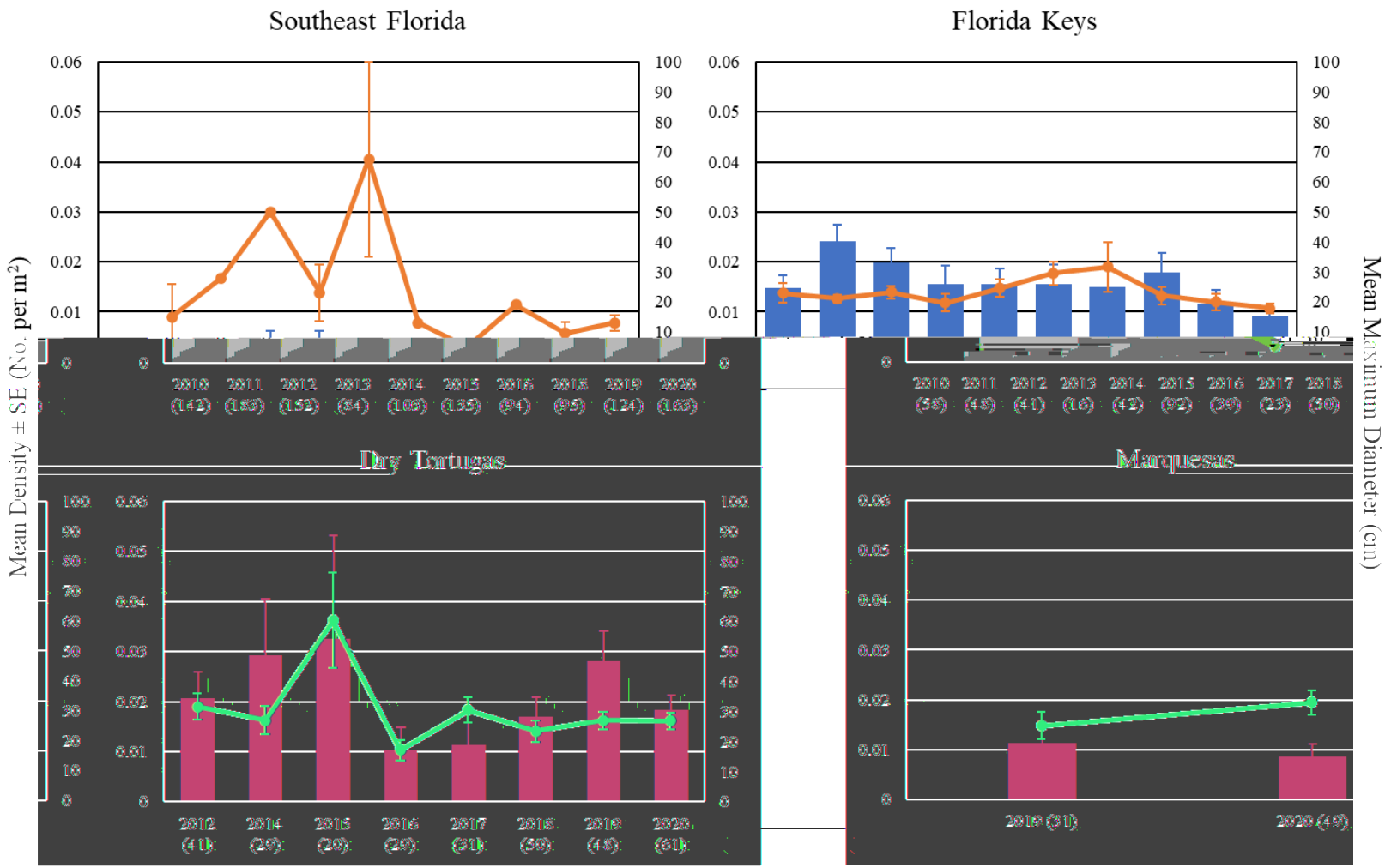



**Figure 6.** Density (blue columns, primary Y axis) and mean maximum diameter (orange lines, secondary Y axis) of target species *Diploria labyrinthiformis* across the four regions for each survey year.

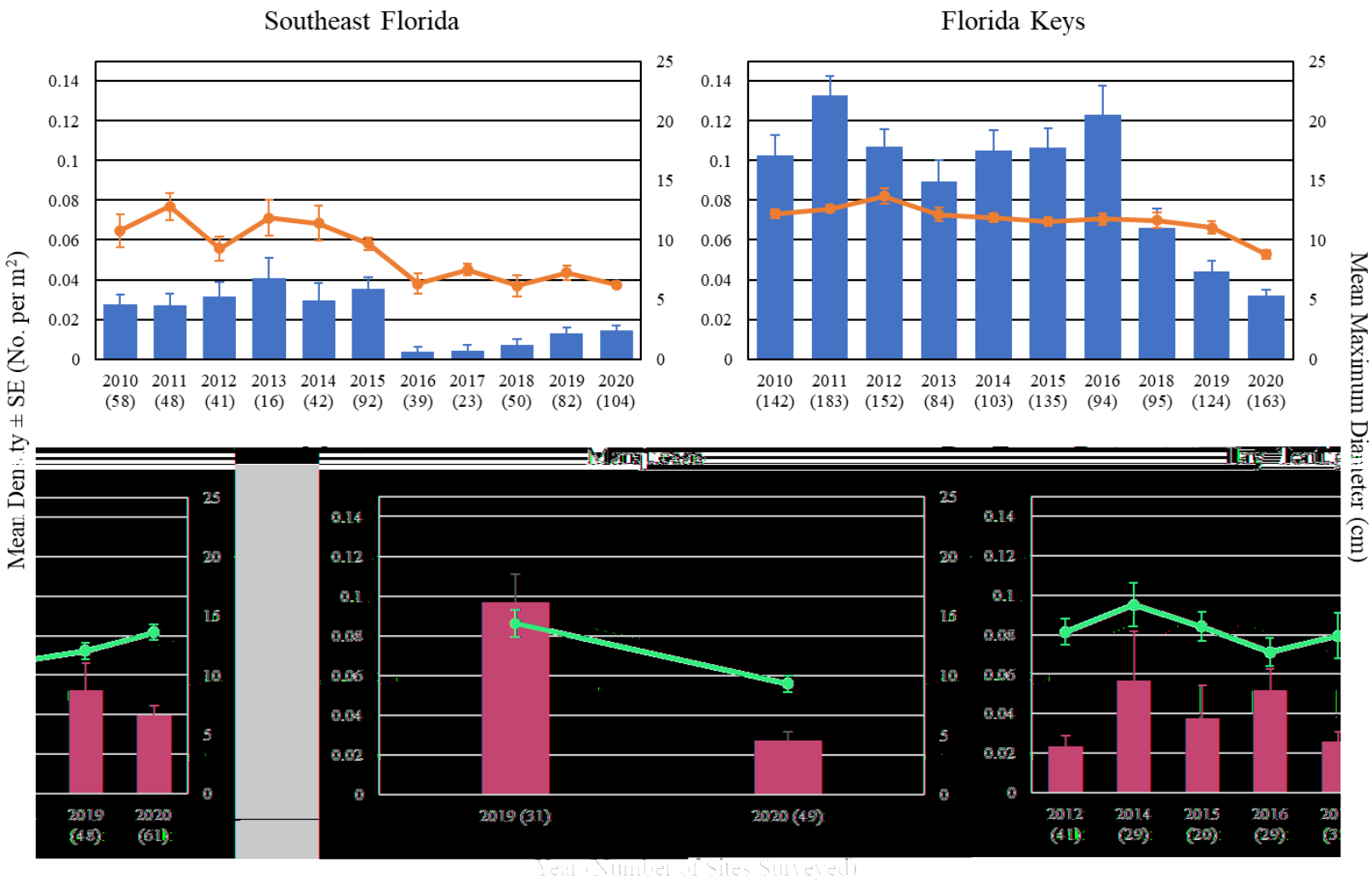



**Figure 7.** Density (blue columns, primary Y axis) and mean maximum diameter (orange lines, secondary Y axis) of target species *Dichocoenia stokesii* across the four regions for each survey year.

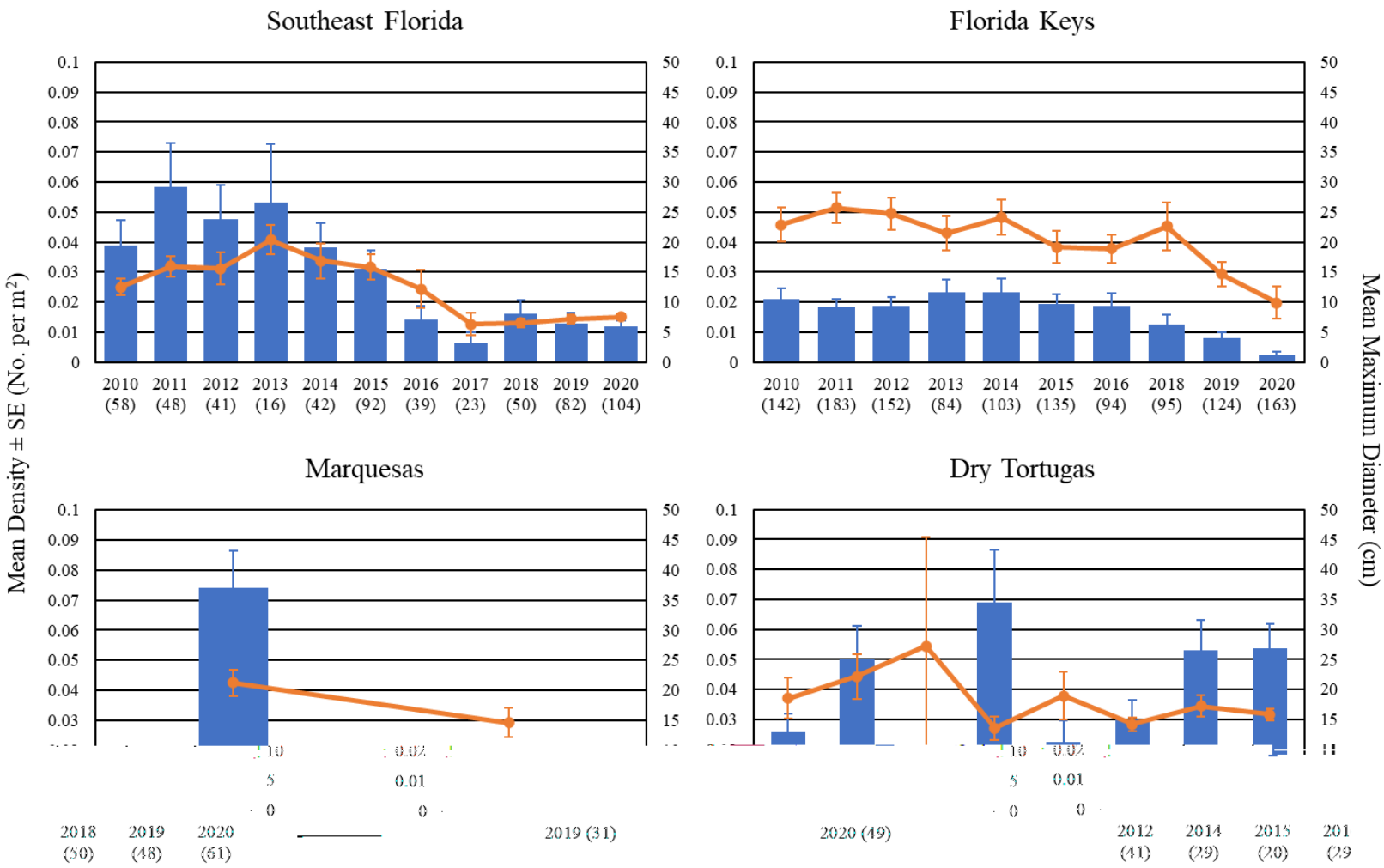



**Figure 8.** Density (blue columns, primary Y axis) and mean maximum diameter (orange lines, secondary Y axis) of target species *Meandrina meandrites* across the four regions for each survey year.

