Appendix 2: Coral 5-Year Status Review

Unpublished Monitoring Data 2014-2020

January 2022

Contents

Acropora cervicornis

Table 1. Information on the data sources used to create the figures within this document for the *Acropora cervicornis* 5 Year Status Review.

DATA SOURCE	LOCATION(S)	YEARS INCLUDED	DATA TYPE(S)
Coral Reef Evaluation and Monitoring Project (CREMP)	Florida Keys, Dry Tortugas	2014 - 2020	Percent cover, abundance, density, Live Tissue Area
Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP)	Southeast Florida	2014 - 2019	Percent cover, abundance, density, Live Tissue Area
Puerto Rico Coral Reef Monitoring Program (PR CRMP)	Puerto Rico	2014 – 2020	Percent cover
Puerto Rico FEMA monitoring	Puerto Rico	2018	Presence absence, density
US Virgin Island Coral Reef Monitoring Program (USVI CRMP)	U.S. Virgin Islands	2014 – 2020	Percent cover
Florida Reef Resilience Program's Disturbance Response Monitoring (FRRP DRM)	Southeast Florida, Florida Keys, Dry Tortugas	2014 -2019	Abundance, density, size, mortality
National Coral Reef Monitoring Program (NCRMP) (includes DRM data)	Southeast Florida, Florida Keys, Dry Tortugas, U.S. Virgin Islands, Puerto Rico	2014-2020	Percent cover, density
Puerto Rico Department of Natural and Environmental Resources (PR DNER)	Puerto Rico	2017	Percent cover
Segment II Listed Stony Coral Species Survey (NSU – Broward County)	Southeast Florida (Broward County only)	2015 – 2020	Abundance, size, mortality
Coastal Eco-Group, Inc. (CEG) Beach Nourishment Project Surveys	Southeast Florida (Broward County only)	2012 – 2020	Abundance

OTHER DATA FROM THE ESA CORAL DATABASE FILE

*The ESA Coral Database file included 611 entries for *A. cervicornis* between 2014 and 2020 that were records of *A. cervicornis* presence from coral outplant surveys and are not presented below.

Coral Reef Evaluation and Monitoring Project (CREMP) and the Southeast Coral Reef Evaluation and Monitoring Project (SECREMP)

The data used to generate **Figure 1** through **Figure 9** (below) were provided by Florida's Coral Reef Evaluation and Monitoring Project (CREMP) and SECREMP (pers. comm., Mike Colella, Florida Fish and Wildlife Conservation Commission (FWC), to Alison Moulding, Aug. 27, 2020). CREMP in the Florida Keys is funded through the EPA South Florida Water Quality Protection Program and CREMP in the Dry Tortugas is funded through the National Park Service. Both Florida Keys and Dry Tortugas surveys were completed by the Coral Program at the FWC Fish and Wildlife Research Institute (FWRI). SECREMP data is credited to Florida Department of Environmental Protection (FDEP) Coral Reef Conservation Program and Dr. David Gilliam's lab at the National Coral Reef Institute (NCRI) and Nova Southeastern University (NSU).

CREMP and SECREMP surveys were conducted annually in permanent transects across sites (n=4 transects per site) in three regions of Florida: Dry Tortugas (DT), Florida Keys (FL Keys), and Southeast Florida (SE FL) north of the Florida Keys (see Table below for number of sites within each region). This sampling scheme includes eight sites that are located at monospecific coral stands or special habitat areas for the coral species in this status review. Thus, data from these eight sites (DT n = 4 sites, FL Keys n = 3 sites; SE FL n = 1 site) were excluded from the general CREMP data analyses and are presented as separate figures (**Figures 3, 6, and 9**). The figures below display Florida-wide, regional and site-specific trends in mean percent coral cover, total or mean live coral area, and total colony counts by species between 2014 and 2019 from CREMP and SECREMP survey data. For these figures means were calculated by using transect as a replicate (n = 260 per year, except for 2017, where n = 258 transects).

Table 2. Number of sites surveyed annually by CREMP and SECREMP programs.

Region	Number of Sites	Number of monospecific or special habitat area sites
Southeast Florida (SE FL)	21	1
Florida Keys	37	3
Dry Tortugas	7	4

CREMP and SECREMP monitoring data summary

PERCENT COVER: Percent cover of *Acropora cervicornis* on average declined in all three regions surveyed by CREMP and SECREMP between 2014 and 2019 (**Figure 1**). In 2014, the mean percent cover of *A. cervicornis* across all 260 transects surveyed was 0.042% ± 0.015 (mean ±SE). Mean percent cover of *A. cervicornis* on transects (n = 260) surveyed by CREMP and SECREMP in 2014 had decreased by an order of magnitude by 2019, with a mean percent cover of 0.003% ± 0.002. In the Dry Tortugas, mean percent cover of *A. cervicornis* was highly variable but ranged from 0.07% to ~0.1% from 2014 to 2016, and then dropped sharply in 2017. By 2019, mean percent cover of *A. cervicornis* in the Dry Tortugas was 0.01% ± 0.009. In 2014, the mean percent cover of *A. cervicornis* in the Florida Keys (FL Keys) and Southeast Florida (SE FL) was ~0.04%. By 2019, the mean percent cover of *A. cervicornis* on transects conducted in the Florida Keys (n = 148 per year) and Southeast Florida (n = 84 per year) was 0.0008% ±0.0008 and 0.006 ± 0.006, respectively.

LIVE TISSUE AREA: The total amount of live tissue area of *A. cervicornis* (estimated area; m^2) on all transects conducted by CREMP and SECREMP in 2014 was 44.32 m^2 (**Figure 4**). Less than half as much live tissue of *A. cervicornis* was recorded on transects in 2017 (18.97 m^2), which further declined to a total of 5.65 m^2 live tissue area of *A. cervicornis* recorded across all transects surveyed in 2019. Patterns of live tissue area at monotypic and species sites had very different patterns from the main CREMP and SECREMP sites (**Figure 6**). The Dry Tortugas was the only region with *A. cervicornis* observed at any monotypic or special habitat sites surveyed from 2014 to 2019. At these sites, the total live tissue area of *A. cervicornis* nearly doubled from 2014 to 2019 (20.78 m^2 vs. 36.0 m^2), even though live tissue area was lowest in 2017 at 7.1 m^2. Although *A. cervicornis* was observed at 4 sites in the Dry Tortugas during the time period considered (2014 to 2016), the patterns at monotypic and species habitat sites were nearly completely driven by patterns at a single site: White Shoal.

DENSITY: The mean density of *A. cervicornis* on transects surveyed by CREMP and SECREMP decreased 4-fold from 2014 to 2019 (0.017 ± 0.004 colonies m^{-2} vs. 0.004 ± 0.002 colonies m^{-2}; **Figure 7**). However, patterns in mean density varied among regions; in the Dry Tortugas, the mean density of *A. cervicornis* colonies was variable but remained relatively similar from 2014 to 2019 (range 0.018 to 0.007 colonies m^{-2}). In contrast, the mean density of *A. cervicornis* in the Florida Keys decreased from 0.021 ± 0.007 colonies m^{-2} in 2014 to 0.003 ± 0.001 colonies m^{-2} in 2019. Similarly, the mean density of *A. cervicornis* on transects in Southeast Florida decreased from 0.01 ± 0.005 colonies m^{-2} in 2014 to 0.005 ± 0.003 colonies m^{-2} in 2019. Similar to patterns in live tissue area, patterns of *A. cervicornis* density at monotypic and special habitat sites were very different from the main sites (**Figure 9**). At these sites, mean *A. cervicornis* density more than doubled from 2014 to 2018 (0.05 ± 0.03 colonies m^{-2} in 2014 vs. 0.13 ± 0.09 colonies m^{-2} in 2018).

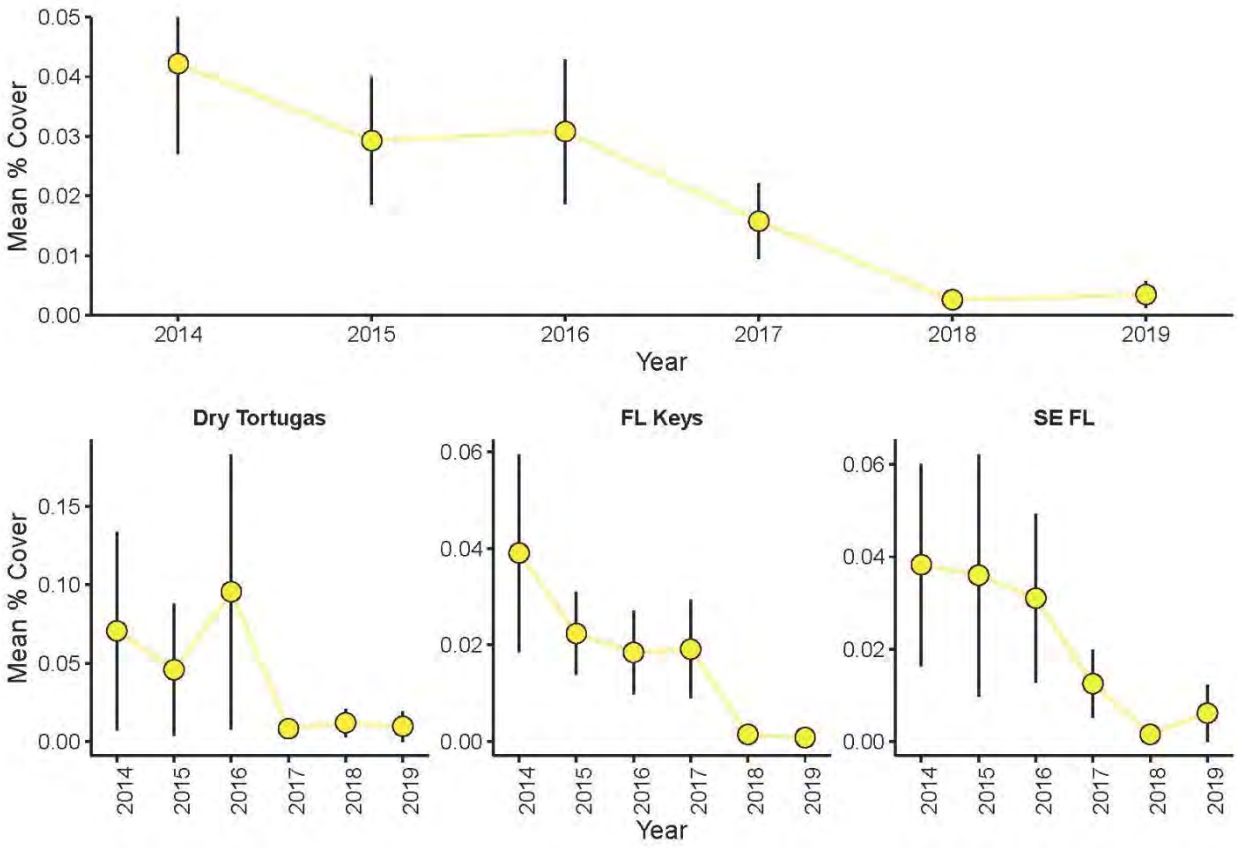

Figure 1. Mean percent cover of *Acropora cervicornis* from 2014 to 2019: Florida-wide and regional patterns. (Top panel) Mean percent cover of *A. cervicornis* averaged across all transects conducted at Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites). (Bottom panels) Mean percent cover of *A. cervicornis* for each region surveyed by CREMP (DT = 7 sites; FL Keys = 37 sites; SE FL = 21 sites). Data presented are means ±SE. Note different y-axis values for each plot.

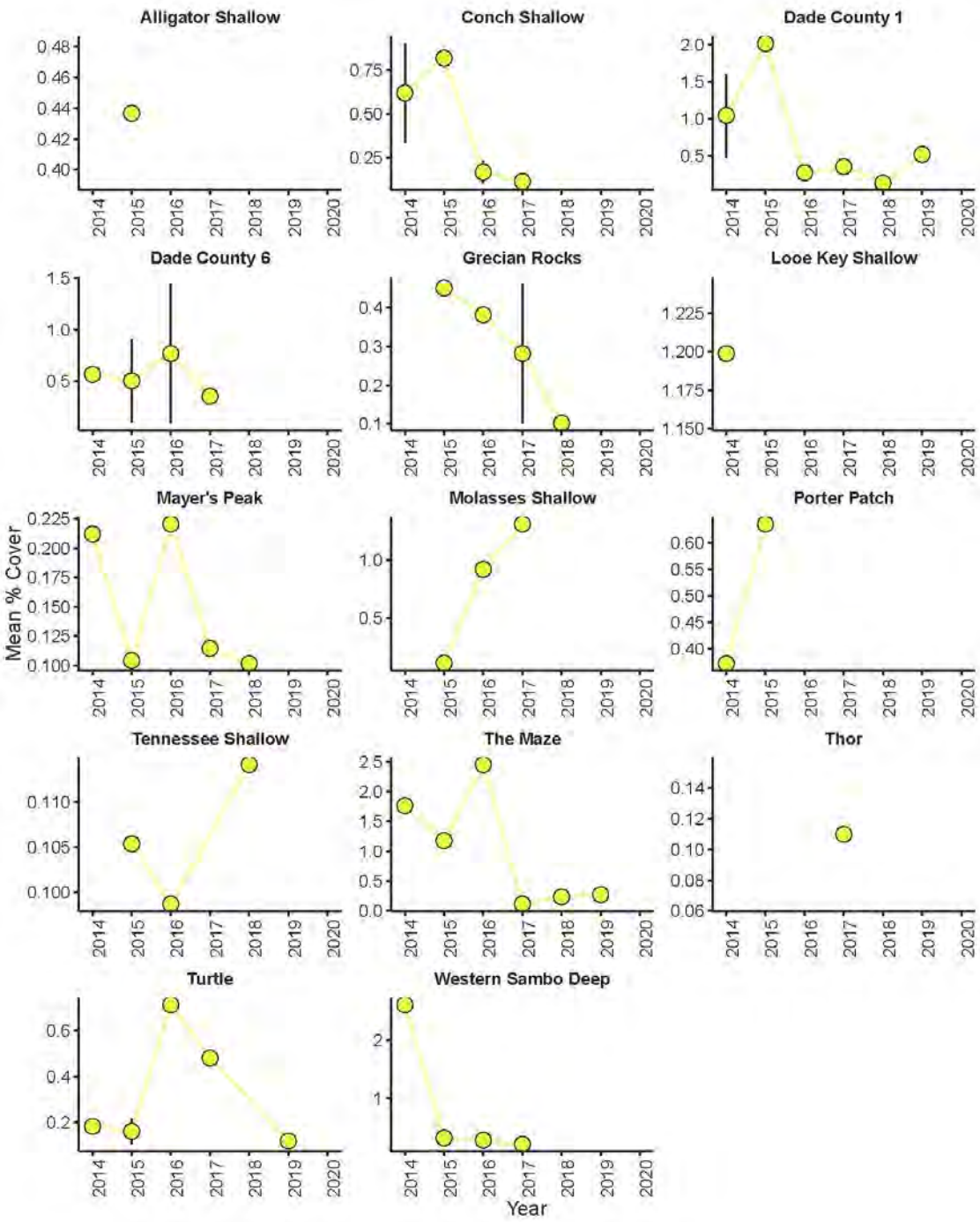

Figure 2. Mean percent cover of *Acropora cervicornis* from 2014 to 2019: Individual site patterns. Mean percent cover of *A. cervicornis* on transects conducted at any Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites) where *A. cervicornis* was recorded on at least one transect between 2014 – 2019. Data presented are means ±SE. Note different y-axis values for each plot.