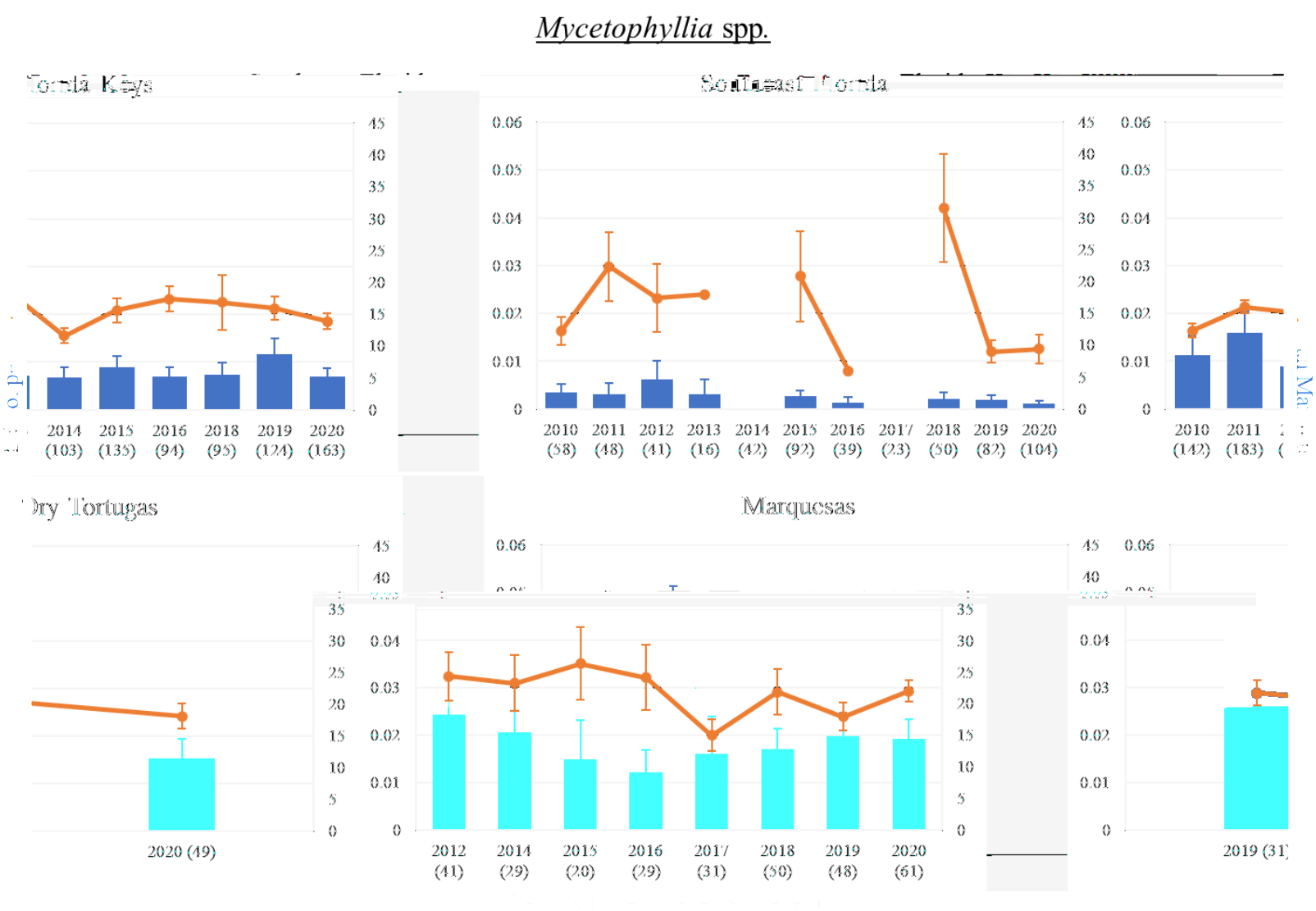



**Figure 9.** Density (blue columns, primary Y axis) and mean maximum diameter (orange lines, secondary Y axis) of target genus *Mycetophyllia* spp. (pooled for *M. aliciae*, *M. ferox*, and *M. lamarckiana*) across the four regions for each survey year.

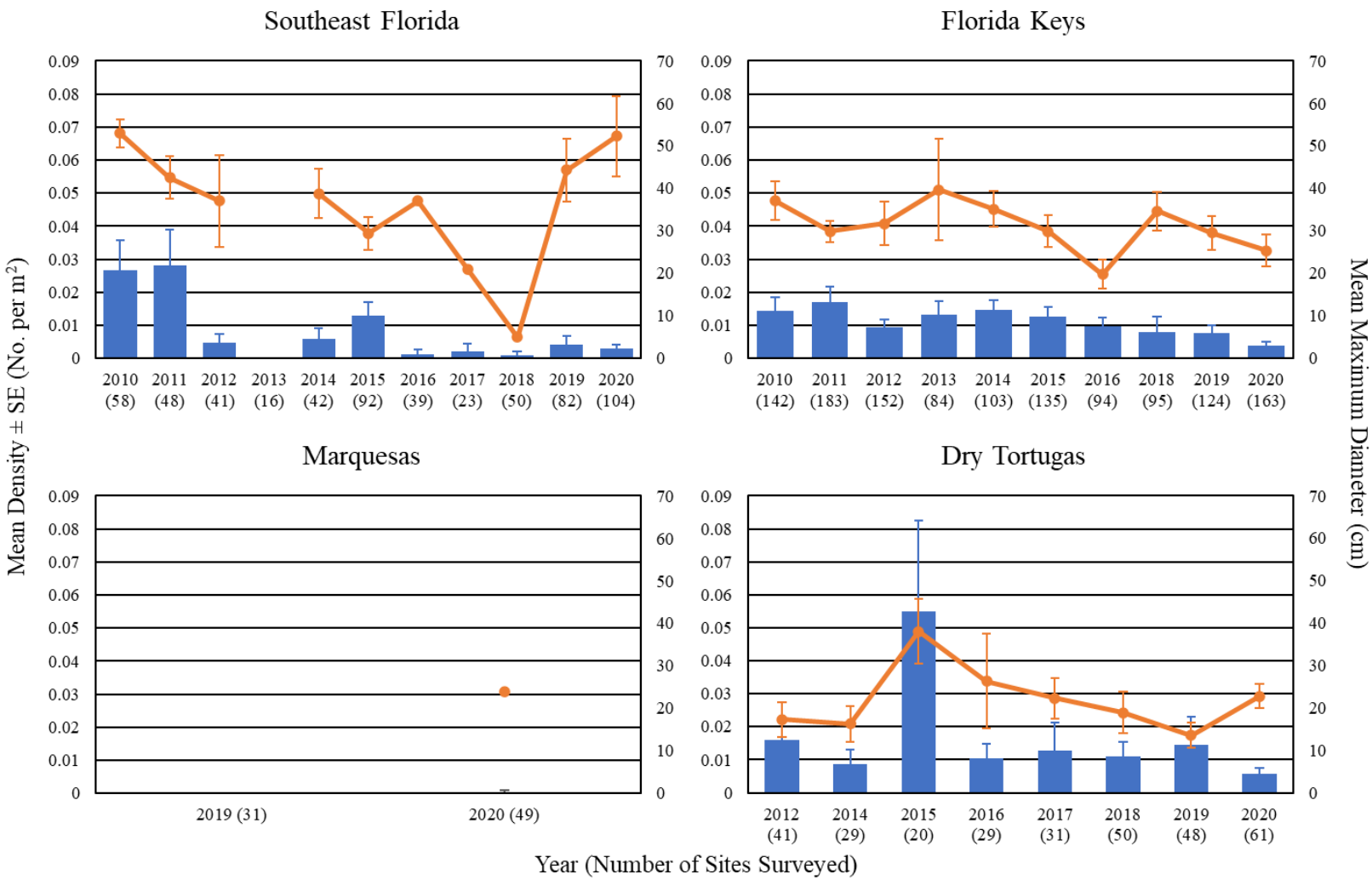



**Figure 10.** Density (blue columns, primary Y axis) and mean maximum diameter (orange lines, secondary Y axis) of target species *Pseudodiploria clivosa* across the four regions for each survey year.