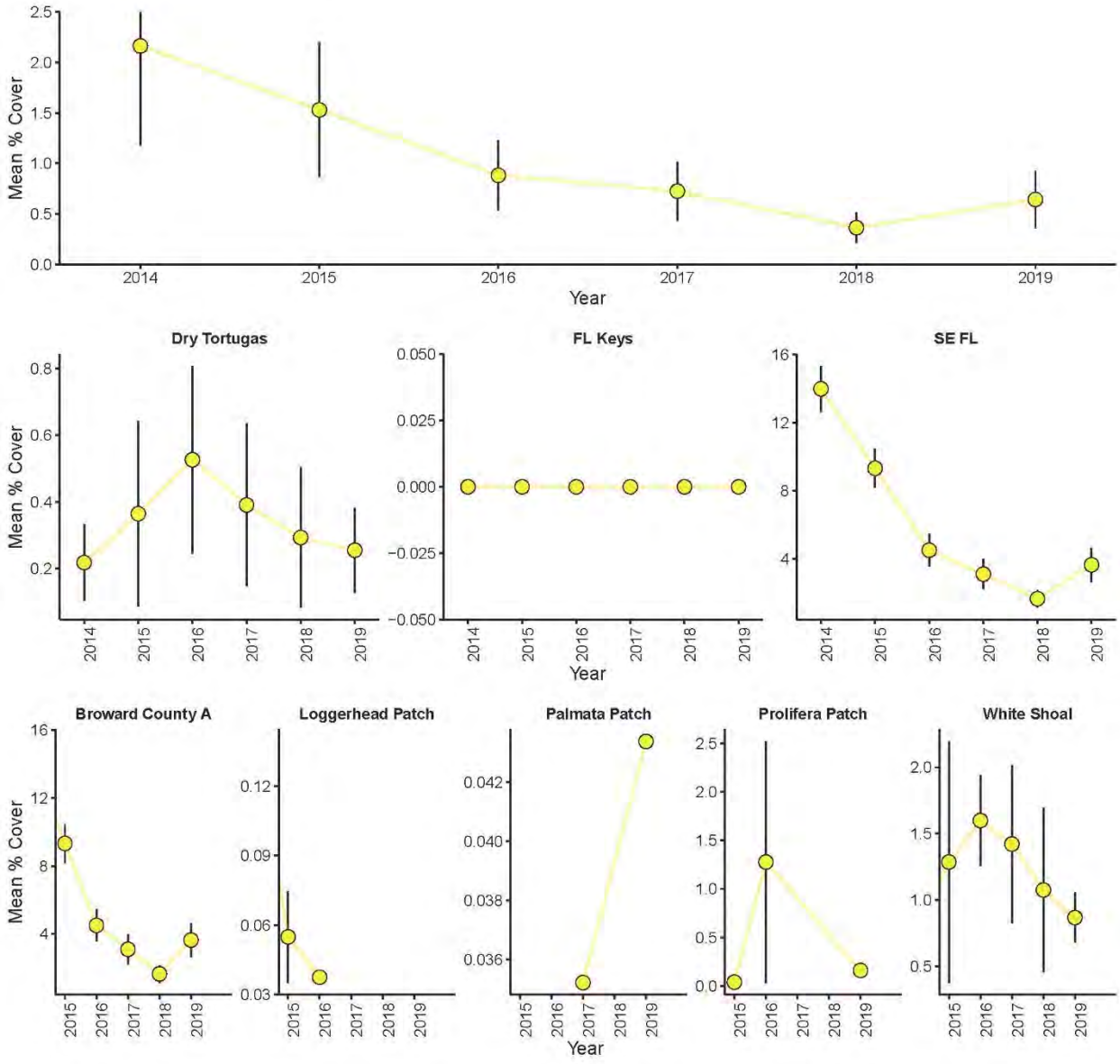

Figure 3. Mean percent cover of *Acropora cervicornis* from 2014 to 2019: monotypic and special habitat sites. (Top panel) Mean percent cover of *A. cervicornis* averaged across all transects conducted at monotypic and special habitat Florida coral reef sites surveyed by CREMP and SECREMP (n = 8). (Middle panels) Mean percent cover of *A. cervicornis* at monotypic and special habitat sites for each region surveyed by CREMP and SECREMP (DT = 4 sites; FL Keys = 3 sites; SE FL = 1 site). (Bottom panels) Mean percent cover of *A. cervicornis* on transects at individual monotypic and special habitat sites where *A. cervicornis* was recorded on at least one transect between 2014 and 2019. For bottom panels data is only presented for years when *A. cervicornis* was present. Data presented are means ±SE. Note different y-axis values for each plot.

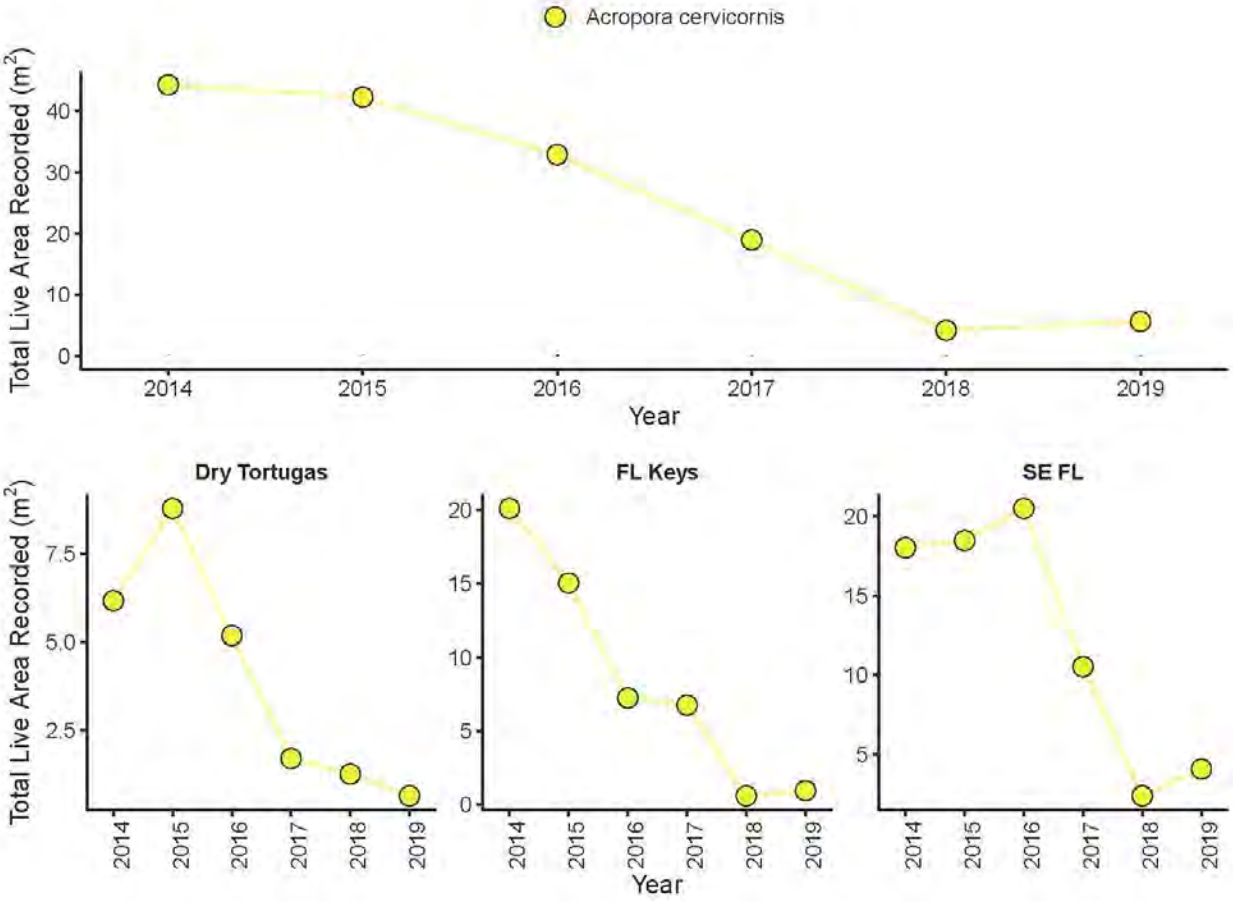

Figure 4. Total live area (m^2) of *Acropora cervicornis* from 2014 to 2019: Florida-wide and regional patterns. (Top panel) Total live area (m^2) of *A. cervicornis* summed across all transects conducted at Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites). (Bottom panels Total live area (m^2) of *A. cervicornis* for each region surveyed by CREMP (DT = 7 sites; FL Keys = 37 sites; SE FL = 21 sites). Note different y-axis values for each plot.

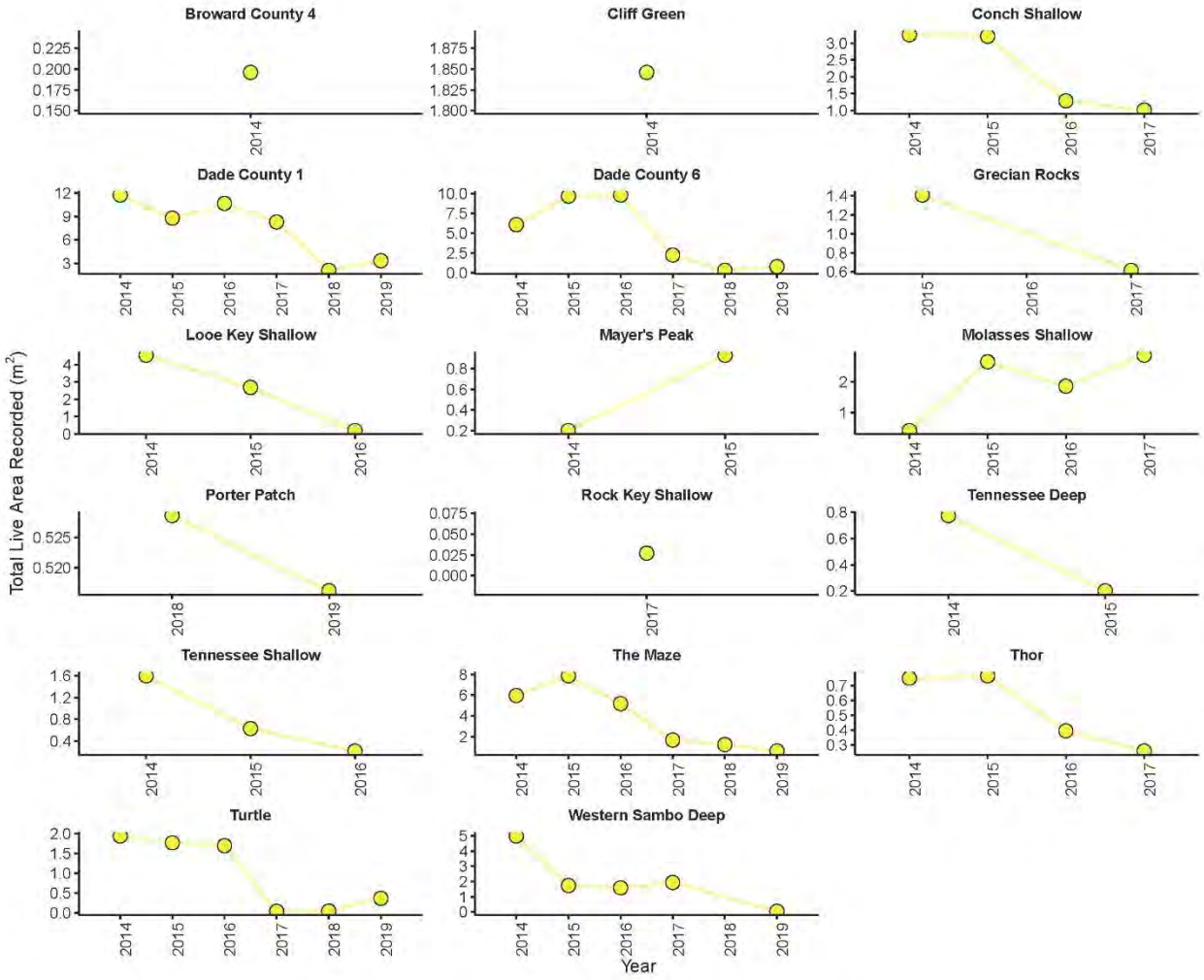

Figure 5. Total live area (m^2) of *Acropora cervicornis* from 2014 to 2019: Individual site patterns. Total live area (m^2) of *A. cervicornis* at any Florida coral reef site surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites) where *A. cervicornis* was recorded on at least one transect between 2014 – 2019. Note different y-axis values for each plot.

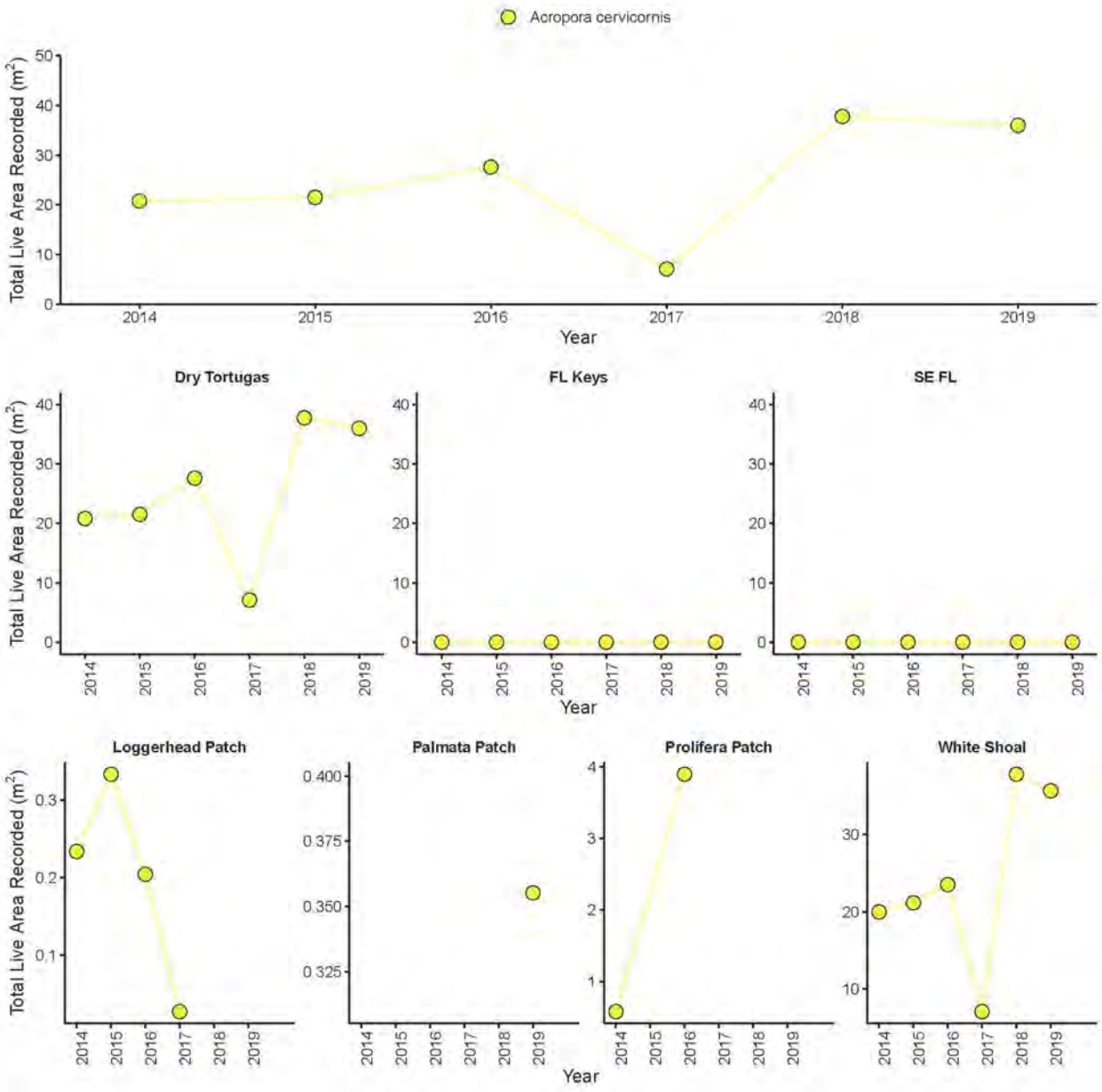

Figure 6. Total live area (m^2) of *Acropora cervicornis* from 2014 to 2019: Florida-wide and regional patterns at monotypic and special habitat sites. Total live area (m^2) of *A. cervicornis* across all transects conducted at monotypic and special habitat Florida coral reef sites surveyed by CREMP and SECREMP (n = 8). (Middle panels) Total live area (m^2) of *A. cervicornis* at monotypic and special habitat sites for each region surveyed by CREMP and SECREMP (DT = 4 sites; FL Keys = 3 sites; SE FL = 1 site). (Bottom panels) Total live area (m^2) of *A. cervicornis* at individual monotypic and special habitat sites (n=8) where *A. cervicornis* was recorded on at least one transect between 2014 and 2019. Data is only presented for years when *A. cervicornis* was present. Note different y-axis values for each plot.