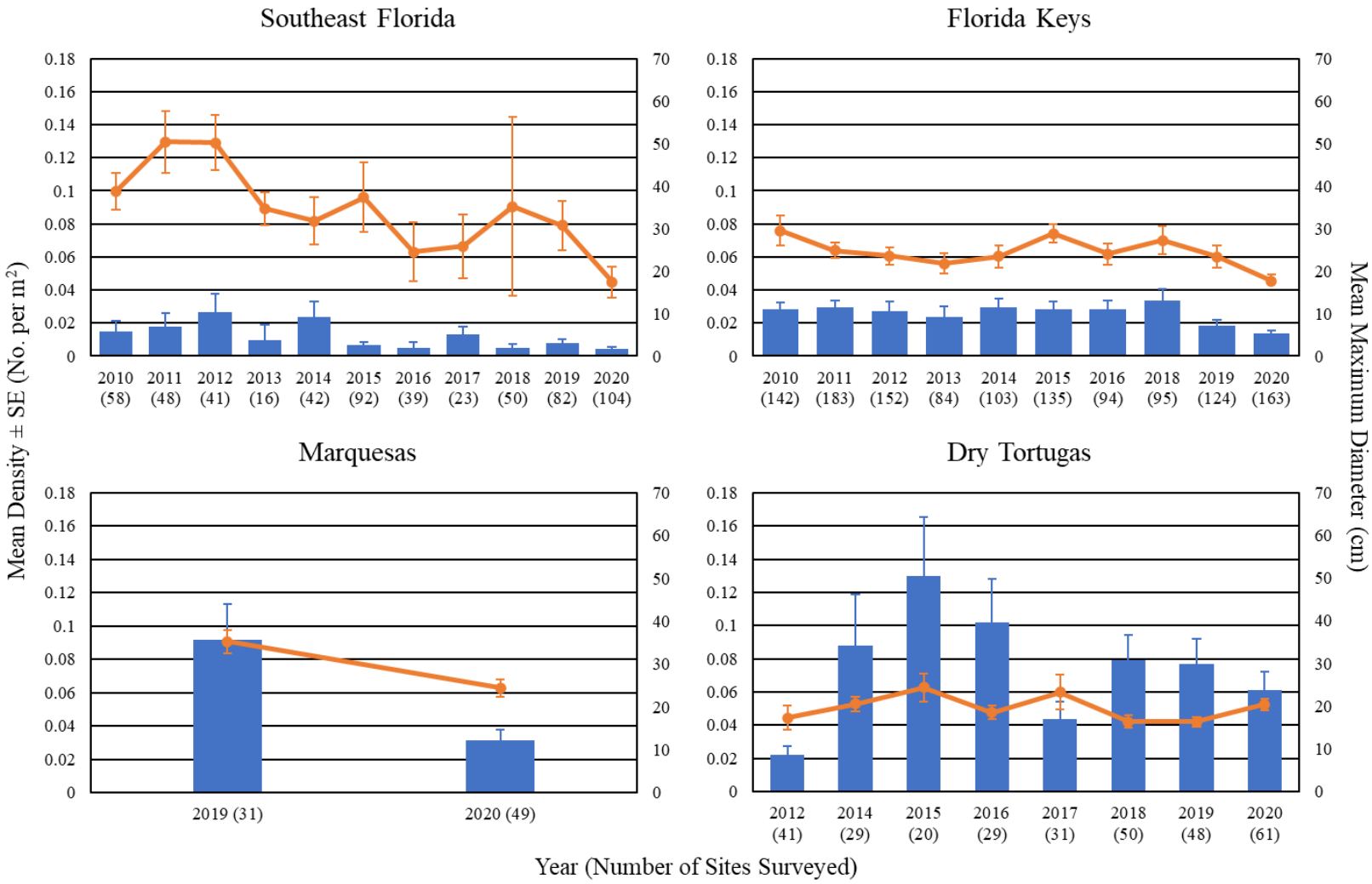



**Figure 11.** Density (blue columns, primary Y axis) and mean maximum diameter (orange lines, secondary Y axis) of target species *Pseudodiploria strigosa* across the four regions for each survey year.

*Southeast Florida*

Three of the target species - *D. stokesii, M. meandrites,* and *P. strigosa* – all had much lower densities in Southeast Florida (Martin, Palm Beach, and Broward-Miami subregions) in 2020 compared to all years prior to 2015. The lower densities in recent years were also associated with smaller mean maximum diameter since 2015. SCTLD was first documented in Southeast Florida in 2014 off Miami-Dade County and spread throughout the region over the next two years. The most abrupt changes in both mean density and maximum diameter occurred between 2014 and 2016 and coincided with the epidemic stage of SCTLD in Southeast Florida, when the disease first hit this region and resulted in high prevalence and coral mortality. The other seven target species did not have sufficient abundance in Southeast Florida across most survey years to make any meaningful interpretations about the impact of SCTLD.

Mean density and maximum diameter graphs for all target species in Southeast Florida are provided in **Figures 5** – **11,** except for *M. angulosa*. Mean density and maximum diameter were sharply lower for *D. stokesii* and *M. meandrites* in Southeast Florida after 2016 and have remained at or near the 2016 level through 2020 (**Figures 7** and **8**). Since the initial catastrophic impacts from SCTLD between 2014 and 2016, the mean density of *D. stokesii* has begun a slight upward trend, which would suggest the potential of some recovery in Southeast Florida. The mean maximum diameter of *D. stokesii* has remained similar since 2016, slightly above the minimum survey size requirement (4 cm), indicating that some combination of small, juvenile *D. stokesii* corals either survived through the epidemic stage of SCTLD or have successfully recruited after Southeast Florida transitioned to an endemic stage and attained a size beyond 4 cm. Mean density for *M. meandrites*, however, has remained relatively low since 2016 with no obvious signs of recovery, and mean maximum diameter continues to indicate mostly small colonies remain.

Mean density values for *P. strigosa* in Southeast Florida were variable across the 11 survey years (**Figure 11**). Despite the interannual variability, the mean density of *P. strigosa* was clearly higher prior to 2015 with a marked loss occurring in 2015, and lower values persisting through 2020. Mean maximum diameter was also variable across the years due to low colony counts; however, there are apparent decreases in mean size first from 2015 to 2016 and again between 2018 and 2020. Mean density and mean maximum diameter of *P. strigosa* in 2020 were the lowest values recorded across the 11 survey years.

*Florida Keys*

SCTLD is believed to have initially spread into the Biscayne and Upper Florida Keys subregions during the winter of 2016, progressed through the Middle Keys in 2017, and reached the Lower Keys subregion in 2018. The losses associated with SCTLD are clearly visible in the mean density changes for six of the target species (*C. natans, D. labyrinthiformis, D. stokesii, M. meandrites, P. clivosa,* and *P. strigosa*) when analyzing the data over the last 10 years (excluding the 2017 Irma dataset). Because the progression of SCTLD took nearly five years to move through the Florida Keys, the reductions in mean density for these six species are evident over multiple years, with the most pronounced affects occurring between 2017 and 2020 when

SCTLD was in the epidemic stage in the Middle and Lower Keys. For all six species, the lowest mean density was recorded in 2020 as well as the lowest mean maximum diameter.

Mean density of *D. stokesii* began to drop in 2016, with the lowest values recorded in 2018, 2019, and then 2020 (**Figure 7**). The loss in mean density began earlier than *C. natans* and *D. labyrinthiformis*, due to the high density of *D. stokesii* in the Biscayne and Upper Keys subregions, where the disease was first observed in 2016. Although mean maximum diameter of *D. stokesii* has remained relatively consistent over the past 10 years, there was a slight drop from 2019 to 2020, resulting in the lowest value recorded. Similar to *D. stokesii*, *M. meandrites* experienced a loss in mean density from 2016 to 2018 and has continued to drop to its lowest value recorded in 2020 (**Figure 8**). Mean maximum diameter of *M. meandrites* became smaller in 2019 and again in 2020, when it reached its lowest value ever recorded in the DRM dataset.

Due to the relatively higher density of *C. natans* in the Lower Keys compared to other Key's subregions, the decline in mean density due to SCTLD was not apparent until 2019 and 2020 (**Figure 5**). The largest declines in mean density of *C. natans* occurred between 2018 and 2019. Mean density was smaller again in 2020 as SCTLD persisted in the Lower Keys and resulted in its lowest value recorded for the 10-year time series (2010-2020). Despite the lower mean density values in 2019 and 2020, mean maximum diameter has remained relatively consistent across the 10 survey years. Similar to *C. natans*, mean density of *P. strigosa* did not begin to decline until 2019 (**Figure 11**). Mean density and mean maximum diameter dropped again in 2020 to the lowest values recorded between 2010 and 2020 for *P. strigosa*. Likewise, the 2019 and 2020 survey years also marked the lowest mean density recorded for *D. labyrinthiformis* over the past 10 years in the Florida Keys (**Figure 6**). Mean maximum diameter for *D. labyrinthiformis* has continued to get smaller since 2016.

The 2018, 2019, and 2020 survey years marked the three lowest mean densities recorded for *P. clivosa* over the past 10 years in the Florida Keys (**Figure 10**). Mean maximum diameter abruptly changed between 2015 and 2016; however, this was not likely due to SCTLD since it had just arrived in the Upper Keys in 2016. A more likely cause of the sharp reduction in mean size was the 2014 and 2015 bleaching events during which corals in shallow habitats, such as *P. clivosa*, were severely impacted by thermal stress. Mean maximum diameter has continued to get smaller over the past two years, which can be attributed to impacts from SCTLD.

Due to their low abundance, *Mycetophyllia* spp. (*M. aliciae*, *M. ferox*, and *M. lamarckiana*) in the Keys were pooled together to calculate mean density and mean maximum diameter. Since 2012, mean density has remained relatively consistent with no apparent impacts throughout the entire time series (**Figure 9**) with the second highest density recorded in 2019. Mean density and maximum diameter were smallest in 2014. Since 2015, the mean maximum diameter of *Mycetophyllia* spp. in the Florida Keys has also been relatively consistent, suggesting that the impacts from SCTLD have been minimal and difficult to detect compared to other susceptible species.

*Marquesas*

DRM surveys within the Marquesas region began in 2019 to track the continued western movement of SCTLD along the reef tract, and thus only two years of data are available. At the time of the DRM survey event in 2019, SCTLD had not yet been identified in the Marquesas region; however, the disease was at the westernmost extent of the Lower Keys subregion boundary. During the survey event in 2020, the disease was found to have spread across the entire extent of the Marquesas. The sites with the highest disease prevalence, indicative of the epidemic stage, were at the western edge of the Marquesas reefs, less than 20 miles from the boundary of Dry Tortugas National Park.

Mean density values for *C. natans, D. stokesii, M. meandrites, Mycetophyllia* spp., and *P. strigosa* all dropped between 2019 and 2020 in the Marquesas region (**Figures 5, 7, 8, 9,** and **11**). *D. stokesii* suffered the greatest loss in mean density from 2019 to 2020 among the target species, coupled with a lower mean maximum diameter. *Colpophyllia natans, M. meandrites, Mycetophyllia* spp., and *P. strigosa* also had smaller mean maximum diameters in 2020. *Diploria labyrinthiformis, M. angulosa* and *P. clivosa* all had less than 10 total colonies recorded for one or both survey years and therefore impacts from SCTLD were not evaluated for these species in the Marquesas region.

*Dry Tortugas*

Fortunately, at the time of the 2020 DRM surveys in August and September, SCTLD was not observed at any of the 61 sites surveyed in the Dry Tortugas. Although SCTLD had not reached the Dry Tortugas, the 2020 data extends the baseline period in the unfortunate event that SCTLD does reach the region. Pre-SCTLD density will be used to estimate impacts to the population. In addition, the geospatial information for the location of SCTLD susceptible corals will aid in making SCTLD response-driven decisions.

## JUVENILE TARGET CORAL FAMILIES

For the first time in 2020, the DRM program incorporated juvenile coral counts into the survey methods. Juveniles of three target coral (sub)families (Meandrinidae, Faviinae, and Mussinae) were enumerated along all four transects. These three families encompass the 10 SCTLD susceptible coral species that were targeted along Transects 3 and 4.

Across all sites surveyed in 2020, 256 had at least one juvenile coral within one of the target families recorded across the transects. Juveniles of all three families were recorded across all subregions except for Martin County, where no juvenile corals of any of the target families were recorded.

Juvenile coral tallies for each family were summed across all four transects and then density values were calculated at the site level. Mean densities for each family were calculated by region (**Table 6**). Density values are further broken down by subregion and are included in **Appendix I** of this report. Across all four regions, juvenile coral densities for Mussinae and Meandrinidae were lowest in Southeast Florida and highest in the Marquesas region. Juvenile densities of Faviinae were lowest in Southeast Florida and highest in the Dry Tortugas. Among the three

families, Meandrinidae had a higher density than both Mussinae and Faviinae in Southeast Florida, Florida Keys, and the Marquesas, while Faviinae had a higher density than Meandrinidae and Mussinae in the Dry Tortugas.