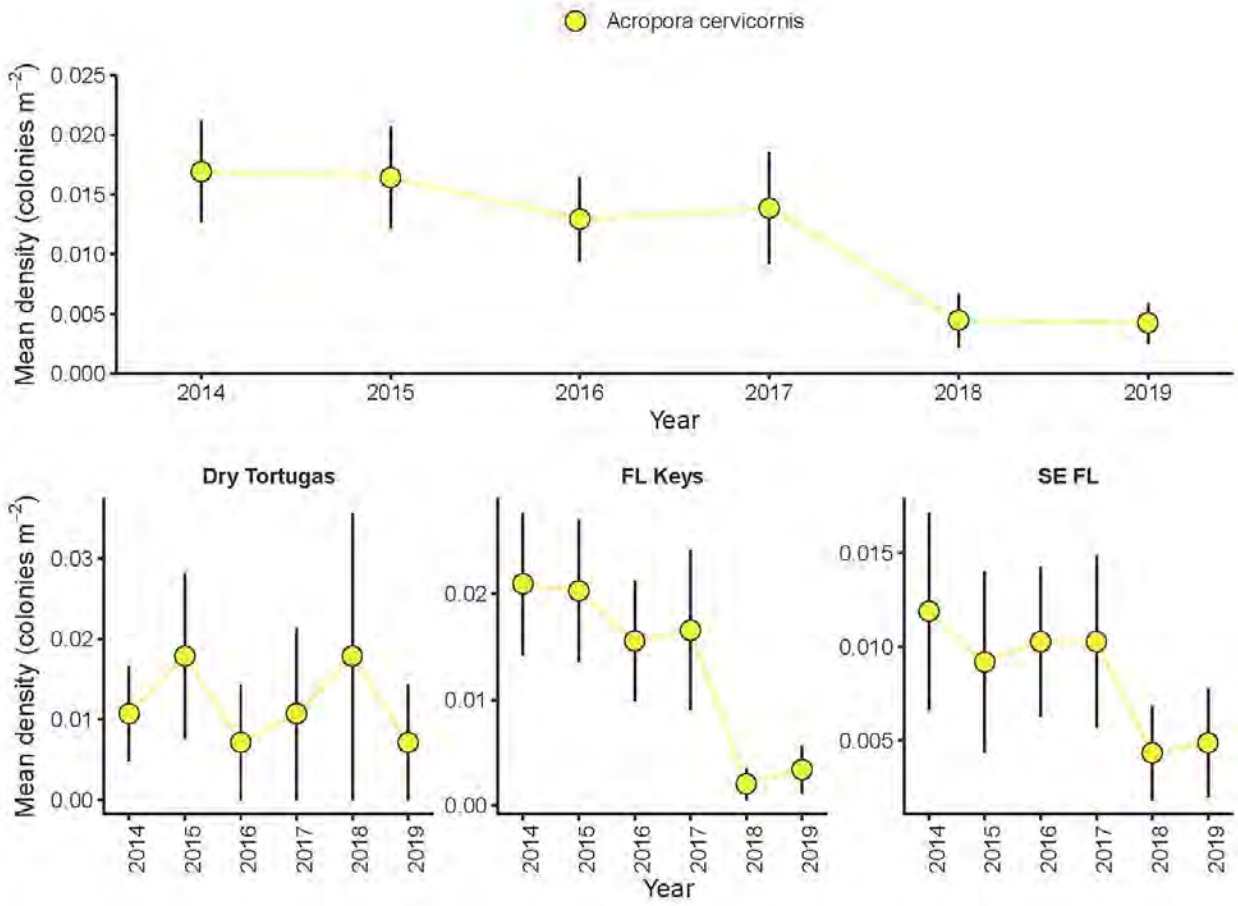

Figure 7. Mean density of *Acropora cervicornis* colonies from 2014 to 2019: Florida-wide and regional patterns. (Top panel) Mean density (colonies m^{-2}) of *A. cervicornis* colonies averaged across all transects conducted at Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites). (Bottom panels) Mean density (colonies m^{-2}) of *A. cervicornis* colonies for each region surveyed by CREMP and SECREMP (DT = 7 sites; FL Keys = 37 sites; SE FL = 21 sites). Data presented are means ±SE. Note different y-axis values for each plot.

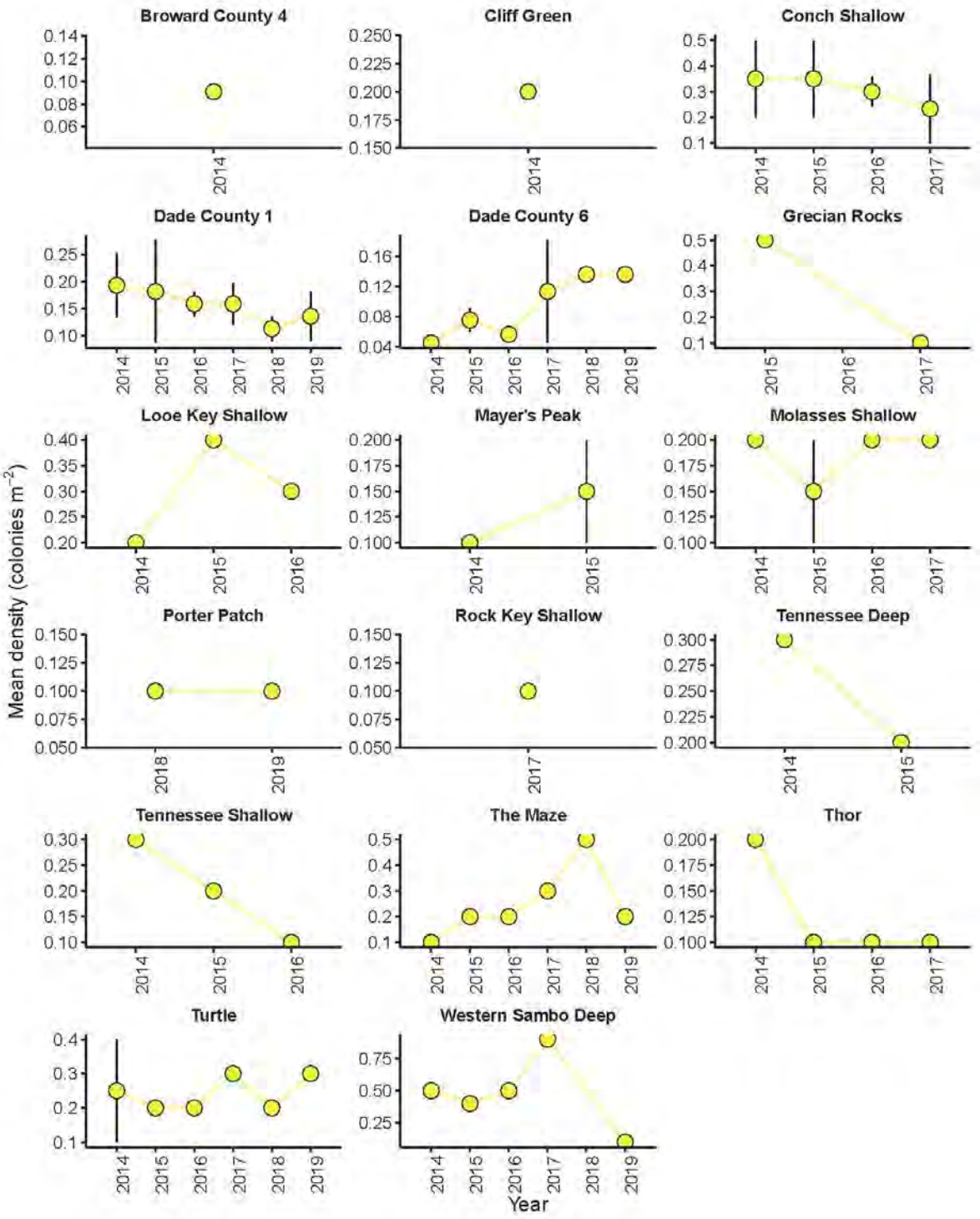

Figure 8. Mean density of *Acropora cervicornis* colonies from 2014 to 2019: Individual site patterns. Mean density (colonies m^{-2}) of *A. cervicornis* colonies on transects at any Florida coral reef site surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites) where *A. cervicornis* was recorded on at least one transect between 2014 – 2019. Data presented are means ±SE. Note different y-axis values for each plot.

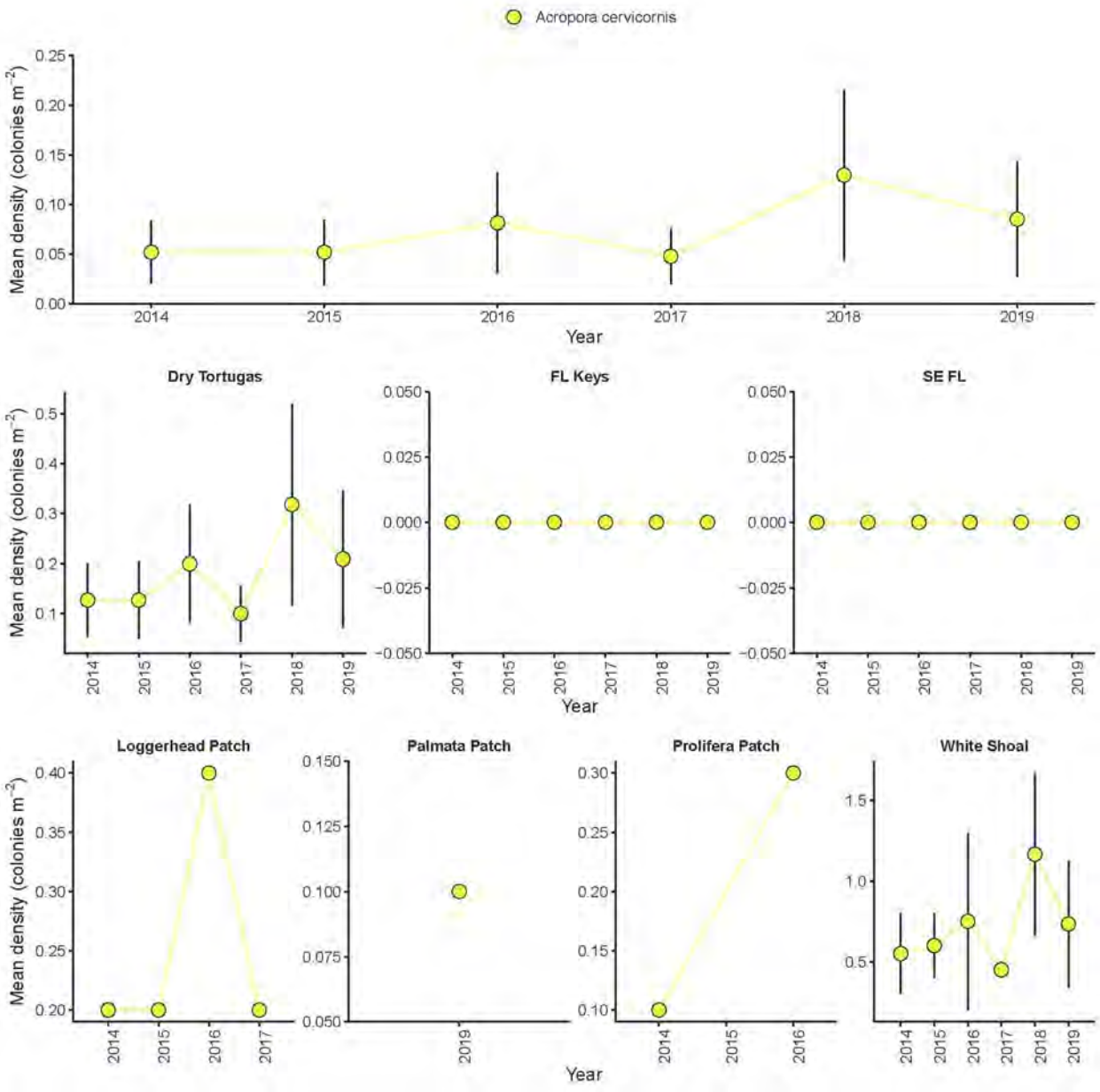

Figure 9. Mean density (colonies m^{-2}) of *Acropora cervicornis* colonies from 2014 to 2019: monotypic and special habitat sites. (Top panel) Mean density (colonies m^{-2}) of *A. cervicornis* colonies averaged across all transects at monotypic and special habitat Florida Coral Reef sites surveyed by CREMP and SECREMP (n = 8). (Middle panels) Mean density (colonies m^{-2}) of *A. cervicornis* colonies on transects at monotypic and special habitat sites for each region surveyed by CREMP and SECREMP (DT = 4 sites; FL Keys = 3 sites; SE FL = 1 site). (Bottom panels) Mean density (colonies m^{-2}) of *A. cervicornis* colonies on transects at individual monotypic and special habitat sites (n=8) where *A. cervicornis* was recorded on at least one transect between 2014 and 2019. For bottom panels data is only presented for years when *A. cervicornis* was present. Data presented are means ±SE. Note different y-axis values for each plot.