**Table 6**. Mean (±SE) density by region of the three target juvenile (sub)families, which are highly SCTLD susceptible**.**

| Target Families | Southeast Florida | Florida Keys | Marquesas | Dry Tortugas |
|---|---|---|---|---|
| Meandrinidae | 0.009 ± 0.002 | 0.038 ± 0.004 | 0.076 ± 0.012 | 0.032 ± 0.006 |
| Faviinae | 0.003 ± 0.001 | 0.03 ± 0.004 | 0.048 ± 0.019 | 0.057 ± 0.011 |
| Mussinae | 0.006 ± 0.002 | 0.014 ± 0.004 | 0.067 ± 0.015 | 0.032 ± 0.008 |
| **Total Sites Surveyed in 2020** | **104** | **163** | **49** | **61** |

The most common species found in the Mussinae subfamily were *Scolymia* spp., which are single polyp corals that typically do not grow larger than 10-15 cm in diameter. The small growth form of *Scolymia* spp. may result in a large portion of the population being tallied as juvenile corals. The less than 4 cm diameter juvenile distinction was used to assist with the speed of diver surveys but does not necessarily distinguish between a juvenile and adult for all species.

## SUMMARY

Overall results from the 2020 bleaching data indicate that it was another mild bleaching year when prevalence values were combined for all subregion-zones (**Figure 1**). When corals recorded with paling are included, bleaching values were moderate (21-50%) in almost half of the subregion-zones surveyed (**Figure 2**) and 26 out of 389 sites were recorded with severe (>50%) bleaching and paling. Martin and Broward-Miami subregions were recorded with the most bleaching and paling. The Martin County values were mostly influenced by *S. radians*, a species that can be naturally pale grey in color and therefore may overestimate bleaching values because this is often ascribed as bleaching or paling by observers. Comparing across the last few years, bleaching prevalence was similar to that recorded in 2018 and 2019 (**Table 7**). Additional information that describes the zones that were surveyed within each subregion over the life of the program are provided on the DRM website on the Surveyor Trainings and Resources page (https://ocean.floridamarine.org/FRRP/Home/About).

Disease prevalence across the reef tract was low (0-5% disease prevalence) in 2020, except at the Marquesas Mid Channel and Offshore Patch Reef zones (**Figure 3**), where SCTLD was recorded on 168 colonies across both zones. Most of the colonies affected by the disease in the Marquesas were *M. cavernosa* and *S. siderea*, which are species that typically manifest symptoms at a later onset than other highly susceptible species to SCTLD, such as *M. meandrites* and *D. stokesii*. Twenty-nine colonies were recorded with SCTLD in the Lower Keys, mostly on *M. cavernosa*, *O. faveolata*, and *S. siderea*, for which disease lesions typically progress slowly. The low prevalence of SCTLD in Southeast Florida and the Florida Keys reflects the subsidence of the disease across most of the reef tract and the vastly smaller population of highly susceptible SCTLD species remaining in the wake of the disease.

**Table 7.** Number of subregion-zones recorded with mild, moderate, or severe bleaching prevalence, and combined bleaching and paling prevalence, for each DRM summer survey event.

| DRM Summer Survey | Bleaching Prevalence | | | Bleaching and Paling Prevalence | | | Total Subregion-Zones Sampled |
|---|---|---|---|---|---|---|---|
| | Mild (0-20%) | Moderate (21-50%) | Severe (>50%) | Mild (0-20%) | Moderate (21-50%) | Severe (>50%) | |
| 2005 | 9 | 6 | 1 | 1 | 10 | 5 | 16 |
| 2006 | 20 | 0 | 0 | 16 | 4 | 0 | 20 |
| 2007 | 27 | 1 | 1 | 16 | 12 | 1 | 29 |
| 2008 | 21 | 0 | 0 | 17 | 4 | 0 | 21 |
| 2009 | 23 | 2 | 0 | 9 | 16 | 0 | 25 |
| 2010 | 22 | 0 | 0 | 15 | 7 | 0 | 22 |
| 2011 | 20 | 5 | 0 | 7 | 16 | 2 | 25 |
| 2012 | 23 | 1 | 0 | 21 | 3 | 0 | 24 |
| 2013 | 23 | 0 | 0 | 16 | 7 | 0 | 23 |
| 2014 | 7 | 13 | 8 | 2 | 9 | 17 | 28 |
| 2015 | 14 | 14 | 1 | 4 | 14 | 11 | 29 |
| 2016 | 28 | 0 | 0 | 13 | 14 | 1 | 28 |
| 2018 | 24 | 2 | 0 | 9 | 14 | 3 | 26 |
| 2019 | 31 | 0 | 0 | 14 | 16 | 1 | 31 |
| 2020 | 24 | 1 | 0 | 8 | 15 | 2 | 25 |

The impact of SCTLD was greatest on *D. stokesii* and *M. meandrites* across all three endemic regions of the reef tract, highlighting how vulnerable their populations are to the disease. The loss in density from the disease was accompanied by a reduction in mean maximum diameter, confirming the disease was most lethal to large, older colonies. Data from Florida's other long-term monitoring programs (e.g., CREMP and SECREMP) confirm that many, if not most, of the large colonies of the SCTLD-susceptible coral species were killed throughout the reef tract, but some small individuals survived. Although less pronounced in some regions, there were sharp reductions in density and mean maximum diameter for *P. strigosa, C. natans* and *D. labyrinthiformis*. The losses for all of these highly susceptible species were not apparent until after 2018 because their greatest abundance was highest in the Middle and Lower Keys and those subregions did not become epidemic until 2018.

Although the DRM program only has one year of juvenile coral data, it is encouraging that each of the SCTLD-susceptible families were observed across all subregions with the exception of Martin County at the northernmost extent of FCR. Approximately 65% of the surveyed sites in 2020 were recorded with at least one of the target juvenile families and 12% of the sites had all three families present. In Southeast Florida, *D. stokesii* may be displaying some signs of recovery after SCTLD. Mean density and maximum diameters have increased in recent years, indicating that juveniles that survived the epidemic phase of SCTLD or recruited after the epidemic phase concluded are continuing to survive and attaining sizes above 4 cm in diameter.

No signs of SCTLD were observed in the Dry Tortugas during the DRM surveys in September 2020. This was of a major concern after confirming the presence of SCTLD at the western end of the Marquesas only a month prior (August 2020). The strategic plan for DRM in 2021 will include surveys for the Dry Tortugas late in the summer with exact dates to be determined. The allocation of survey sites in 2021 will include both randomly selected sites and strategic sites targeting areas of the park most vulnerable to the spread of SCTLD. This will include areas of the Dry Tortugas that are exposed to regular vessel traffic and those closest to the Marquesas Islands and Rebecca Shoal where SCTLD was last reported.

For more information about FRRP and its DRM effort, see the website http://ocean.floridamarine.org/FRRP/. For more information about the Summer 2020 DRM results, contact Jennifer Stein at Jennifer.Stein@MyFWC.com.

# Appendix I

## Table of Contents

**a) Mean (±SE) density of target SCTLD susceptible species by subregion in southeast Florida.**

| Subregion | Batch | C. natans | D. labyrinthiformis | D. stokesii | M. alicae | M. angulosa |
|---|---|---|---|---|---|---|
| Martin | FRRP 2010C | 0 ± 0 | 0 ± 0 | 0.008 ± 0.008 | 0 ± 0 | 0 ± 0 |
| Martin | FRRP 2011 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0.008 ± 0.008 |
| Martin | FRRP 2012 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Martin | FRRP 2014 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Martin | FRRP 2015B | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Martin | FRRP 2016B | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Martin | FRRP 2020 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Palm Beach | FRRP 2010C | 0.006 ± 0.006 | 0 ± 0 | 0.05 ± 0.019 | 0 ± 0 | 0 ± 0 |
| Palm Beach | FRRP 2011 | 0 ± 0 | 0.008 ± 0.008 | 0.033 ± 0.017 | 0 ± 0 | 0 ± 0 |
| Palm Beach | FRRP 2012 | 0 ± 0 | 0 ± 0 | 0.017 ± 0.017 | 0 ± 0 | 0 ± 0 |
| Palm Beach | FRRP 2013 | 0 ± 0 | 0 ± 0 | 0.05 ± 0.02 | 0 ± 0 | 0 ± 0 |
| Palm Beach | FRRP 2014 | 0 ± 0 | 0 ± 0 | 0.008 ± 0.008 | 0 ± 0 | 0 ± 0 |
| Palm Beach | FRRP 2015B | 0 ± 0 | 0 ± 0 | 0.025 ± 0.009 | 0 ± 0 | 0 ± 0 |
| Palm Beach | FRRP 2016B | 0 ± 0 | 0 ± 0 | 0.007 ± 0.007 | 0 ± 0 | 0 ± 0 |
| Palm Beach | FRRP 2018 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Palm Beach | FRRP 2019 | 0 ± 0 | 0 ± 0 | 0.01 ± 0.007 | 0 ± 0 | 0 ± 0 |
| Palm Beach | FRRP 2020 | 0.003 ± 0.003 | 0 ± 0 | 0.022 ± 0.007 | 0.006 ± 0.004 | 0 ± 0 |
| Broward-Miami | FRRP 2010C | 0.007 ± 0.003 | 0 ± 0 | 0.026 ± 0.005 | 0.002 ± 0.002 | 0.001 ± 0.001 |
| Broward-Miami | FRRP 2011 | 0.007 ± 0.003 | 0.001 ± 0.001 | 0.031 ± 0.007 | 0 ± 0 | 0 ± 0 |
| Broward-Miami | FRRP 2012 | 0.013 ± 0.004 | 0.002 ± 0.002 | 0.039 ± 0.009 | 0 ± 0 | 0 ± 0 |
| Broward-Miami | FRRP 2013 | 0.008 ± 0.006 | 0.004 ± 0.004 | 0.038 ± 0.013 | 0.004 ± 0.004 | 0 ± 0 |
| Broward-Miami | FRRP 2014 | 0.006 ± 0.004 | 0.004 ± 0.003 | 0.035 ± 0.01 | 0 ± 0 | 0 ± 0 |
| Broward-Miami | FRRP 2015B | 0.006 ± 0.002 | 0.001 ± 0.001 | 0.039 ± 0.007 | 0.001 ± 0.001 | 0 ± 0 |
| Broward-Miami | FRRP 2016B | 0.004 ± 0.003 | 0.002 ± 0.002 | 0.004 ± 0.003 | 0.002 ± 0.002 | 0 ± 0 |
| Broward-Miami | FRRP 2017A | 0.004 ± 0.003 | 0.002 ± 0.002 | 0.004 ± 0.003 | 0 ± 0 | 0 ± 0 |
| Broward-Miami | FRRP 2018 | 0 ± 0 | 0.001 ± 0.001 | 0.007 ± 0.003 | 0 ± 0 | 0 ± 0 |
| Broward-Miami | FRRP 2019 | 0.003 ± 0.002 | 0.005 ± 0.002 | 0.013 ± 0.003 | 0.002 ± 0.001 | 0.001 ± 0.001 |
| Broward-Miami | FRRP 2020 | 0.004 ± 0.001 | 0.004 ± 0.001 | 0.016 ± 0.003 | 0.001 ± 0 | 0 ± 0 |

**b) Mean (±SE) density of target SCTLD susceptible species by subregion in southeast Florida.**

| Subregion | Batch | M. ferox | M. lamarkiana | M. meandrites | P. clivosa | P. strigosa |
|---|---|---|---|---|---|---|
| Martin | FRRP 2010C | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0.2 ± 0.043 | 0.1 ± 0.053 |
| Martin | FRRP 2011 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0.133 ± 0.054 | 0.117 ± 0.051 |
| Martin | FRRP 2012 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0.017 ± 0.011 | 0.142 ± 0.055 |
| Martin | FRRP 2014 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0.05 ± 0.05 | 0.175 ± 0.175 |
| Martin | FRRP 2015B | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0.033 ± 0.025 | 0.008 ± 0.008 |
| Martin | FRRP 2016B | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Martin | FRRP 2020 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Palm Beach | FRRP 2010C | 0 ± 0 | 0 ± 0 | 0.063 ± 0.038 | 0 ± 0 | 0.019 ± 0.009 |
| Palm Beach | FRRP 2011 | 0 ± 0 | 0 ± 0 | 0.092 ± 0.074 | 0.05 ± 0.05 | 0 ± 0 |
| Palm Beach | FRRP 2012 | 0 ± 0 | 0.05 ± 0.05 | 0.083 ± 0.083 | 0 ± 0 | 0 ± 0 |
| Palm Beach | FRRP 2013 | 0 ± 0 | 0 ± 0 | 0.038 ± 0.024 | 0 ± 0 | 0 ± 0 |
| Palm Beach | FRRP 2014 | 0 ± 0 | 0 ± 0 | 0.008 ± 0.008 | 0.008 ± 0.008 | 0.017 ± 0.011 |
| Palm Beach | FRRP 2015B | 0 ± 0 | 0 ± 0 | 0.05 ± 0.019 | 0.031 ± 0.025 | 0 ± 0 |
| Palm Beach | FRRP 2016B | 0 ± 0 | 0 ± 0 | 0.029 ± 0.015 | 0 ± 0 | 0 ± 0 |
| Palm Beach | FRRP 2018 | 0 ± 0 | 0 ± 0 | 0.017 ± 0.017 | 0 ± 0 | 0.017 ± 0.017 |
| Palm Beach | FRRP 2019 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Palm Beach | FRRP 2020 | 0 ± 0 | 0 ± 0 | 0.016 ± 0.008 | 0 ± 0 | 0 ± 0 |
| Broward-Miami | FRRP 2010C | 0 ± 0 | 0 ± 0 | 0.04 ± 0.009 | 0.008 ± 0.003 | 0.002 ± 0.002 |
| Broward-Miami | FRRP 2011 | 0 ± 0 | 0 ± 0 | 0.063 ± 0.015 | 0.007 ± 0.004 | 0.004 ± 0.002 |
| Broward-Miami | FRRP 2012 | 0 ± 0 | 0 ± 0 | 0.053 ± 0.012 | 0.003 ± 0.002 | 0.008 ± 0.003 |
| Broward-Miami | FRRP 2013 | 0 ± 0 | 0 ± 0 | 0.058 ± 0.025 | 0 ± 0 | 0.013 ± 0.013 |
| Broward-Miami | FRRP 2014 | 0 ± 0 | 0 ± 0 | 0.046 ± 0.01 | 0.003 ± 0.002 | 0.016 ± 0.005 |
| Broward-Miami | FRRP 2015B | 0 ± 0 | 0 ± 0 | 0.031 ± 0.007 | 0.01 ± 0.003 | 0.007 ± 0.002 |
| Broward-Miami | FRRP 2016B | 0 ± 0 | 0 ± 0 | 0.013 ± 0.005 | 0.002 ± 0.002 | 0.008 ± 0.005 |
| Broward-Miami | FRRP 2017A | 0 ± 0 | 0 ± 0 | 0.007 ± 0.004 | 0.002 ± 0.002 | 0.013 ± 0.005 |
| Broward-Miami | FRRP 2018 | 0.001 ± 0.001 | 0 ± 0 | 0.016 ± 0.005 | 0.001 ± 0.001 | 0.004 ± 0.002 |
| Broward-Miami | FRRP 2019 | 0 ± 0 | 0 ± 0 | 0.016 ± 0.004 | 0.005 ± 0.003 | 0.01 ± 0.002 |
| Broward-Miami | FRRP 2020 | 0 ± 0 | 0 ± 0 | 0.013 ± 0.002 | 0.004 ± 0.002 | 0.005 ± 0.001 |

## c) Mean (±SE) density of target SCTLD susceptible species by subregion in the Florida Keys.

| Subregion | Batch | C. natans | D. labyrinthiformis | D. stokesii | M. alicae | M. angulosa |
|---|---|---|---|---|---|---|
| Biscayne | FRRP 2010C | 0.013 ± 0.005 | 0.023 ± 0.006 | 0.119 ± 0.023 | 0 ± 0 | 0 ± 0 |
| Biscayne | FRRP 2011 | 0.014 ± 0.006 | 0.017 ± 0.005 | 0.177 ± 0.021 | 0 ± 0 | 0.002 ± 0.002 |
| Biscayne | FRRP 2012 | 0.015 ± 0.004 | 0.016 ± 0.005 | 0.161 ± 0.024 | 0 ± 0 | 0.003 ± 0.002 |
| Biscayne | FRRP 2013 | 0.01 ± 0.004 | 0.008 ± 0.004 | 0.087 ± 0.014 | 0 ± 0 | 0 ± 0 |
| Biscayne | FRRP 2014 | 0.005 ± 0.004 | 0.003 ± 0.003 | 0.105 ± 0.02 | 0 ± 0 | 0 ± 0 |
| Biscayne | FRRP 2015B | 0.005 ± 0.003 | 0.005 ± 0.003 | 0.075 ± 0.013 | 0 ± 0 | 0 ± 0 |
| Biscayne | FRRP 2016B | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Biscayne | FRRP 2018 | 0.005 ± 0.003 | 0.02 ± 0.007 | 0.043 ± 0.011 | 0.002 ± 0.002 | 0 ± 0 |
| Biscayne | FRRP 2019 | 0.003 ± 0.003 | 0.007 ± 0.005 | 0.027 ± 0.008 | 0 ± 0 | 0 ± 0 |
| Biscayne | FRRP 2020 | 0.005 ± 0.003 | 0.003 ± 0.003 | 0.058 ± 0.015 | 0.003 ± 0.003 | 0 ± 0 |
| Upper Keys | FRRP 2010C | 0.025 ± 0.006 | 0.01 ± 0.004 | 0.093 ± 0.017 | 0 ± 0 | 0 ± 0 |
| Upper Keys | FRRP 2011 | 0.01 ± 0.006 | 0.022 ± 0.006 | 0.111 ± 0.016 | 0 ± 0 | 0 ± 0 |
| Upper Keys | FRRP 2012 | 0.013 ± 0.004 | 0.017 ± 0.005 | 0.072 ± 0.011 | 0.001 ± 0.001 | 0.001 ± 0.001 |
| Upper Keys | FRRP 2013 | 0.014 ± 0.007 | 0.024 ± 0.009 | 0.114 ± 0.031 | 0 ± 0 | 0 ± 0 |
| Upper Keys | FRRP 2014 | 0.012 ± 0.007 | 0.016 ± 0.008 | 0.102 ± 0.028 | 0 ± 0 | 0 ± 0 |
| Upper Keys | FRRP 2015B | 0.011 ± 0.004 | 0.017 ± 0.008 | 0.1 ± 0.027 | 0 ± 0 | 0 ± 0 |
| Upper Keys | FRRP 2016B | 0.012 ± 0.008 | 0.035 ± 0.018 | 0.131 ± 0.04 | 0 ± 0 | 0 ± 0 |
| Upper Keys | FRRP 2018 | 0.018 ± 0.01 | 0.011 ± 0.005 | 0.018 ± 0.006 | 0.006 ± 0.005 | 0 ± 0 |
| Upper Keys | FRRP 2019 | 0.004 ± 0.003 | 0.012 ± 0.005 | 0.041 ± 0.008 | 0 ± 0 | 0 ± 0 |
| Upper Keys | FRRP 2020 | 0.003 ± 0.001 | 0.014 ± 0.004 | 0.043 ± 0.008 | 0.002 ± 0.001 | 0 ± 0 |
| Middle Keys | FRRP 2010C | 0.073 ± 0.043 | 0.025 ± 0.008 | 0.136 ± 0.038 | 0 ± 0 | 0.002 ± 0.002 |
| Middle Keys | FRRP 2011 | 0.087 ± 0.028 | 0.024 ± 0.008 | 0.1 ± 0.019 | 0 ± 0 | 0.01 ± 0.005 |
| Middle Keys | FRRP 2012 | 0.067 ± 0.027 | 0.029 ± 0.008 | 0.126 ± 0.023 | 0 ± 0 | 0 ± 0 |
| Middle Keys | FRRP 2013 | 0.103 ± 0.053 | 0.016 ± 0.01 | 0.078 ± 0.023 | 0 ± 0 | 0.003 ± 0.003 |
| Middle Keys | FRRP 2014 | 0.032 ± 0.015 | 0.009 ± 0.005 | 0.1 ± 0.025 | 0 ± 0 | 0 ± 0 |
| Middle Keys | FRRP 2015B | 0.11 ± 0.043 | 0.038 ± 0.019 | 0.136 ± 0.036 | 0 ± 0 | 0.007 ± 0.004 |
| Middle Keys | FRRP 2016B | 0.028 ± 0.015 | 0.011 ± 0.005 | 0.161 ± 0.031 | 0.002 ± 0.002 | 0 ± 0 |
| Middle Keys | FRRP 2018 | 0.023 ± 0.012 | 0.023 ± 0.014 | 0.077 ± 0.022 | 0 ± 0 | 0 ± 0 |
| Middle Keys | FRRP 2019 | 0.039 ± 0.022 | 0.014 ± 0.009 | 0.05 ± 0.015 | 0.014 ± 0.008 | 0 ± 0 |
| Middle Keys | FRRP 2020 | 0.052 ± 0.021 | 0.013 ± 0.003 | 0.036 ± 0.007 | 0.002 ± 0.002 | 0 ± 0 |
| Lower Keys | FRRP 2010C | 0.095 ± 0.031 | 0.008 ± 0.003 | 0.083 ± 0.014 | 0 ± 0 | 0.008 ± 0.004 |
| Lower Keys | FRRP 2011 | 0.125 ± 0.034 | 0.031 ± 0.008 | 0.14 ± 0.019 | 0 ± 0 | 0.003 ± 0.002 |
| Lower Keys | FRRP 2012 | 0.104 ± 0.029 | 0.019 ± 0.006 | 0.101 ± 0.019 | 0 ± 0 | 0.003 ± 0.002 |
| Lower Keys | FRRP 2013 | 0.045 ± 0.024 | 0.017 ± 0.009 | 0.076 ± 0.016 | 0 ± 0 | 0.005 ± 0.003 |
| Lower Keys | FRRP 2014 | 0.101 ± 0.025 | 0.024 ± 0.005 | 0.108 ± 0.015 | 0 ± 0 | 0.001 ± 0.001 |
| Lower Keys | FRRP 2015B | 0.091 ± 0.03 | 0.012 ± 0.004 | 0.113 ± 0.012 | 0 ± 0 | 0.005 ± 0.002 |
| Lower Keys | FRRP 2016B | 0.079 ± 0.03 | 0.015 ± 0.005 | 0.118 ± 0.019 | 0.001 ± 0.001 | 0.001 ± 0.001 |
| Lower Keys | FRRP 2018 | 0.203 ± 0.052 | 0.022 ± 0.009 | 0.134 ± 0.024 | 0.009 ± 0.006 | 0.005 ± 0.003 |
| Lower Keys | FRRP 2019 | 0.067 ± 0.019 | 0.012 ± 0.004 | 0.05 ± 0.009 | 0.007 ± 0.004 | 0.006 ± 0.003 |
| Lower Keys | FRRP 2020 | 0.017 ± 0.004 | 0.006 ± 0.002 | 0.022 ± 0.003 | 0.006 ± 0.001 | 0.003 ± 0.001 |
| Marquesas | FRRP 2019 | 0.082 ± 0.024 | 0.011 ± 0.004 | 0.097 ± 0.014 | 0.04 ± 0.011 | 0.013 ± 0.005 |
| Marquesas | FRRP 2020 | 0.016 ± 0.004 | 0.009 ± 0.002 | 0.028 ± 0.004 | 0.014 ± 0.004 | 0.004 ± 0.002 |
| Dry Tortugas NP | FRRP 2011 | 0.01 ± 0.01 | 0.01 ± 0.01 | 0.04 ± 0.01 | 0 ± 0 | 0 ± 0 |
| Dry Tortugas NP | FRRP 2012 | 0.08 ± 0.023 | 0.021 ± 0.005 | 0.023 ± 0.006 | 0.004 ± 0.002 | 0.005 ± 0.003 |
| Dry Tortugas NP | FRRP 2014 | 0.052 ± 0.013 | 0.029 ± 0.011 | 0.057 ± 0.025 | 0 ± 0 | 0.01 ± 0.006 |
| Dry Tortugas NP | FRRP 2015B | 0.075 ± 0.027 | 0.033 ± 0.021 | 0.038 ± 0.017 | 0 ± 0 | 0.01 ± 0.005 |
| Dry Tortugas NP | FRRP 2016B | 0.066 ± 0.019 | 0.01 ± 0.005 | 0.052 ± 0.011 | 0 ± 0 | 0.009 ± 0.004 |
| Dry Tortugas NP | FRRP 2017A | 0.047 ± 0.019 | 0.011 ± 0.004 | 0.026 ± 0.005 | 0 ± 0 | 0.013 ± 0.01 |
| Dry Tortugas NP | FRRP 2018 | 0.058 ± 0.013 | 0.017 ± 0.004 | 0.047 ± 0.011 | 0.012 ± 0.004 | 0.002 ± 0.002 |
| Dry Tortugas NP | FRRP 2019 | 0.079 ± 0.013 | 0.028 ± 0.006 | 0.052 ± 0.014 | 0.018 ± 0.005 | 0.005 ± 0.003 |
| Dry Tortugas NP | FRRP 2020 | 0.055 ± 0.008 | 0.018 ± 0.003 | 0.04 ± 0.005 | 0.015 ± 0.003 | 0.005 ± 0.001 |