National Coral Reef Monitoring program (NCRMP) and the Florida Reef Resilience Program (FRRP) Disturbance Response Monitoring (DRM)

The National Coral Reef Monitoring Program (NCRMP) provides a biennial ecological characterization at a broad spatial scale of general reef condition for reef fishes, corals and benthic habitat (i.e., fish species composition/density/size, benthic cover, and coral density/size/condition). Data collection occurs at stratified random sites where the sampling domain for each region (e.g., Florida, Puerto Rico, U.S. Virgin Islands, Flower Garden Banks National Marine Sanctuary [FGBNMS]) is partitioned by habitat type and depth, sub-regional location (e.g., along-shelf position) and management zone.

The FRRP DRM uses a stratified random sampling design and focuses on bleaching species in <60 ft of water. Two $10m^2$ belt transects (1m width x 10m length) were completed at each site for a total of $20m^2$ surveyed at each site. Because NCRMP and DRM sampling overlaps in the geographic regions they survey and both employ a stratified random sampling design, density, percent cover and coral colony measures (maximum diameter, height, and percent partial mortality) data for these two surveys were combined and presented together.

Table 3. Number of surveys conducted by NCRMP and DRM monitoring programs each year from 2014 to 2020 broken down by each region surveyed. SE FL = Southeast Florida, STTSTJ = St. Thomas and St. John, STX = St. Croix.*In 2018 NCRMP and DRM surveys were conducted together and were not provided as individual data sets.

Year	Region	Survey	No. Surveys		Year	Region	Survey	No. Surveys
2014	Dry Tortugas	DRM	29		2017	Dry Tortugas	DRM	31
2014	Dry Tortugas	NCRMP	105		2017	FL Keys	DRM	18
2014	FL Keys	DRM	86		2017	SE FL	DRM	23
2014	FL Keys	NCRMP	314		2017	STTSTJ	NCRMP	230
2014	SE FL	DRM	41		2017	STX	NCRMP	171
2014	SE FL	NCRMP	49		2018	Dry Tortugas	NCRMP/ DRM*	139
2014	Puerto Rico	NCRMP	103		2018	FL Keys	DRM	95
2015	Dry Tortugas	DRM	20		2018	FL Keys	NCRMP	86
2015	FL Keys	DRM	129		2018	SE FL	DRM	50
2015	SE FL	DRM	100		2018	SE FL	NCRMP	70
2015	STTSTJ	NCRMP	162		2019	Dry Tortugas	DRM	79
2015	STX	NCRMP	133		2019	FL Keys	DRM	123
2016	Dry Tortugas	DRM	29		2019	SE FL	DRM	81
2016	Dry Tortugas	NCRMP	97		2019	Puerto Rico	NCRMP	147
2016	FL Keys	DRM	107		2019	STTSTJ	NCRMP	221
2016	FL Keys	NCRMP	92		2019	STX	NCRMP	245
2016	SE FL	DRM	48		2020	Dry Tortugas	DRM	108
2016	SE FL	NCRMP	93		2020	FL Keys	DRM	165
2016	Puerto Rico	NCRMP	157		2020	SE FL	DRM	116

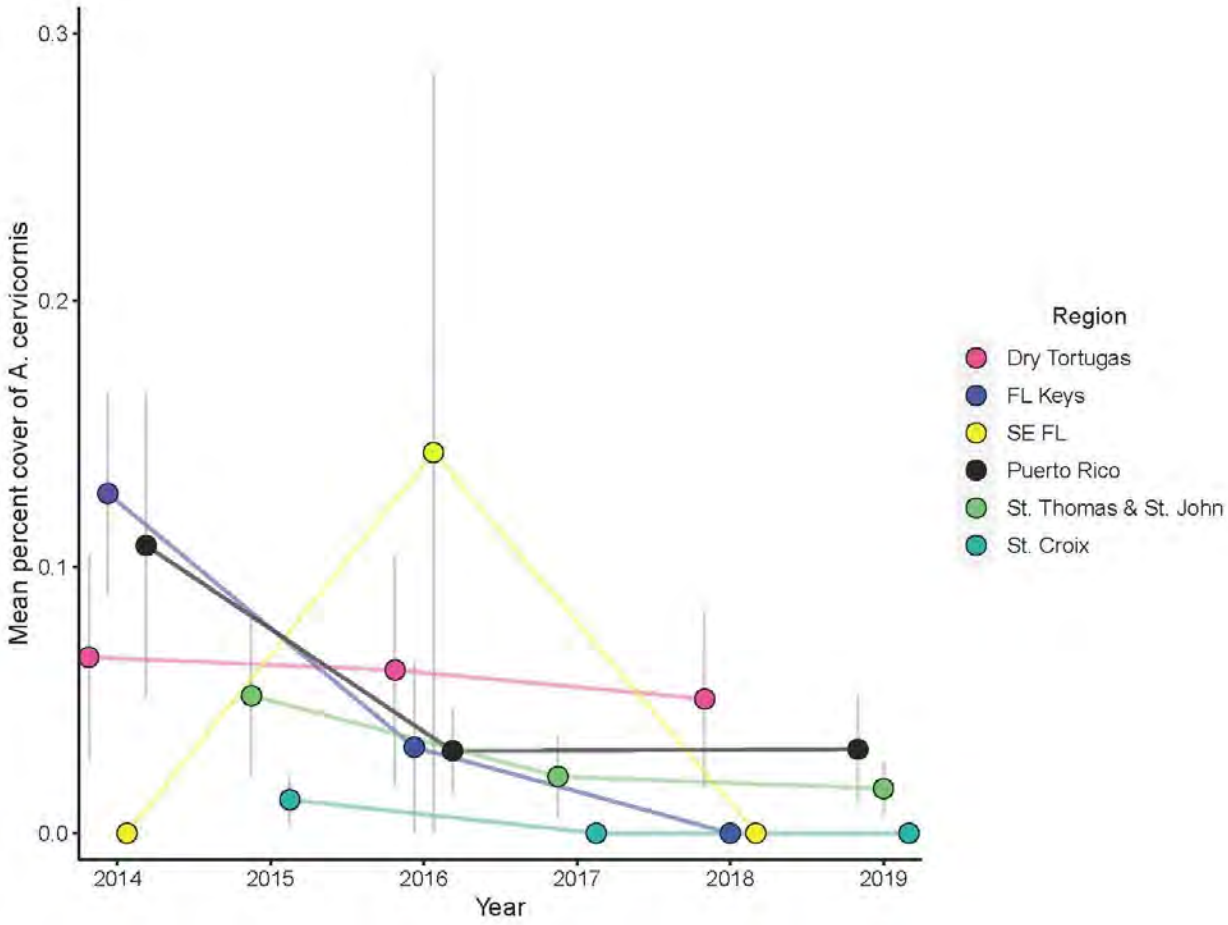

Figure 10. Mean percent cover of *Acropora cervicornis* for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

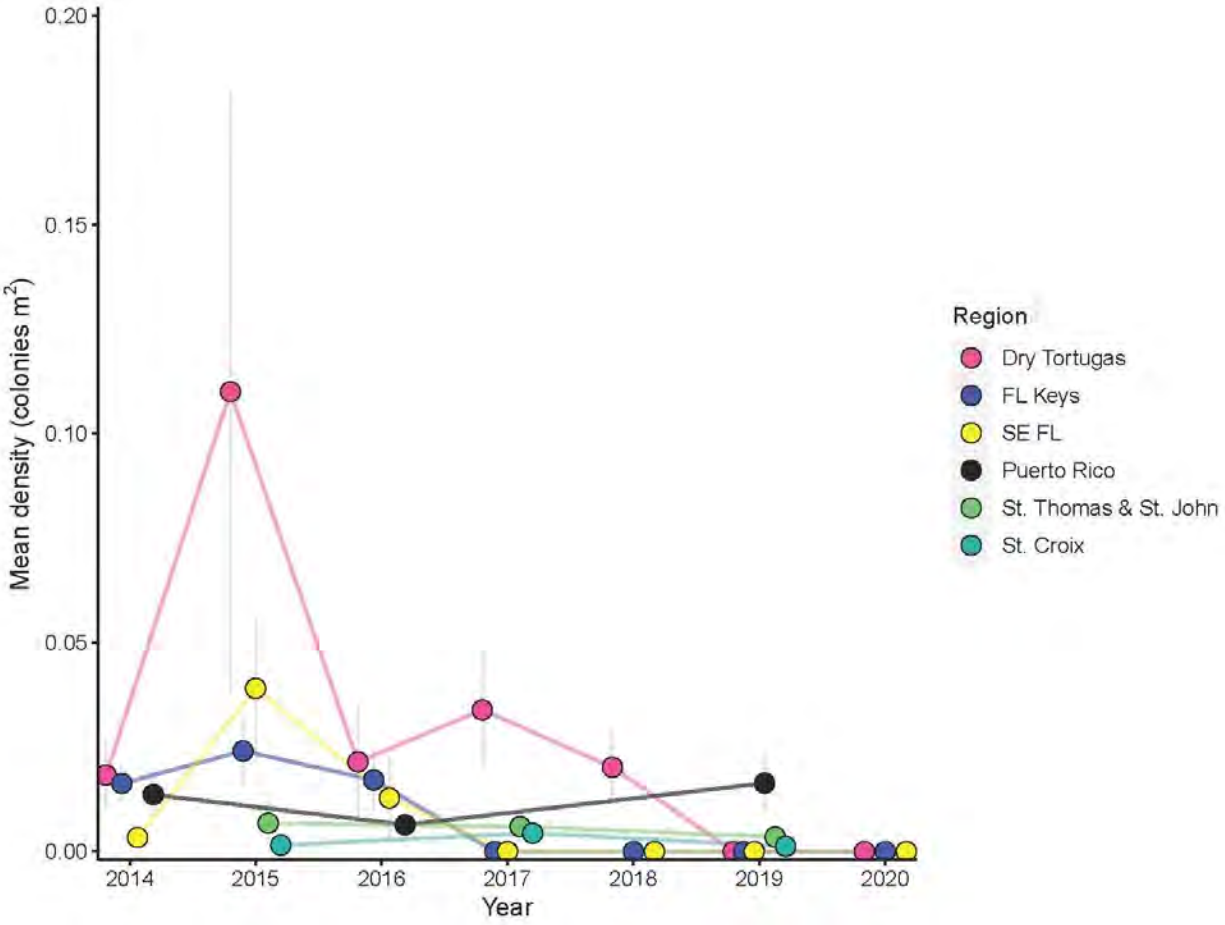

Figure 11. Mean density (colonies m^{-2}) of *A. cervicornis* colonies for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

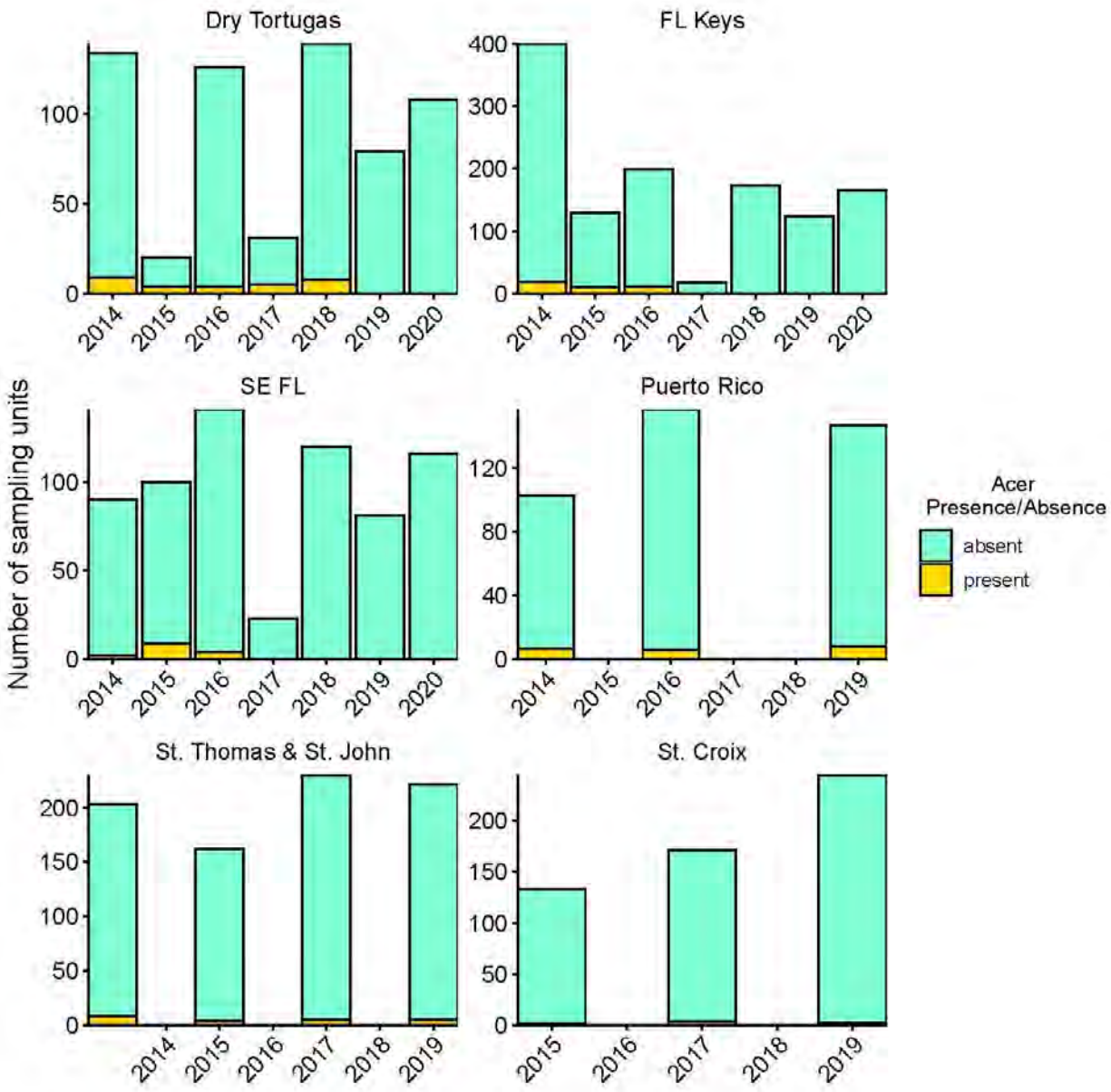

Figure 12. Number of sites where *Acropora cervicornis* was observed (gold) or absent (teal) for each year and region surveyed by NCRMP and DRM from 2014 to 2020.