**d) Mean (±SE) density of target SCTLD susceptible species by subregion in the Florida Keys.**

| Subregion | Batch | M. ferox | M. lamarkiana | M. meandrites | P. clivosa | P. strigosa |
|---|---|---|---|---|---|---|
| Biscayne | FRRP 2010C | 0 ± 0 | 0 ± 0 | 0.03 ± 0.009 | 0.005 ± 0.003 | 0.027 ± 0.007 |
| Biscayne | FRRP 2011 | 0 ± 0 | 0 ± 0 | 0.026 ± 0.008 | 0.013 ± 0.005 | 0.041 ± 0.009 |
| Biscayne | FRRP 2012 | 0 ± 0 | 0 ± 0 | 0.026 ± 0.008 | 0.011 ± 0.004 | 0.019 ± 0.007 |
| Biscayne | FRRP 2013 | 0 ± 0 | 0 ± 0 | 0.035 ± 0.01 | 0.015 ± 0.006 | 0.019 ± 0.012 |
| Biscayne | FRRP 2014 | 0 ± 0 | 0 ± 0 | 0.029 ± 0.012 | 0.024 ± 0.007 | 0.024 ± 0.016 |
| Biscayne | FRRP 2015B | 0 ± 0 | 0 ± 0 | 0.005 ± 0.003 | 0.021 ± 0.007 | 0.032 ± 0.012 |
| Biscayne | FRRP 2016B | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0.006 ± 0.006 | 0.028 ± 0.015 |
| Biscayne | FRRP 2018 | 0 ± 0 | 0 ± 0 | 0.002 ± 0.002 | 0.023 ± 0.02 | 0.014 ± 0.005 |
| Biscayne | FRRP 2019 | 0 ± 0 | 0.003 ± 0.003 | 0 ± 0 | 0.013 ± 0.008 | 0 ± 0 |
| Biscayne | FRRP 2020 | 0 ± 0 | 0 ± 0 | 0.008 ± 0.005 | 0 ± 0 | 0.015 ± 0.006 |
| Upper Keys | FRRP 2010C | 0 ± 0 | 0 ± 0 | 0.017 ± 0.005 | 0.026 ± 0.011 | 0.02 ± 0.006 |
| Upper Keys | FRRP 2011 | 0 ± 0 | 0 ± 0 | 0.012 ± 0.003 | 0.02 ± 0.014 | 0.007 ± 0.003 |
| Upper Keys | FRRP 2012 | 0 ± 0 | 0.002 ± 0.002 | 0.014 ± 0.004 | 0.009 ± 0.004 | 0.012 ± 0.004 |
| Upper Keys | FRRP 2013 | 0 ± 0 | 0.002 ± 0.002 | 0.012 ± 0.006 | 0.01 ± 0.006 | 0.019 ± 0.017 |
| Upper Keys | FRRP 2014 | 0 ± 0 | 0 ± 0 | 0.02 ± 0.007 | 0.01 ± 0.005 | 0.022 ± 0.009 |
| Upper Keys | FRRP 2015B | 0 ± 0 | 0 ± 0 | 0.024 ± 0.014 | 0.013 ± 0.013 | 0.037 ± 0.013 |
| Upper Keys | FRRP 2016B | 0 ± 0 | 0 ± 0 | 0.004 ± 0.004 | 0 ± 0 | 0.015 ± 0.009 |
| Upper Keys | FRRP 2018 | 0 ± 0 | 0.002 ± 0.002 | 0.006 ± 0.004 | 0.005 ± 0.003 | 0.011 ± 0.004 |
| Upper Keys | FRRP 2019 | 0 ± 0 | 0 ± 0 | 0.005 ± 0.003 | 0.004 ± 0.002 | 0.004 ± 0.002 |
| Upper Keys | FRRP 2020 | 0 ± 0 | 0.001 ± 0.001 | 0.003 ± 0.002 | 0.005 ± 0.003 | 0.005 ± 0.002 |
| Middle Keys | FRRP 2010C | 0 ± 0 | 0 ± 0 | 0.014 ± 0.005 | 0.016 ± 0.007 | 0.036 ± 0.01 |
| Middle Keys | FRRP 2011 | 0 ± 0 | 0 ± 0 | 0.013 ± 0.005 | 0.016 ± 0.009 | 0.021 ± 0.01 |
| Middle Keys | FRRP 2012 | 0 ± 0 | 0 ± 0 | 0.022 ± 0.008 | 0.012 ± 0.006 | 0.066 ± 0.024 |
| Middle Keys | FRRP 2013 | 0 ± 0 | 0 ± 0 | 0.016 ± 0.008 | 0 ± 0 | 0.038 ± 0.015 |
| Middle Keys | FRRP 2014 | 0 ± 0 | 0 ± 0 | 0.006 ± 0.004 | 0.021 ± 0.011 | 0.021 ± 0.007 |
| Middle Keys | FRRP 2015B | 0 ± 0 | 0 ± 0 | 0.033 ± 0.011 | 0.012 ± 0.006 | 0.031 ± 0.009 |
| Middle Keys | FRRP 2016B | 0 ± 0 | 0 ± 0 | 0.02 ± 0.007 | 0.013 ± 0.005 | 0.034 ± 0.012 |
| Middle Keys | FRRP 2018 | 0 ± 0 | 0 ± 0 | 0.005 ± 0.005 | 0 ± 0 | 0.036 ± 0.015 |
| Middle Keys | FRRP 2019 | 0 ± 0 | 0.003 ± 0.003 | 0.003 ± 0.003 | 0.003 ± 0.003 | 0.028 ± 0.011 |
| Middle Keys | FRRP 2020 | 0.001 ± 0.001 | 0.001 ± 0.001 | 0.001 ± 0.001 | 0.004 ± 0.002 | 0.017 ± 0.006 |
| Lower Keys | FRRP 2010C | 0 ± 0 | 0 ± 0 | 0.023 ± 0.007 | 0.009 ± 0.004 | 0.034 ± 0.007 |
| Lower Keys | FRRP 2011 | 0 ± 0 | 0 ± 0 | 0.022 ± 0.006 | 0.018 ± 0.006 | 0.048 ± 0.01 |
| Lower Keys | FRRP 2012 | 0 ± 0 | 0 ± 0 | 0.018 ± 0.007 | 0.006 ± 0.003 | 0.028 ± 0.007 |
| Lower Keys | FRRP 2013 | 0 ± 0 | 0 ± 0 | 0.026 ± 0.007 | 0.024 ± 0.014 | 0.024 ± 0.009 |
| Lower Keys | FRRP 2014 | 0 ± 0 | 0 ± 0 | 0.03 ± 0.008 | 0.011 ± 0.005 | 0.04 ± 0.009 |
| Lower Keys | FRRP 2015B | 0 ± 0 | 0 ± 0 | 0.019 ± 0.004 | 0.009 ± 0.003 | 0.023 ± 0.005 |
| Lower Keys | FRRP 2016B | 0 ± 0 | 0 ± 0 | 0.026 ± 0.008 | 0.011 ± 0.005 | 0.028 ± 0.006 |
| Lower Keys | FRRP 2018 | 0 ± 0 | 0 ± 0 | 0.031 ± 0.008 | 0.003 ± 0.002 | 0.074 ± 0.019 |
| Lower Keys | FRRP 2019 | 0.001 ± 0.001 | 0.006 ± 0.004 | 0.014 ± 0.004 | 0.01 ± 0.004 | 0.031 ± 0.007 |
| Lower Keys | FRRP 2020 | 0.001 ± 0.001 | 0.004 ± 0.002 | 0.003 ± 0.001 | 0.004 ± 0.001 | 0.016 ± 0.003 |
| Marquesas | FRRP 2019 | 0 ± 0 | 0 ± 0 | 0.074 ± 0.012 | 0 ± 0 | 0.092 ± 0.021 |
| Marquesas | FRRP 2020 | 0 ± 0 | 0.002 ± 0.001 | 0.012 ± 0.003 | 0.001 ± 0.001 | 0.032 ± 0.006 |
| Dry Tortugas NP | FRRP 2011 | 0 ± 0 | 0 ± 0 | 0 ± 0 | 0.02 ± 0.012 | 0.11 ± 0.056 |
| Dry Tortugas NP | FRRP 2012 | 0.004 ± 0.002 | 0.001 ± 0.001 | 0.026 ± 0.006 | 0.016 ± 0.006 | 0.022 ± 0.006 |
| Dry Tortugas NP | FRRP 2014 | 0 ± 0 | 0 ± 0 | 0.05 ± 0.011 | 0.009 ± 0.004 | 0.088 ± 0.031 |
| Dry Tortugas NP | FRRP 2015B | 0 ± 0 | 0 ± 0 | 0.013 ± 0.005 | 0.055 ± 0.028 | 0.13 ± 0.035 |
| Dry Tortugas NP | FRRP 2016B | 0 ± 0 | 0 ± 0 | 0.069 ± 0.018 | 0.01 ± 0.005 | 0.102 ± 0.026 |
| Dry Tortugas NP | FRRP 2017A | 0 ± 0 | 0 ± 0 | 0.023 ± 0.007 | 0.013 ± 0.008 | 0.044 ± 0.011 |
| Dry Tortugas NP | FRRP 2018 | 0.003 ± 0.002 | 0.002 ± 0.001 | 0.03 ± 0.007 | 0.011 ± 0.004 | 0.079 ± 0.015 |
| Dry Tortugas NP | FRRP 2019 | 0 ± 0 | 0.002 ± 0.001 | 0.053 ± 0.01 | 0.015 ± 0.009 | 0.077 ± 0.015 |
| Dry Tortugas NP | FRRP 2020 | 0.002 ± 0.001 | 0.002 ± 0.001 | 0.054 ± 0.008 | 0.006 ± 0.002 | 0.061 ± 0.011 |