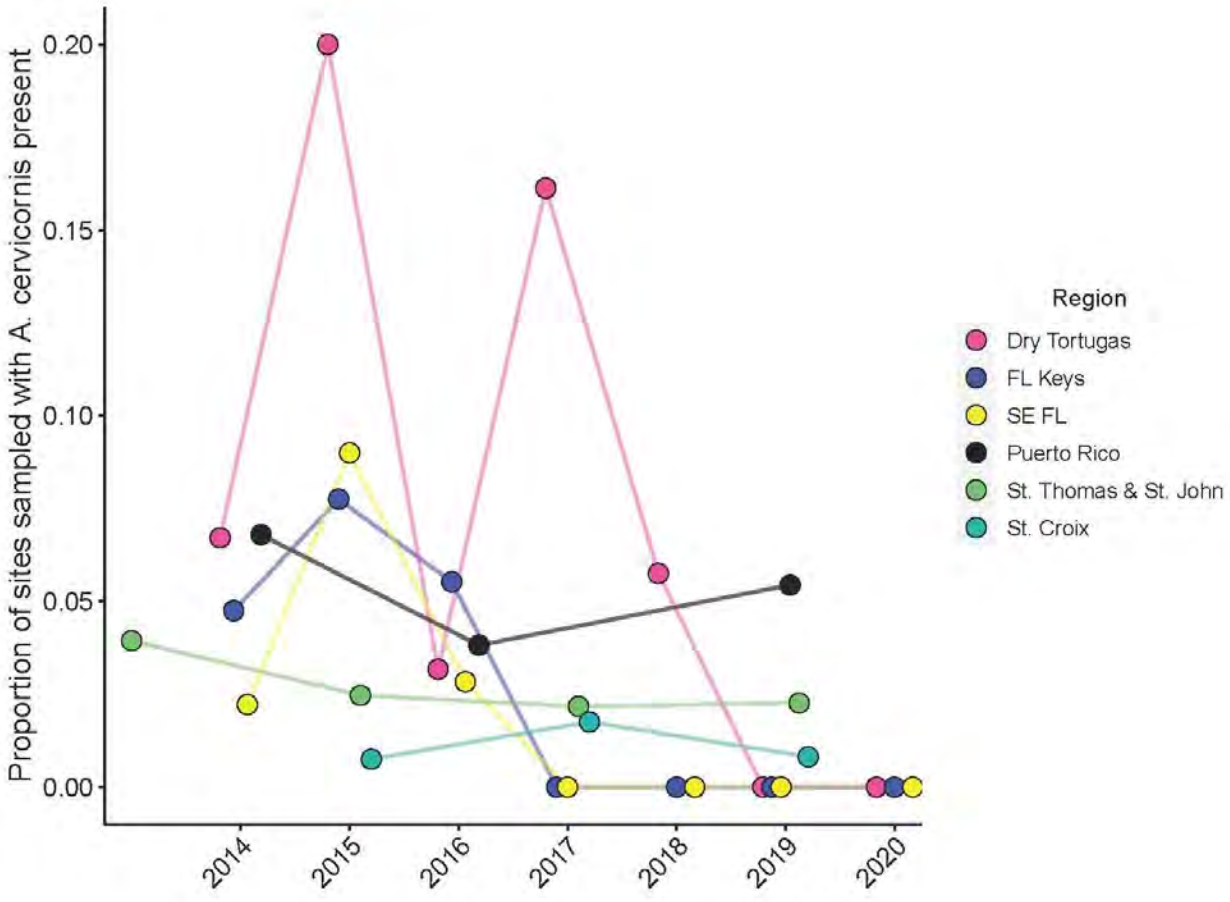

Figure 13. Proportion of all sites surveyed where *Acropora cervicornis* was present for each year and region surveyed by NCRMP and DRM from 2014 to 2020.

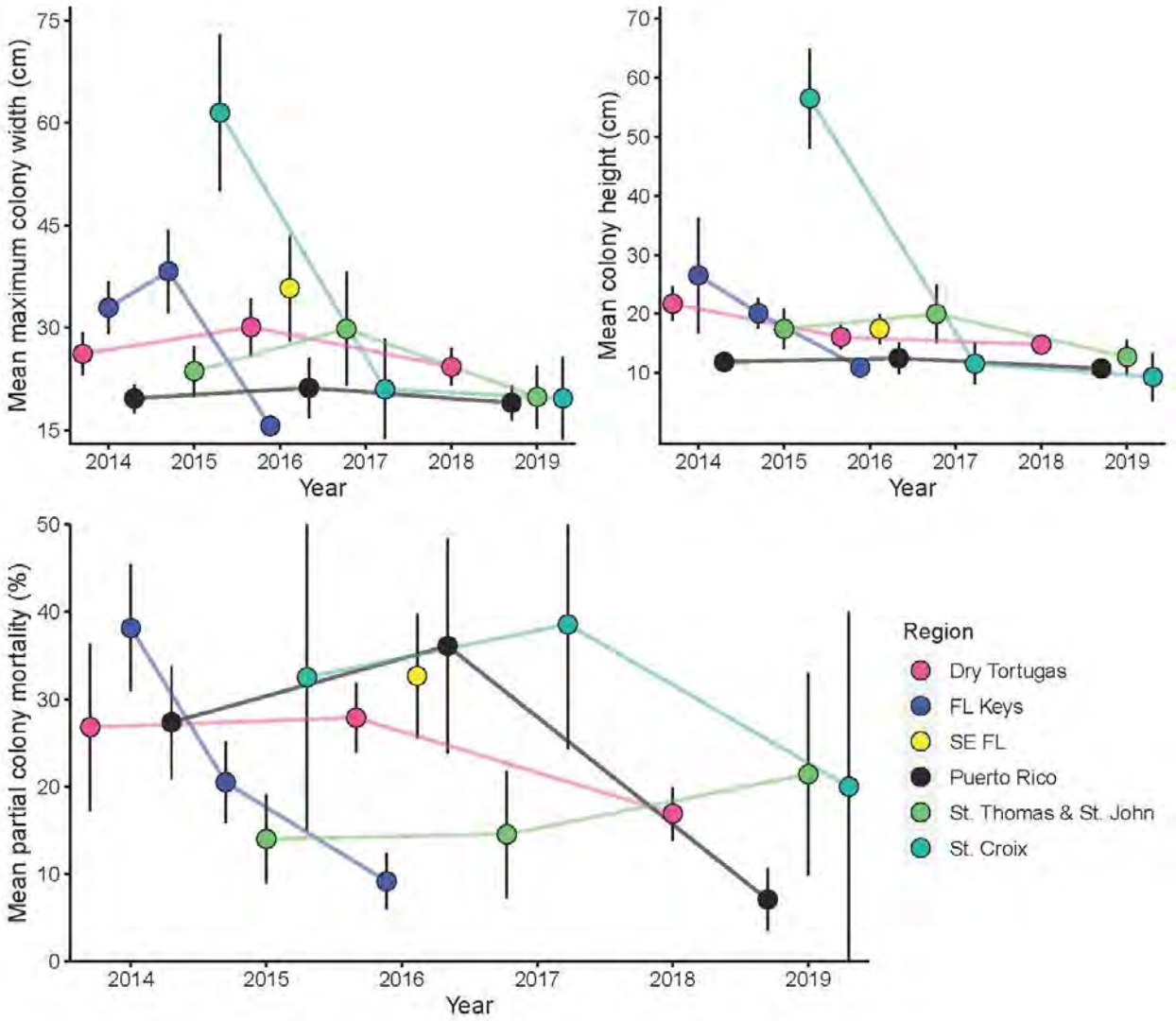

Figure 14. (Top Left) Mean maximum diameter (cm), (Top Right) mean height (cm), and (Bottom) mean partial colony mortality (%) of *A. cervicornis* colonies surveyed on each transect for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

Nova Southeastern University – Broward County monitoring

The below figures (**Figures 15-16** in this document) are directly from the following report: Segment II Listed Stony Coral Species Survey, Broward County, Florida. 2017 DRAFT Annual Report. Prepared for Broward County Board of County Commissioners by: David S. Gilliam. Nova Southeastern University, Halmos College of Natural Sciences and Oceanography. 8000 N. Ocean Dr., Dania, FL 33004.

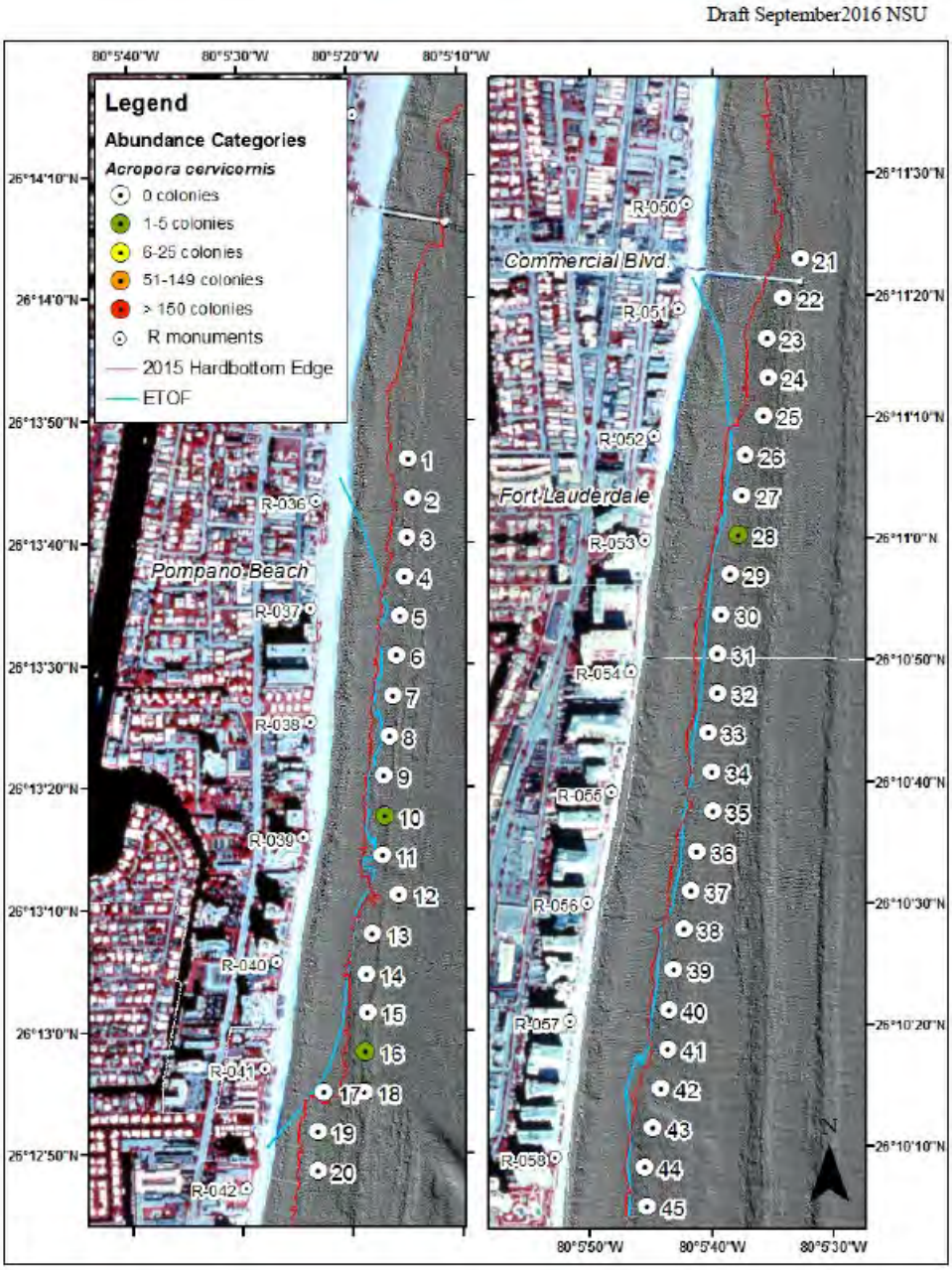

Figure 15. *Acropora cervicornis* abundance category for each site along the Pompano section and northern end of the Fort Lauderdale section.

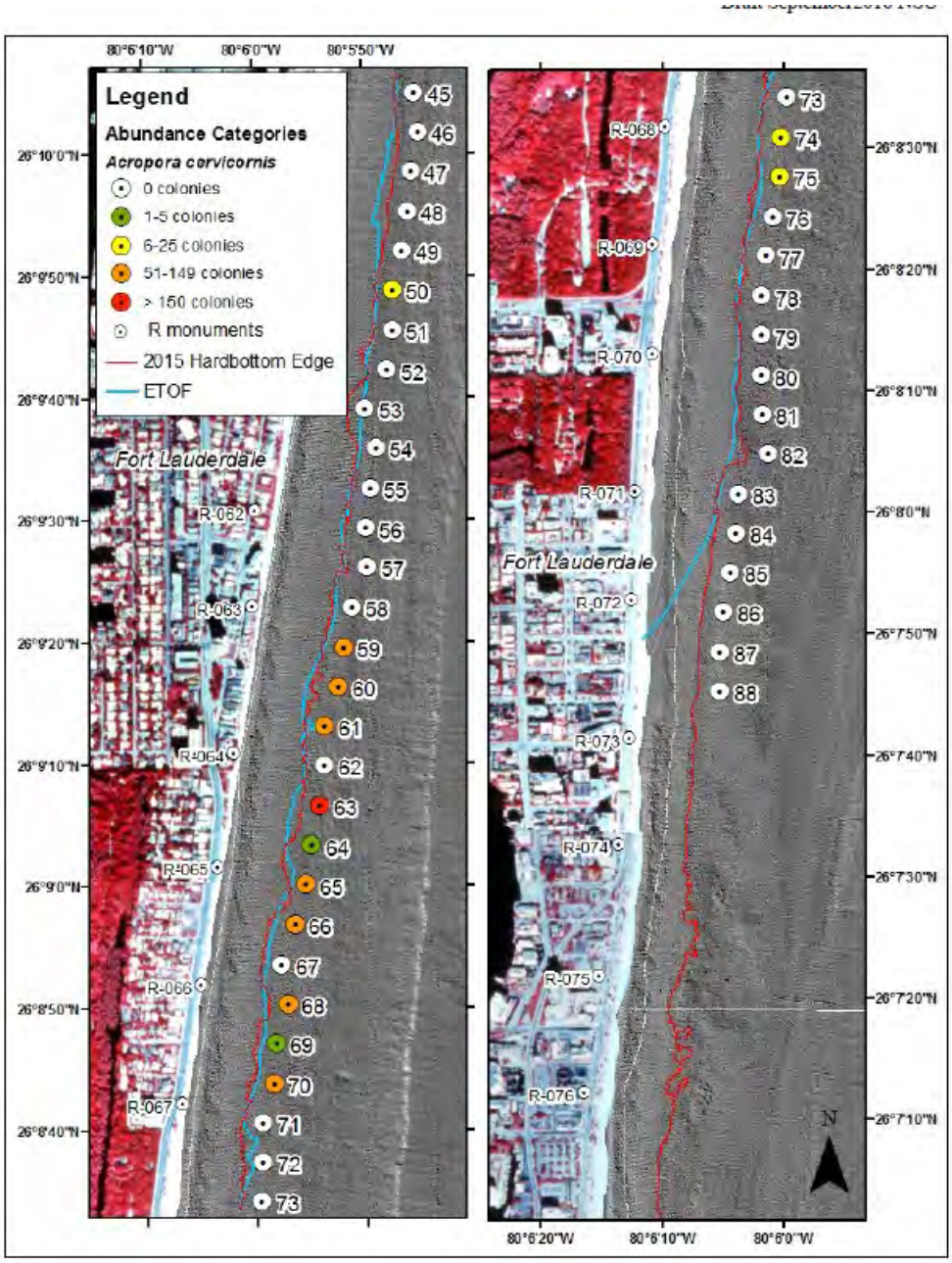

Figure 16. *Acropora cervicornis* abundance category for each site along the southern end of the Fort Lauderdale section.