**e) Mean (±SE) maximum width of target SCTLD susceptible species by subregion in southeast Florida.**

| Subregion | Batch | C. natans | D. labyrinthiformis | D. stokesii | M. alicae | M. angulosa |
|---|---|---|---|---|---|---|
| Martin | FRRP 2010C | | | | | |
| Martin | FRRP 2011 | | | | | |
| Martin | FRRP 2012 | | | | | |
| Martin | FRRP 2014 | | | | | |
| Martin | FRRP 2015B | | | | | |
| Palm Beach | FRRP 2010C | | | 15 ± 13.6 | | |
| Palm Beach | FRRP 2011 | | | | | |
| Palm Beach | FRRP 2012 | | | | | |
| Palm Beach | FRRP 2013 | | | | | |
| Palm Beach | FRRP 2014 | | | | | |
| Palm Beach | FRRP 2015B | | | | | |
| Palm Beach | FRRP 2016B | | | | | |
| Palm Beach | FRRP 2018 | | | | | |
| Palm Beach | FRRP 2019 | | | | | |
| Palm Beach | FRRP 2020 | | | 6 ± 1.9 | 8 ± 0.7 | |
| Broward-Miami | FRRP 2010C | 63 ± 13.1 | | 9 ± 1.7 | 13 ± 2.6 | |
| Broward-Miami | FRRP 2011 | 22 ± 5 | | 14 ± 2.7 | | |
| Broward-Miami | FRRP 2012 | 24 ± 8.7 | | 9 ± 1.8 | | |
| Broward-Miami | FRRP 2013 | 49 ± 31.5 | | 12 ± 4.1 | | |
| Broward-Miami | FRRP 2014 | 29 ± 8.4 | 23 ± 8.2 | 11 ± 3.8 | | |
| Broward-Miami | FRRP 2015B | 36 ± 5.9 | 68 ± 15.3 | 10 ± 1.4 | | |
| Broward-Miami | FRRP 2016B | 9 ± 3 | | 7 ± 1 | | |
| Broward-Miami | FRRP 2017A | 40 ± 23.5 | | 8 ± 0.5 | | |
| Broward-Miami | FRRP 2018 | | | | | |
| Broward-Miami | FRRP 2019 | 8 ± 2.3 | 10 ± 4.8 | 7 ± 1.3 | 9 ± 1.5 | |
| Broward-Miami | FRRP 2020 | 20 ± 5.2 | 13 ± 2.6 | 6 ± 0.6 | 14 ± 1.2 | |

**f) Mean (±SE) maximum width of target SCTLD susceptible species by subregion in southeast Florida.**

| Subregion | Batch | M. ferox | M. lamarkiana | M. meandrites | P. clivosa | P. strigosa |
|---|---|---|---|---|---|---|
| Martin | FRRP 2010C | | | | | |
| Martin | FRRP 2011 | | | | | |
| Martin | FRRP 2012 | | | | | |
| Martin | FRRP 2014 | | | | | |
| Martin | FRRP 2015B | | | | | |
| Palm Beach | FRRP 2010C | | | 11 ± 5.8 | | 27 ± 7.6 |
| Palm Beach | FRRP 2011 | | | | | |
| Palm Beach | FRRP 2012 | | | | | |
| Palm Beach | FRRP 2013 | | | | | |
| Palm Beach | FRRP 2014 | | | | | |
| Palm Beach | FRRP 2015B | | | | | |
| Palm Beach | FRRP 2016B | | | | | |
| Palm Beach | FRRP 2018 | | | | | |
| Palm Beach | FRRP 2019 | | | | | |
| Palm Beach | FRRP 2020 | | | 12 ± 2.3 | | |
| Broward-Miami | FRRP 2010C | | | 13 ± 4.2 | 50 ± 6.8 | 23 ± 2.9 |
| Broward-Miami | FRRP 2011 | | | 16 ± 5.9 | 40 ± 15.9 | 44 ± 14.8 |
| Broward-Miami | FRRP 2012 | | | 16 ± 6.3 | 21 ± 7 | 24 ± 8.7 |
| Broward-Miami | FRRP 2013 | | | 20 ± 7.8 | | 35 ± 4.7 |
| Broward-Miami | FRRP 2014 | | | 17 ± 8.4 | 26 ± 0.7 | 32 ± 15.1 |
| Broward-Miami | FRRP 2015B | | | 15 ± 5.6 | 30 ± 6.8 | 39 ± 9.7 |
| Broward-Miami | FRRP 2016B | | | 8 ± 2.3 | | 25 ± 9.9 |
| Broward-Miami | FRRP 2017A | | | 6 ± 2.3 | | 26 ± 13.1 |
| Broward-Miami | FRRP 2018 | | | | | |
| Broward-Miami | FRRP 2019 | | | 7 ± 1.7 | 44 ± 9.7 | 31 ± 10.4 |
| Broward-Miami | FRRP 2020 | | | 7 ± 0.8 | 52 ± 9.4 | 17 ± 4.5 |

**g) Mean (±SE) maximum width of target SCTLD susceptible species by subregion in the Florida Keys.**

| Subregion | Batch | C. natans | D. labyrinthiformis | D. stokesii | M. alicae | M. angulosa |
|---|---|---|---|---|---|---|
| Biscayne | FRRP 2010C | 30 ± 7.3 | 17 ± 5.5 | 12 ± 2.6 | | |
| Biscayne | FRRP 2011 | 33 ± 9 | 11 ± 2.3 | 12 ± 2.6 | | 14 ± 0.6 |
| Biscayne | FRRP 2012 | 36 ± 10.3 | 20 ± 3.6 | 17 ± 6.2 | | 23 ± 1.2 |
| Biscayne | FRRP 2013 | 63 ± 27.8 | 22 ± 6.5 | 13 ± 3.6 | | |
| Biscayne | FRRP 2014 | 18 ± 7.5 | | 13 ± 3.6 | | |
| Biscayne | FRRP 2015B | 18 ± 11.2 | 31 ± 8.6 | 12 ± 2.9 | | |
| Biscayne | FRRP 2016B | | | | | |
| Biscayne | FRRP 2018 | 29 ± 3 | 13 ± 8.6 | 12 ± 5.3 | | |
| Biscayne | FRRP 2019 | | 13 ± 0 | 13 ± 5.1 | | |
| Biscayne | FRRP 2020 | 6 ± 1 | | 6 ± 1.6 | | |
| Upper Keys | FRRP 2010C | 55 ± 11.1 | 26 ± 3.5 | 15 ± 1.5 | | |
| Upper Keys | FRRP 2011 | 36 ± 7.8 | 21 ± 3 | 13 ± 2.1 | | |
| Upper Keys | FRRP 2012 | 34 ± 8.2 | 20 ± 2.8 | 12 ± 1.4 | | |
| Upper Keys | FRRP 2013 | 52 ± 24.6 | 16 ± 6.8 | 12 ± 2.5 | | |
| Upper Keys | FRRP 2014 | 37 ± 8.2 | 27 ± 6.3 | 14 ± 2.9 | | |
| Upper Keys | FRRP 2015B | 29 ± 10.8 | 25 ± 6.4 | 13 ± 3.1 | | |
| Upper Keys | FRRP 2016B | 11 ± 2.3 | 38 ± 42.1 | 17 ± 8.5 | | |
| Upper Keys | FRRP 2018 | 68 ± 17.4 | 22 ± 6.4 | 14 ± 4.1 | 12 ± 1.8 | |
| Upper Keys | FRRP 2019 | 32 ± 15.8 | 13 ± 4.5 | 10 ± 3.5 | | |
| Upper Keys | FRRP 2020 | 10 ± 4.5 | 14 ± 5.5 | 9 ± 3.2 | 17 ± 4.9 | |
| Middle Keys | FRRP 2010C | 84 ± 12.1 | 20 ± 1.1 | 11 ± 0.8 | | |
| Middle Keys | FRRP 2011 | 56 ± 6 | 27 ± 1.6 | 12 ± 0.7 | | 21 ± 2.1 |
| Middle Keys | FRRP 2012 | 36 ± 4.1 | 28 ± 3.4 | 12 ± 0.9 | | |
| Middle Keys | FRRP 2013 | 55 ± 9.5 | 24 ± 3.7 | 10 ± 1.1 | | |
| Middle Keys | FRRP 2014 | 28 ± 10.8 | 5 ± 0.2 | 11 ± 1.4 | | |
| Middle Keys | FRRP 2015B | 37 ± 4.8 | 21 ± 1.8 | 12 ± 1 | | 12 ± 1.2 |
| Middle Keys | FRRP 2016B | 52 ± 9.9 | 13 ± 1.1 | 10 ± 1.1 | | |
| Middle Keys | FRRP 2017A | 22 ± 6.4 | 27 ± 5.9 | 11 ± 1.8 | | |
| Middle Keys | FRRP 2018 | 12 ± 5.7 | 23 ± 1.7 | 11 ± 2.8 | | |
| Middle Keys | FRRP 2019 | 30 ± 9.3 | 21 ± 3.9 | 13 ± 1.4 | 22 ± 3.3 | |
| Middle Keys | FRRP 2020 | 51 ± 6.1 | 19 ± 1.9 | 9 ± 0.6 | 7 ± 0.4 | |
| Lower Keys | FRRP 2010C | 35 ± 2.3 | 36 ± 4.3 | 10 ± 0.4 | | 17 ± 0.9 |
| Lower Keys | FRRP 2011 | 48 ± 4.3 | 23 ± 0.9 | 13 ± 0.6 | | 19 ± 0.8 |
| Lower Keys | FRRP 2012 | 36 ± 3.5 | 24 ± 2.3 | 12 ± 0.7 | | 15 ± 0 |
| Lower Keys | FRRP 2013 | 49 ± 9.2 | 21 ± 2.4 | 13 ± 1.4 | | 20 ± 2.6 |
| Lower Keys | FRRP 2014 | 33 ± 2.7 | 27 ± 1.7 | 11 ± 0.5 | | |
| Lower Keys | FRRP 2015B | 43 ± 3.2 | 41 ± 3.3 | 11 ± 0.6 | | 15 ± 0.6 |
| Lower Keys | FRRP 2016B | 39 ± 2.9 | 38 ± 3.3 | 12 ± 0.8 | | |
| Lower Keys | FRRP 2017A | 49 ± 6.6 | 35 ± 4.3 | 12 ± 0.8 | | |
| Lower Keys | FRRP 2018 | 47 ± 3.2 | 28 ± 1.7 | 11 ± 0.5 | 25 ± 2.4 | 20 ± 0.5 |
| Lower Keys | FRRP 2019 | 39 ± 2.8 | 25 ± 2.2 | 11 ± 0.7 | 18 ± 1.3 | 14 ± 0.6 |
| Lower Keys | FRRP 2020 | 38 ± 4 | 20 ± 1.2 | 9 ± 0.7 | 17 ± 1.3 | 12 ± 0.5 |
| Marquesas | FRRP 2019 | 36 ± 3.5 | 25 ± 1.7 | 14 ± 1.2 | 22 ± 1.4 | 18 ± 1.1 |
| Marquesas | FRRP 2020 | 28 ± 4.8 | 32 ± 3 | 9 ± 0.9 | 19 ± 1.9 | 25 ± 0.8 |
| Dry Tortugas | FRRP 2011 | | | 12 ± 4.5 | | |
| Dry Tortugas | FRRP 2012 | 59 ± 5.4 | 32 ± 2.2 | 14 ± 0.6 | 31 ± 2.1 | 21 ± 0.2 |
| Dry Tortugas | FRRP 2014 | 31 ± 7.9 | 27 ± 3.5 | 16 ± 1.9 | | 13 ± 1.3 |
| Dry Tortugas | FRRP 2015B | 51 ± 8.8 | 60 ± 10.4 | 14 ± 0.9 | | 14 ± 1.6 |
| Dry Tortugas | FRRP 2016B | 40 ± 5.2 | 17 ± 1.4 | 12 ± 1 | | 18 ± 0.9 |
| Dry Tortugas | FRRP 2017A | 48 ± 8.2 | 31 ± 2.1 | 13 ± 1.4 | | 23 ± 6 |
| Dry Tortugas | FRRP 2018 | 45 ± 5.5 | 24 ± 1.9 | 11 ± 0.7 | 22 ± 2.3 | 10 ± 0.2 |
| Dry Tortugas | FRRP 2019 | 41 ± 4.1 | 27 ± 1.7 | 12 ± 0.6 | 19 ± 1.2 | 12 ± 0.3 |
| Dry Tortugas | FRRP 2020 | 36 ± 2.5 | 27 ± 1.6 | 14 ± 0.6 | 21 ± 1 | 16 ± 0.7 |