The below figures (**Figures 17-18**) were generated from data collected as part of the Broward County Monitoring Program and were provided by Nova Southeastern University.

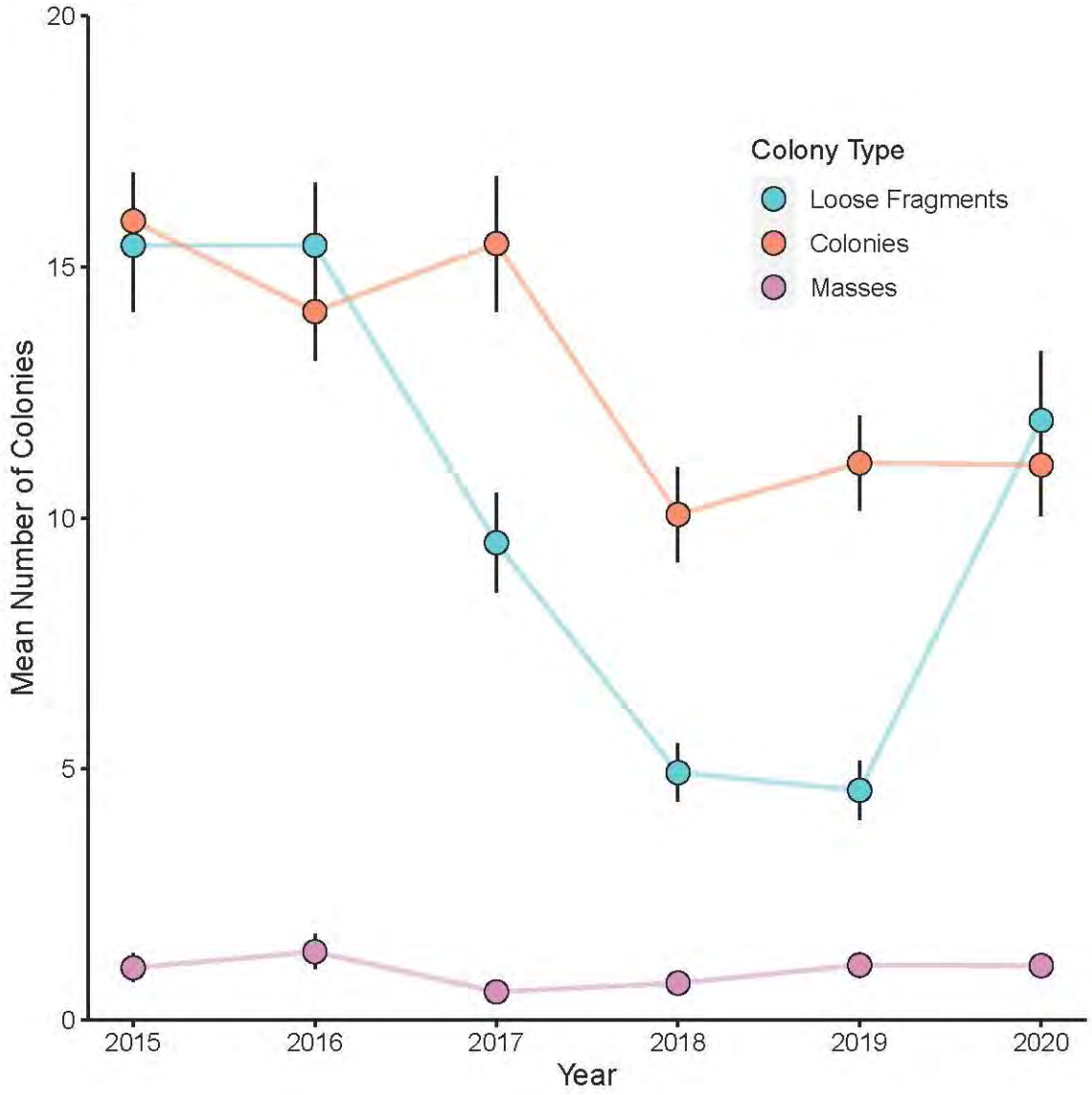

Figure 17. Mean number of *Acropora cervicornis* colonies, masses, and loose fragments observed in Broward County (Florida) Segment II Elkhorn (*Acropora palmata*) and Staghorn (*Acropora cervicornis*) Coral Monitoring from 2015 to 2020.

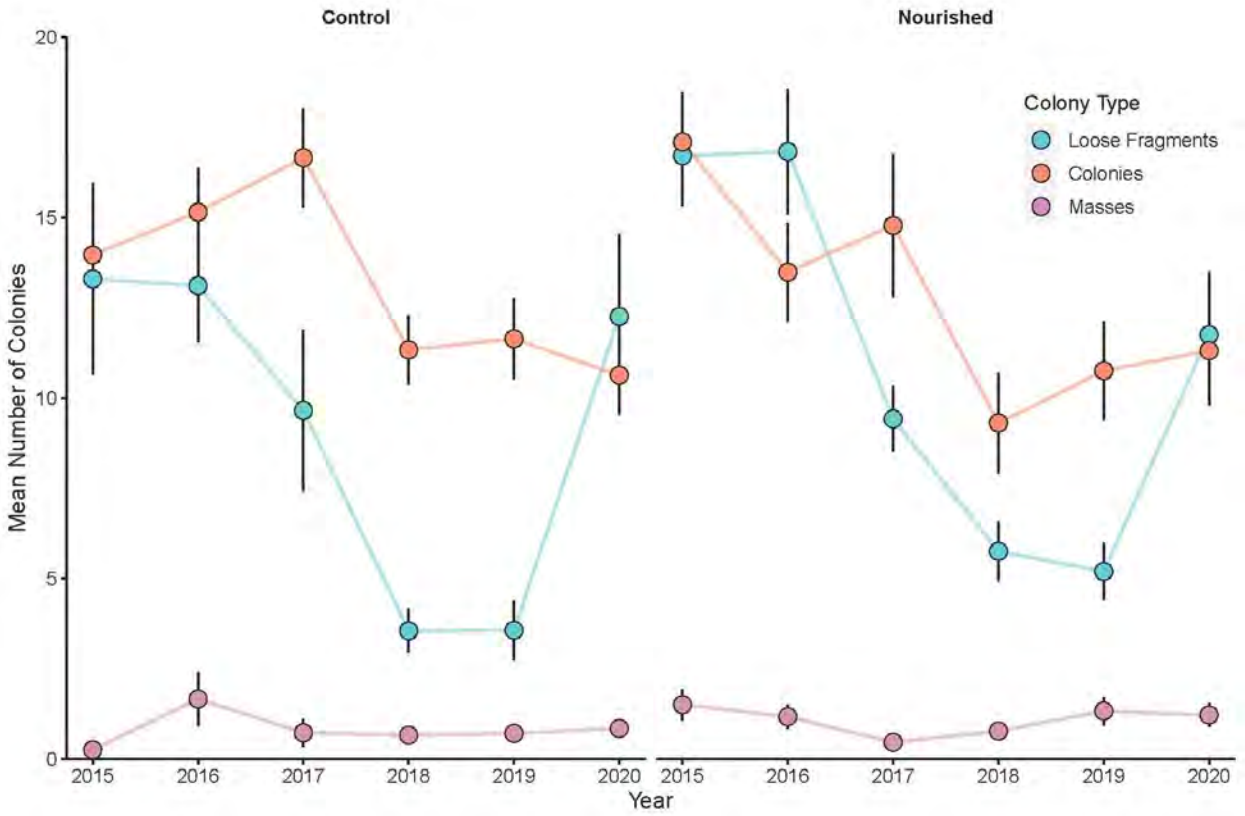

Figure 18. Mean number of *Acropora cervicornis* colonies, masses, and loose fragments observed in control areas (left panel) and areas adjacent to beach nourish activities in 2016 (right panel) plots Broward County (Florida) Segment II Elkhorn (*Acropora palmata*) and Staghorn (*Acropora cervicornis*) Coral Monitoring from 2015 to 2020.

Inventory of Coastal Eco-Group, Inc. (CEG)

ESA listed coral colonies recorded during monitoring efforts associated with beach nourishment project surveys. Projects included Hollywood Beach, Broward County Segment II and III. CEG scientists searched all Broward County project databases, hardbottom edge mapping notes, and transect videos in areas documented to have listed coral colonies for the seven listed corals species. Every listed colony observation from July 18, 2012 to December 16, 2020 is recorded in this shapefile. Individuals colonies can be filtered by using the "RepeatColony" field in the attribute table. Colonies were labeled as "Repeat", "Single Occurrence", or "Last Observation" in order to capture the overall total of individual ESA listed colonies in Broward County. A "Repeat" is defined as a colony that occurred in the same quadrat over multiple years and only the "Last Observation" will be used in overall totals of individuals colonies. Coordinates are located at the beginning of each transect and not in the actual quadrat location on the transect of the coral colony.

Table 4. Presence of ESA-listed coral species at sites monitored for beach nourishment projects in Broward County, FL.

Project	Transect	*Acropora cervicornis*	*Orbicella faveolata*	Date Range Observed
Seg II	P036	1	-	9/9/2020
Seg II	P041	1	1	9/18/200
Seg II	P063	1	-	11/9/2018 - 12/18/2019
Seg II	P065a	5	-	7/22/2015 - 1/27/2020
Seg II	P066	1	-	7/22/2015 - 1/27/2020
Seg II	P067	2	-	7/22/2015
Seg II	HB Edge Mapping	2	-	8/31/2020 and 1/14/2021
Seg III	HB Edge Mapping	1	-	5/6/2020
Hollywood Beach	N110a	2	-	7/20/2012
Hollywood Beach	N121b	14	-	7/18/2012 - 6/29/2015
Hollywood Beach	TS119	4	-	7/18/2012 - 6/26/2015
Hollywood Beach	TS120	4	-	7/18/2012 - 9/2/2014
Hollywood Beach	TS120+700	14	-	7/19/2012 - 8/21/2018
Overall Total	**-**	**52**	**1**	-

Puerto Rico CREMP (PR CREMP)

Data used in the figures below was provided by The Puerto Rico Coral Reef Monitoring Program (Miguel G Figuerola Hernandez, University of Puerto Rico, to Mark Ladd. Nov 24, 2020) and is publicly available at https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.nodc:0204647.

Benthic data collection and description (Directly from from NCEI website): Data files include raw data (by transect) for 86 stations where substrate cover by sessile-benthic categories and fish, and motile megabenthic invertebrate taxonomic composition and densities have been characterized from 1999-2020. At present, 42 permanent stations are surveyed biannually (21 per year). For the benthic characterization, a set of five 10-meter-long permanent transects are surveyed at each station. Sessile-benthic reef communities are characterized by the continuous intercept chain-link method, following the Caribbean Coastal Marine Productivity (CARICOMP) (1994) protocol. The PRCREMP data files also include a site classification spreadsheet with descriptors for each monitoring station, some of which can be used as spatial and temporal factors for statistical analyses. These descriptors include information about depth, habitat type, distance from shore, marine protected areas attributes, coordinates, and other metadata.

Table 5. Number of sites monitored between 2015 and 2020 for the Puerto Rico Coral Reef Monitoring Program (PR CREMP).

Year	***Depth Zone***	***Number of Sites***
2015	Very Shallow	8
2015	Shallow	4
2015	Intermediate	7
2015	Mesophotic	2
2016	Very Shallow	6
2016	Shallow	8
2016	Intermediate	6
2016	Mesophotic	1
2017	Very Shallow	8
2017	Shallow	6
2017	Intermediate	6
2017	Mesophotic	1
2018	Very Shallow	6
2018	Shallow	6
2018	Intermediate	7
2018	Mesophotic	2
2019	Very Shallow	8
2019	Shallow	5
2019	Intermediate	7
2019	Mesophotic	1
2020	Shallow	1
2020	Intermediate	1
2020	Mesophotic	1

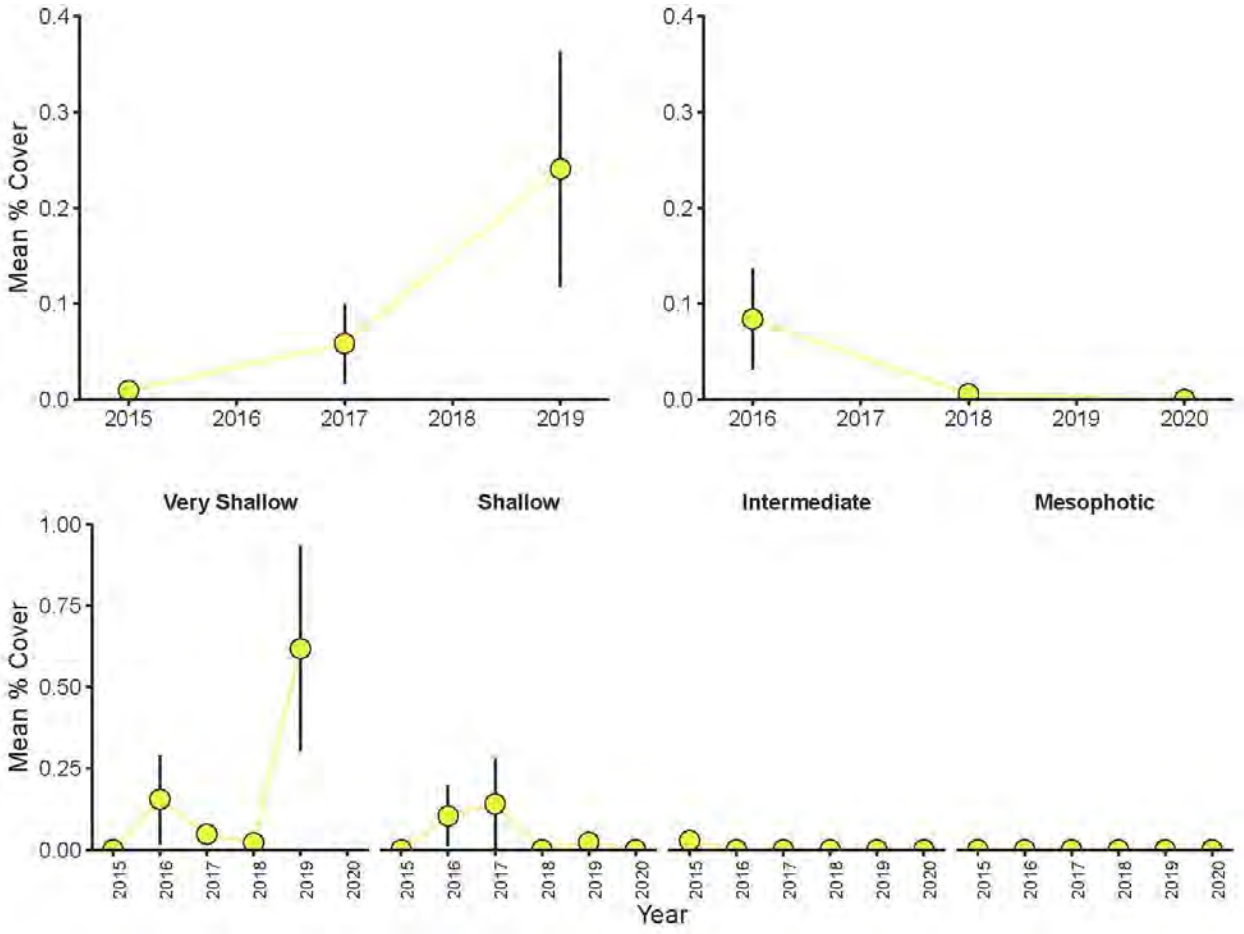

Figure 19. Mean percent cover of *Acropora cervicornis* from 2015 to 2020 at sites monitored by Puerto Rico CREMP. (Top left panel) Mean percent cover of *A. cervicornis* averaged across all transects at sites surveyed by PR CREMP in 2015, 2017, and 2019. (Top right panel) Mean percent cover of *A. cervicornis* averaged across all transects at sites surveyed by PR CREMP in 2016, 2018, and 2020. (21 sites surveyed in 2016 and 2018, only 3 sites included for 2020). (Bottom panels) Mean percent cover of *A. cervicornis* at all sties surveyed by PR CREMP broken down by site depth (21 sites surveyed 2015 to 2019, only 3 sites included for 2020).