**h) Mean (±SE) maximum width of target SCTLD susceptible species by subregion in the Florida Keys.**

| Subregion | Batch | M. ferox | M. lamarkiana | M. meandrites | P. clivosa | P. strigosa |
|---|---|---|---|---|---|---|
| Biscayne | FRRP 2010C | | | 28 ± 6.4 | 25 ± 4.7 | 27 ± 10.3 |
| Biscayne | FRRP 2011 | | | 22 ± 5.9 | 22 ± 5.1 | 21 ± 6.2 |
| Biscayne | FRRP 2012 | | | 20 ± 2.5 | 22 ± 5.3 | 22 ± 5.2 |
| Biscayne | FRRP 2013 | | | 24 ± 9.2 | 19 ± 6.6 | 17 ± 4.2 |
| Biscayne | FRRP 2014 | | | 35 ± 19.3 | 28 ± 8.9 | 40 ± 12.9 |
| Biscayne | FRRP 2015B | | | 47 ± 36.6 | 27 ± 9 | 37 ± 9.5 |
| Biscayne | FRRP 2016B | | | | | |
| Biscayne | FRRP 2018 | | | | 36 ± 14.4 | 33 ± 22.6 |
| Biscayne | FRRP 2019 | | | | 41 ± 25.2 | |
| Biscayne | FRRP 2020 | | | 5 ± 0.7 | | 14 ± 7.7 |
| Upper Keys | FRRP 2010C | | | 30 ± 7.1 | 36 ± 4 | 38 ± 11.2 |
| Upper Keys | FRRP 2011 | | | 33 ± 8 | 37 ± 4.6 | 32 ± 6.6 |
| Upper Keys | FRRP 2012 | | 26 ± 2.7 | 31 ± 7.6 | 35 ± 5.9 | 24 ± 6.6 |
| Upper Keys | FRRP 2013 | | | 18 ± 4.8 | 88 ± 44.4 | 9 ± 2.7 |
| Upper Keys | FRRP 2014 | | | 25 ± 6.4 | 44 ± 4.3 | 21 ± 11 |
| Upper Keys | FRRP 2015B | | | 19 ± 8.3 | 55 ± 13.9 | 33 ± 11.7 |
| Upper Keys | FRRP 2016B | | | | | 45 ± 2.4 |
| Upper Keys | FRRP 2018 | | | 42 ± 11.9 | 33 ± 4.6 | 37 ± 11.7 |
| Upper Keys | FRRP 2019 | | | 6 ± 0.6 | 23 ± 8.3 | 10 ± 3.2 |
| Upper Keys | FRRP 2020 | | | 7 ± 1 | 28 ± 8.7 | 14 ± 4.1 |
| Middle Keys | FRRP 2010C | | | 19 ± 3.4 | 28 ± 5 | 28 ± 3.9 |
| Middle Keys | FRRP 2011 | | | 28 ± 3.6 | 35 ± 3.1 | 24 ± 2 |
| Middle Keys | FRRP 2012 | | | 28 ± 3.1 | 42 ± 7 | 24 ± 2.8 |
| Middle Keys | FRRP 2013 | | | 24 ± 4.6 | | 31 ± 2.7 |
| Middle Keys | FRRP 2014 | | | 6 ± 0.4 | 40 ± 9 | 16 ± 2.1 |
| Middle Keys | FRRP 2015B | | | 23 ± 2.3 | 30 ± 2.6 | 29 ± 2.8 |
| Middle Keys | FRRP 2016B | | | 17 ± 3 | 18 ± 4.1 | 18 ± 3.1 |
| Middle Keys | FRRP 2017A | | | 25 ± 6.2 | 8 ± 1.6 | 17 ± 2.5 |
| Middle Keys | FRRP 2018 | | | | | 10 ± 2.5 |
| Middle Keys | FRRP 2019 | | | | | 17 ± 2.9 |
| Middle Keys | FRRP 2020 | | | | 14 ± 1.5 | 13 ± 1.4 |
| Lower Keys | FRRP 2010C | | | 14 ± 1.2 | 54 ± 5.6 | 27 ± 1.9 |
| Lower Keys | FRRP 2011 | | | 25 ± 1.4 | 23 ± 1.8 | 26 ± 1.3 |
| Lower Keys | FRRP 2012 | | | 18 ± 2.1 | 23 ± 1.6 | 24 ± 2.4 |
| Lower Keys | FRRP 2013 | | | 19 ± 2.7 | 37 ± 9.7 | 26 ± 4.1 |
| Lower Keys | FRRP 2014 | | | 21 ± 1.9 | 33 ± 3.3 | 21 ± 1.9 |
| Lower Keys | FRRP 2015B | | | 13 ± 0.8 | 19 ± 1.3 | 21 ± 1.3 |
| Lower Keys | FRRP 2016B | | | 20 ± 2 | 22 ± 1.7 | 29 ± 2.7 |
| Lower Keys | FRRP 2017A | | | 14 ± 1 | 26 ± 5 | 22 ± 2.3 |
| Lower Keys | FRRP 2018 | | | 20 ± 0.9 | 30 ± 0.6 | 28 ± 2.2 |
| Lower Keys | FRRP 2019 | | 10 ± 0.6 | 17 ± 1 | 30 ± 1.6 | 27 ± 2.2 |
| Lower Keys | FRRP 2020 | 20 ± 1.9 | 11 ± 0.5 | 13 ± 1.9 | 30 ± 2.9 | 21 ± 2.2 |
| Marquesas | FRRP 2019 | | | 21 ± 2.1 | | 35 ± 2.8 |
| Marquesas | FRRP 2020 | | 8 ± 0.5 | 15 ± 2.1 | | 24 ± 2.9 |
| Dry Tortugas | FRRP 2011 | | | | 8 ± 2.8 | 12 ± 5.2 |
| Dry Tortugas | FRRP 2012 | 30 ± 2.1 | | 19 ± 1.9 | 17 ± 1.8 | 17 ± 1.5 |
| Dry Tortugas | FRRP 2014 | | | 22 ± 3.7 | 16 ± 1.7 | 21 ± 2.2 |
| Dry Tortugas | FRRP 2015B | | | 27 ± 7.5 | 38 ± 6.5 | 24 ± 4.4 |
| Dry Tortugas | FRRP 2016B | | | 14 ± 1.9 | 26 ± 4.5 | 19 ± 2 |
| Dry Tortugas | FRRP 2017A | | | 19 ± 2.8 | 22 ± 2.5 | 23 ± 4 |
| Dry Tortugas | FRRP 2018 | 25 ± 1.2 | 16 ± 0.7 | 14 ± 0.9 | 19 ± 2.2 | 16 ± 1.8 |
| Dry Tortugas | FRRP 2019 | | 12 ± 0.2 | 17 ± 1.5 | 14 ± 1.3 | 16 ± 1.1 |
| Dry Tortugas | FRRP 2020 | 34 ± 0.7 | 14 ± 0.3 | 16 ± 0.9 | 23 ± 0.9 | 20 ± 1.4 |

**i) Mean (±SE) density of target SCTLD susceptible juvenile coral families by subregion.**

| Subregion | # of Sites Surveyed in 2020 | Mussinae | Faviinae | Meandrinidae |
|---|---|---|---|---|
| Martin | 13 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| Palm Beach | 8 | 0.022 ± 0.022 | 0.006 ± 0.006 | 0.016 ± 0.007 |
| Broward-Miami | 83 | 0.005 ± 0.002 | 0.003 ± 0.001 | 0.01 ± 0.002 |
| Biscayne | 10 | 0.008 ± 0.005 | 0.018 ± 0.007 | 0.038 ± 0.012 |
| Upper Keys | 38 | 0.005 ± 0.003 | 0.046 ± 0.012 | 0.072 ± 0.013 |
| Middle Keys | 32 | 0.02 ± 0.008 | 0.049 ± 0.015 | 0.05 ± 0.011 |
| Lower Keys | 83 | 0.016 ± 0.006 | 0.016 ± 0.003 | 0.018 ± 0.003 |
| Marquesas | 49 | 0.067 ± 0.015 | 0.048 ± 0.019 | 0.076 ± 0.012 |
| Dry Tortugas | 61 | 0.032 ± 0.008 | 0.057 ± 0.011 | 0.032 ± 0.006 |