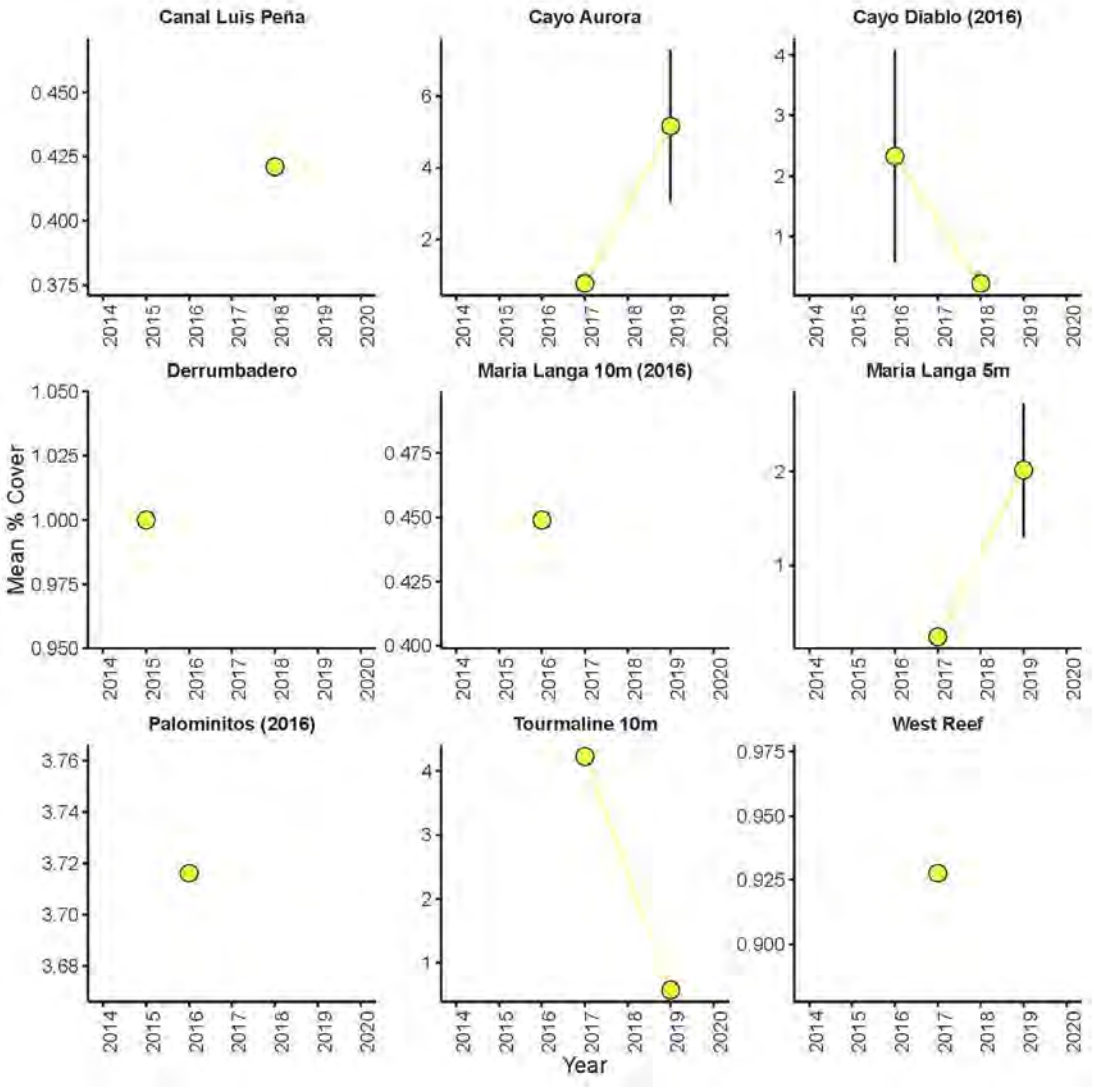

Figure 20. Mean percent cover of *A. cervicornis* at individual sites where *A. cervicornis* was recorded on at least one transect between 2015 and 2019 in PR CREMP surveys. For bottom panels data are only presented for years when *A. cervicornis* was present. Note different y-axis values for each plot. Data presented are means ±SE. 21 sites were surveyed from 2015 to 2019, only data from 3 sites was provided for 2020.

Puerto Rico FEMA surveys

Monitoring was conducted in coral reef habitat at six subregions of Puerto Rico in 2018. These surveys were conducted in March of 2018, following Hurricane Irma, which affected the area in the fall of 2017. Two types of surveys were conducted to collect two types of data: (1) presence-absence data and (2) density data. Both presence-absence and density data were collected via a combination of roving diver surveys and transect surveys. The total number of surveys conducted in 2018 within each subregion of Puerto Rico is provided in the table below. Density surveys were conducted at a subset of sites where presence-absence surveys were conducted. The area covered by roving diver surveys ranged from 157 m^2 to 1,702 m^2, whereas transect areas ranged from 50 m^2 to 1000 m^2.

Table 6. Number of surveys conducted in Puerto Rico in 2018 broken down by Subregion, roving surveys, and transects surveys.

Survey Type	Subregion	Roving surveys	Transect surveys	Total surveys
Presence - Absence Surveys	North	11	9	20
Presence - Absence Surveys	Northeast	52	57	109
Presence - Absence Surveys	Southeast	8	7	15
Presence - Absence Surveys	Southwest	14	10	24
Presence - Absence Surveys	West	16	12	28
Presence - Absence Surveys	Vieques	19	18	37
Presence - Absence Surveys	**Total**	**120**	**113**	**233**
Density Surveys	North	11	9	20
Density Surveys	Northeast	52	56	108
Density Surveys	Southeast	8	7	15
Density Surveys	Southwest	14	10	24
Density Surveys	West	15	12	27
Density Surveys	Vieques	19	18	37
Density Surveys	**Total**	**119**	**112**	**231**

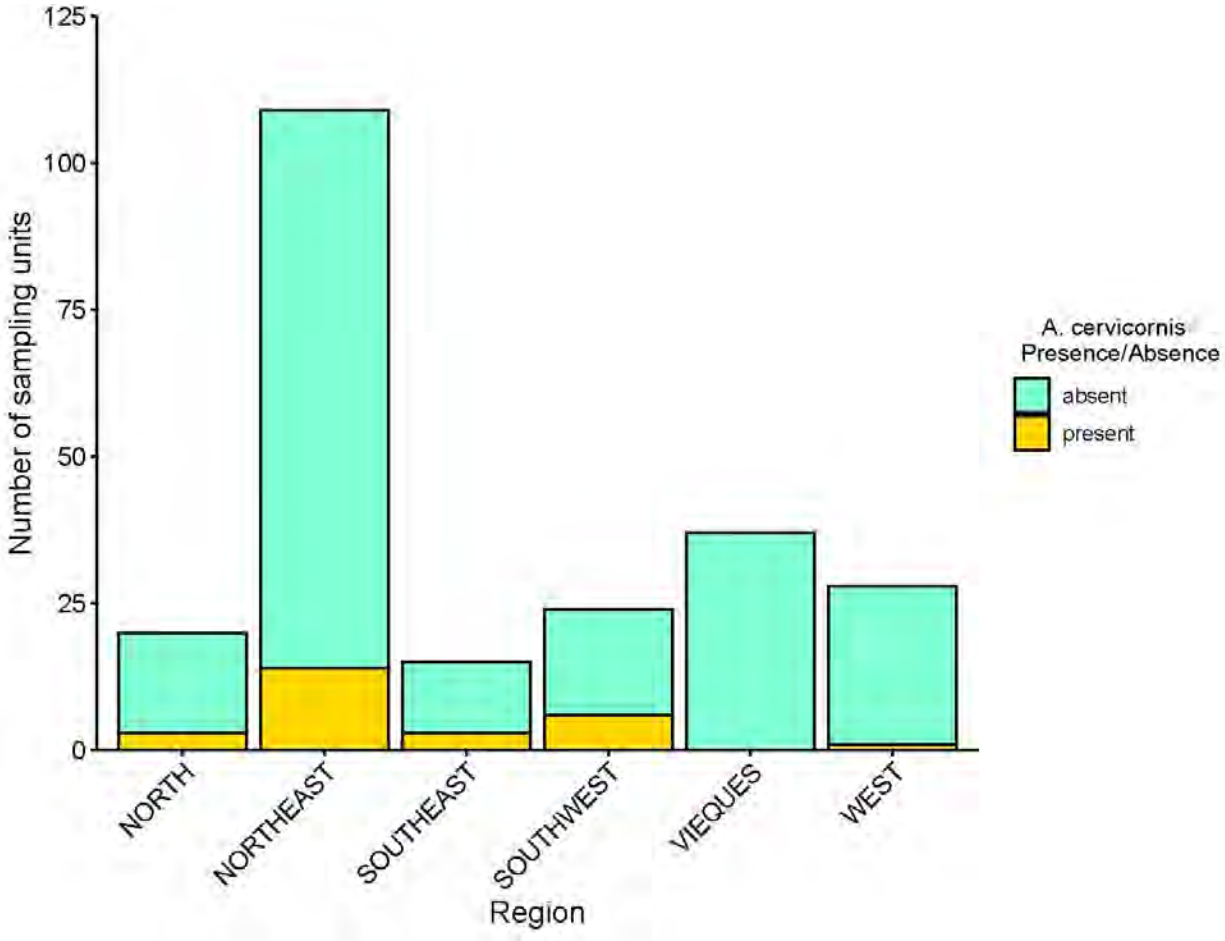

Figure 21. Number of surveys where *Acropora cervicornis* was present (gold) or absent (teal) in each subregion of Puerto Rico. Surveys were conducted in March of 2018 and were a mix of transect and roving diver surveys.

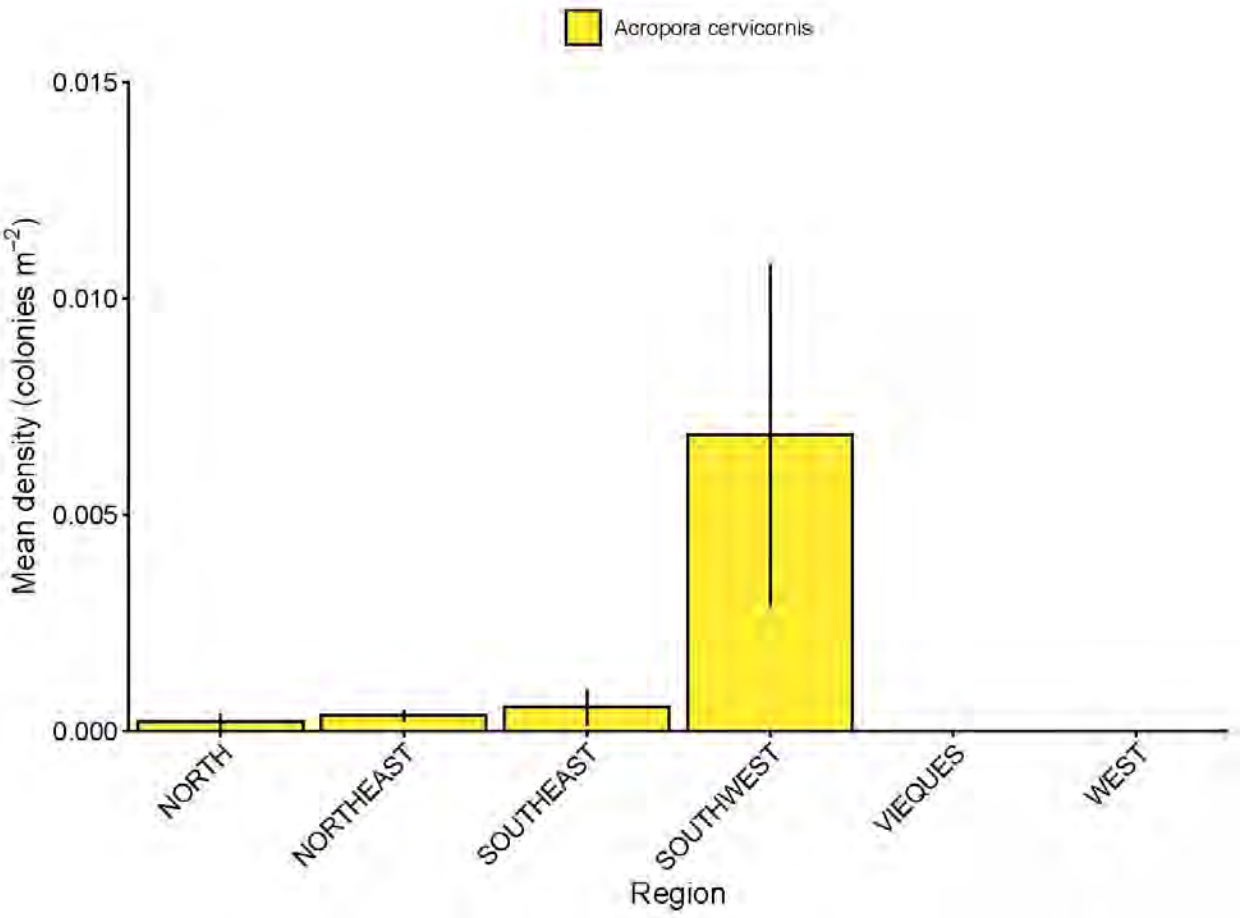

Figure 22. Density of *Acropora cervicornis* colonies (corals m^{-2}*)* in each subregion of Puerto Rico. Surveys were conducted in March of 2018 and were a mix of transect and roving diver surveys.

US Virgin Islands CREMP

Benthic cover data collection and description from website**:** At each site, benthic cover surveys are conducted annually along six 10 m long permanent transects marked with steel or brass rods. Video sampling consists of one diver traversing each transect videotaping the benthic cover using a high definition digital video recorder. After taping, images from each transect are captured and imported into RStudio where twenty randomly allocated points are superimposed on each image. Analysis consists of identifying the substrate located under each point. For each transect, the percent cover of coral, epilithic algae (EAC), macroalgae, sponges, gorgonians, and sand/sediment are calculated by dividing the number of random dots falling on that substrate type by the total number of dots for that transect.

The USVI CREMP program monitors 34 sites. However, not all sites were surveyed each year. Number of sites surveyed for each year included in this review were: 2015: n = 33; 2016: n = 32; 2017: n = 11; 2018: n = 34; 2019: n = 33; 2020: n = 19. In 2018 and 2019 some sites were surveyed twice in one year and thus there are 12 instead of 6 transects total for those sites.

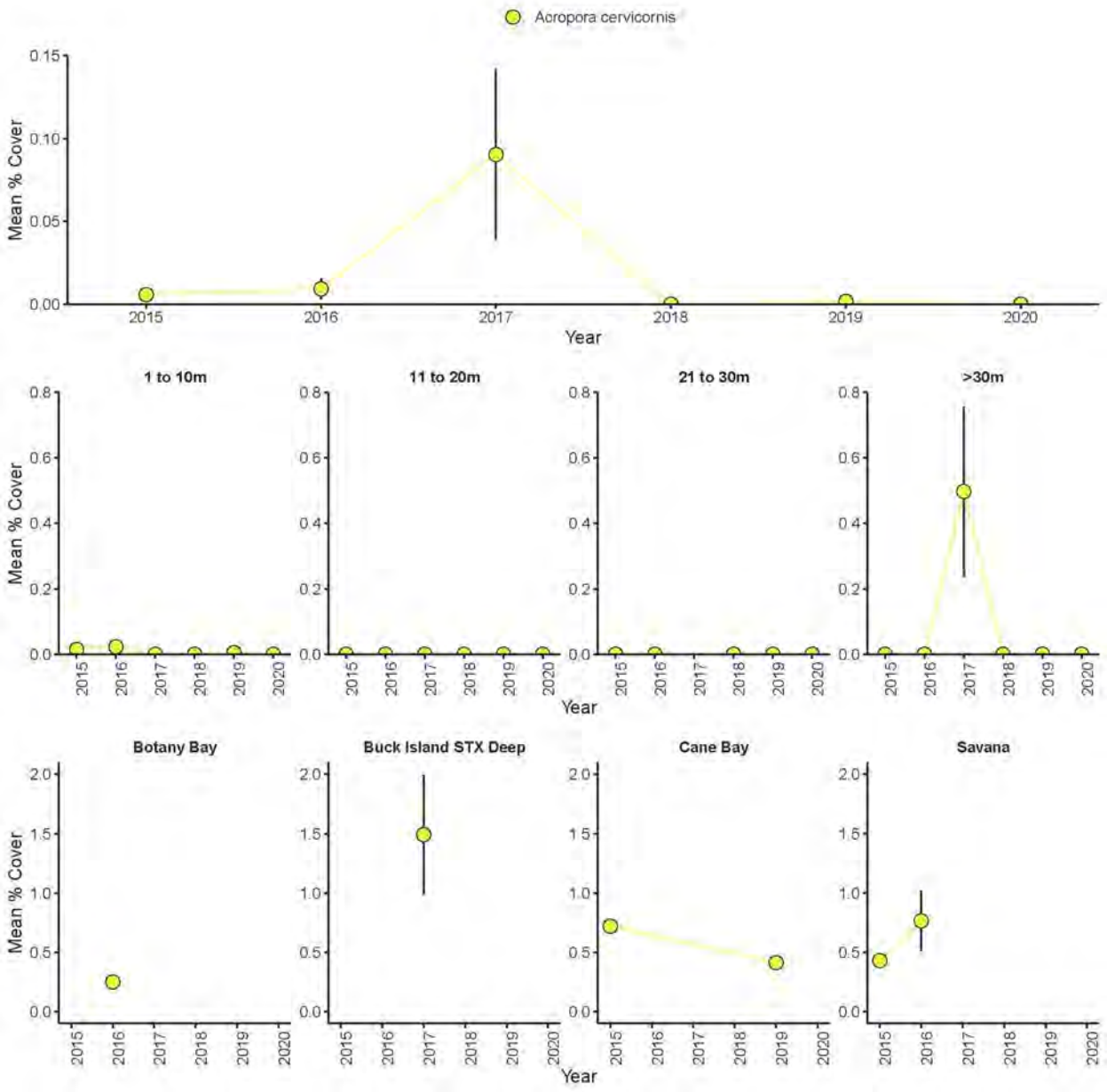

Figure 23. Mean percent cover of *Acropora cervicornis* from 2015 to 2020 at sites monitored by USVI CREMP. (Top panel) Mean percent cover of *A. cervicornis* averaged across all transects at sites surveyed by USVI CREMP (range: 11 to 34 sites per year). (Middle panels) Mean percent cover of *A. cervicornis* at all sties surveyed by USVI CREMP broken down by site depth. (Bottom panels) Mean percent cover of *A. cervicornis* at individual sites where *A. cervicornis* was recorded on at least one transect between 2015 and 2019. For bottom panels data is only presented for years when *A. cervicornis* was present. Note different y-axis values for each plot. Data presented are means ±SE.

Puerto Rico Department of Natural and Environmental Resources (PR DNER)

Data was obtained from the ESA Coral Database provided data for surveys conducted by the PR DNER a twelve reef sites in 2017. *Acropora cervicornis* was recorded on transects at three of the twelve sites. Note the number after the site names in the figure below represents the depth of the site (in meters).

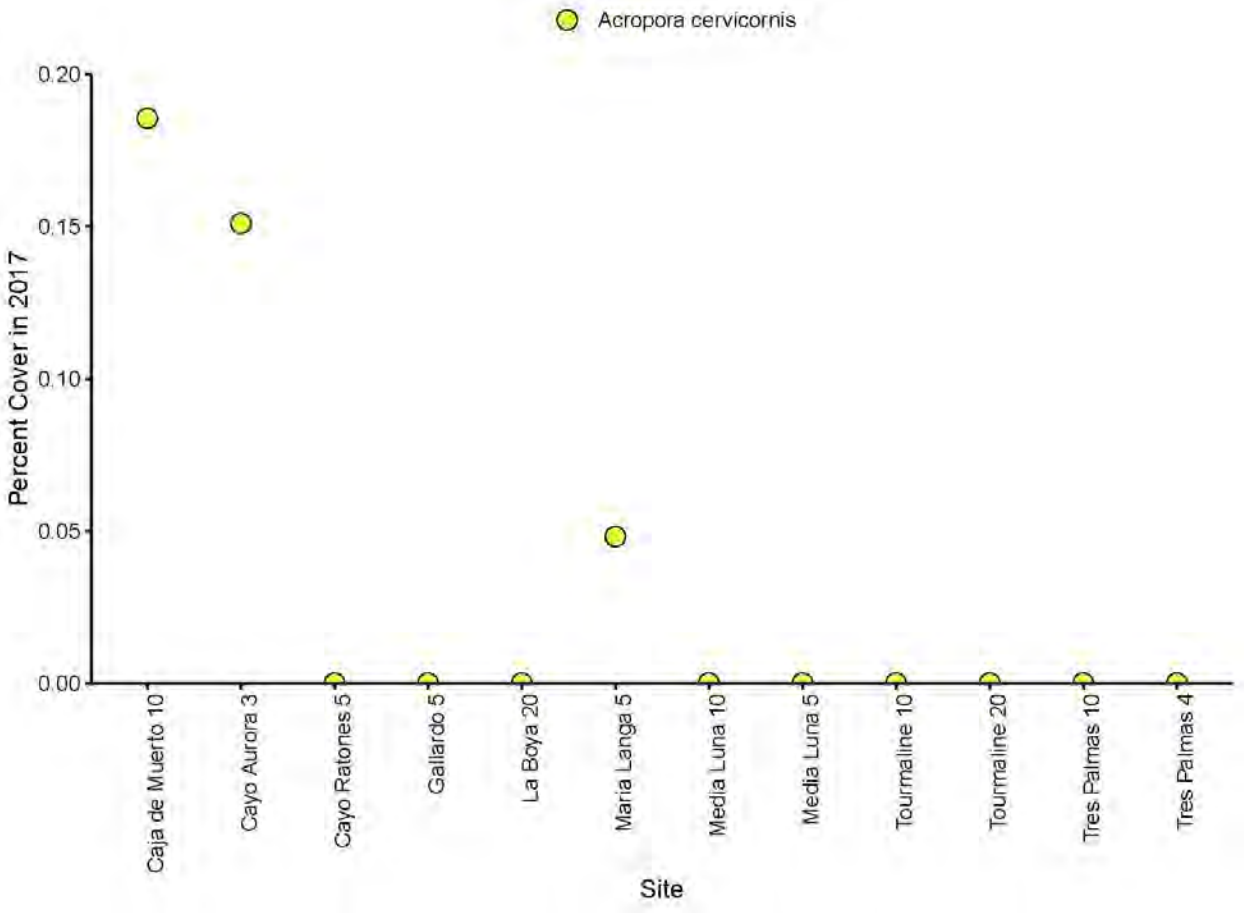

Figure 24. Data from the ESA Coral Database for surveys conducted by the PR DNER at twelve reef sites in 2017. *Acropora cervicornis* was recorded on transects at three of the twelve sites.

Acropora palmata

Table 7. Information on the data sources used to create the figures within this document for the *Acropora palmata* 5 Year Status Review.

DATA SOURCE	LOCATION(S)	YEARS INCLUDED	DATA TYPE(S)
Coral Reef Evaluation and Monitoring Project (CREMP)	Florida Keys, Dry Tortugas	2014 - 2020	Percent cover, abundance, density, Live Tissue Area
Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP)	Southeast Florida	2014 - 2019	Percent cover, abundance, density, Live Tissue Area
Puerto Rico Coral Reef Monitoring Program (PR CRMP)	Puerto Rico	2014 – 2020	Percent cover
Puerto Rico FEMA monitoring	Puerto Rico	2018	Presence absence, density
US Virgin Island Coral Reef Monitoring Program (USVI CRMP)	U.S. Virgin Islands	2014 – 2020	Percent cover
Florida Reef Resilience Program's Disturbance Response Monitoring (FRRP DRM)	Southeast Florida, Florida Keys, Dry Tortugas	2014 -2019	Abundance, density, size, mortality
National Coral Reef Monitoring Program (NCRMP)	Southeast Florida, Florida Keys, Dry Tortugas, U.S. Virgin Islands, Puerto Rico	2014-2020	Percent cover, density
Puerto Rico Department of Natural and Environmental Resources (PR DNER)	Puerto Rico	2017	Percent cover
NOAA Fisheries - SEFSC *Acropora palmata* population monitoring	Upper Florida Keys	2004 - 2019	Live Area Index

OTHER DATA FROM THE ESA CORAL DATABASE FILE

*The ESA Coral Database file included 1,385 entries for *Acropora palmata* between 2014 and 2020. They were:

1. SCREAM data on presence/absence (58 observations) - 2014 only

2. "Various, see data" data from 2014, 2015, 2016, 2017 and 2018 - 103 observations of "present only data" of outplanted corals

Coral Reef Evaluation and Monitoring Project (CREMP) and the Southeast Coral Reef Evaluation and Monitoring Project (SECREMP)

The data used to generate **Figure 25** through **Figure 28** (below) were provided by Florida's Coral Reef Evaluation and Monitoring Project (CREMP) and SECREMP (pers. comm., Mike Colella, Florida Fish and Wildlife Conservation Commission (FWC), to Alison Moulding, Aug. 27, 2020). CREMP in the Florida Keys is funded through the EPA South Florida Water Quality Protection Program and CREMP in the Dry Tortugas is funded through the National Park Service. Both Florida Keys and Dry Tortugas surveys were completed by the Coral Program at the FWC Fish and Wildlife Research Institute (FWRI). SECREMP data is credited to Florida Department of Environmental Protection (FDEP) Coral Reef Conservation Program and Dr. David Gilliam's lab at the National Coral Reef Institute (NCRI) and Nova Southeastern University (NSU).

CREMP and SECREMP surveys were conducted annually in permanent transects across sites (n=4 transects per site) in three regions of Florida: Dry Tortugas (DT), Florida Keys (FL Keys), and Southeast Florida (SE FL) north of the Florida Keys (see Table below for number of sites within each region). This sampling scheme includes eight sites that are located at monospecific coral stands or special habitat areas for the coral species in this status review. Thus, data from these eight sites (DT n = 4 sites, FL Keys n = 3 sites; SE FL n = 1 site) were excluded from the general CREMP data analyses and are presented as separate figures (**Figures 26**, **28**, and **30**). The figures below display Florida-wide, regional and site-specific trends in mean percent coral cover, total or mean live coral area, and total colony counts by species between 2014 and 2019 from CREMP and SECREMP survey data. For these figures means were calculated by using transect as a replicate (n = 260 per year, except for 2017, where n = 258 transects).

Table 8. Number of sites surveyed annually by CREMP and SECREMP programs.

Region	Number of Sites	Number of monospecific or special habitat area sites
Southeast Florida (SE FL)	21	1
Florida Keys	37	3
Dry Tortugas	7	4

CREMP and SECREMP monitoring data summary

Acropora palmata was observed on transects conducted at five sites in the Florida Keys region during CREMP and SECREMP surveys that took place from 2014 to 2019.

PERCENT COVER: Percent cover of *Acropora palmata* on average declined from 2014 to 2019 (**Figure 25**). In 2014, the mean percent cover of *A. palmata* across all 260 transects surveyed was 0.085% ± 0.04 (mean ±SE) and decreased to 0.018% ± 0.01 in 2019. In the Florida Keys, the only region where *A. palmata* was observed on any transects (n = 148 surveyed per year), mean percent cover decreased from 0.15% ± 0.07 in 2014 to 0.03% ± 0.02 in 2019. *Acropora palmata* was observed at a single monotypic/special habitat site: "Palmata Patch", located in the Dry Tortugas region. Mean percent cover of *A. palmata* at this site was relatively stable between 2014 and 2019, ranging from a high of 8.05% ± 6.3 in 2014 to a low of 5.08% ± 4.6 in 2018 (**Figure 26**).

LIVE TISSUE AREA: The total amount of live tissue area of *A. palmata* (estimated area; m^2) on all transects conducted by CREMP and SECREMP was highest in 2015, when an estimated total of 57.37 m^2 was recorded (**Figure 27**), and was relatively consistent from 2014 to 2016 (range: 57.37 to 46.40 m^2). A four-fold decline in total live tissue area of *A. palmata* was observed from 2016 to 2017. After 2017 total live tissue area of *A. palmata* further declined, with only 0.05m^2 observed on transects conducted in 2019. Patterns of live tissue area at the single monotypic sites where *A. palmata* was recorded (Palmata Patch) displayed very different patterns from the main CREMP and SECREMP sites (**Figure 28**). At this site, the total live tissue area of *A. palmata* remained relatively consistent from 2014 to 2019, (27.7 m^2 vs. 20.0 m^2), with the highest value recorded in 2014 and the lowest value recorded in 2018 (16.3 m^2).

DENSITY: The mean density of *A. palmata* on transects surveyed by CREMP and SECREMP decreased by an order of magnitude from 2014 to 2019 (0.004 ± 0.002 colonies m^{-2} vs. 0.0004 ± 0.0004 colonies m^{-2}; **Figure 29**). Similar to patterns in live tissue area, patterns of *A. palmata* density at monotypic and special habitat sites were very different from the main sites (**Figure 30**). At Palmata Patch, the only monotypic/special habitat site where *A. palmata* was observed on transects conducted between 2014 and 2019, mean *A. palmata* density increased from 1.25 ± 1.15 colonies m^{-2} in 2014 to 2.20 colonies m^{-2} in 2019.

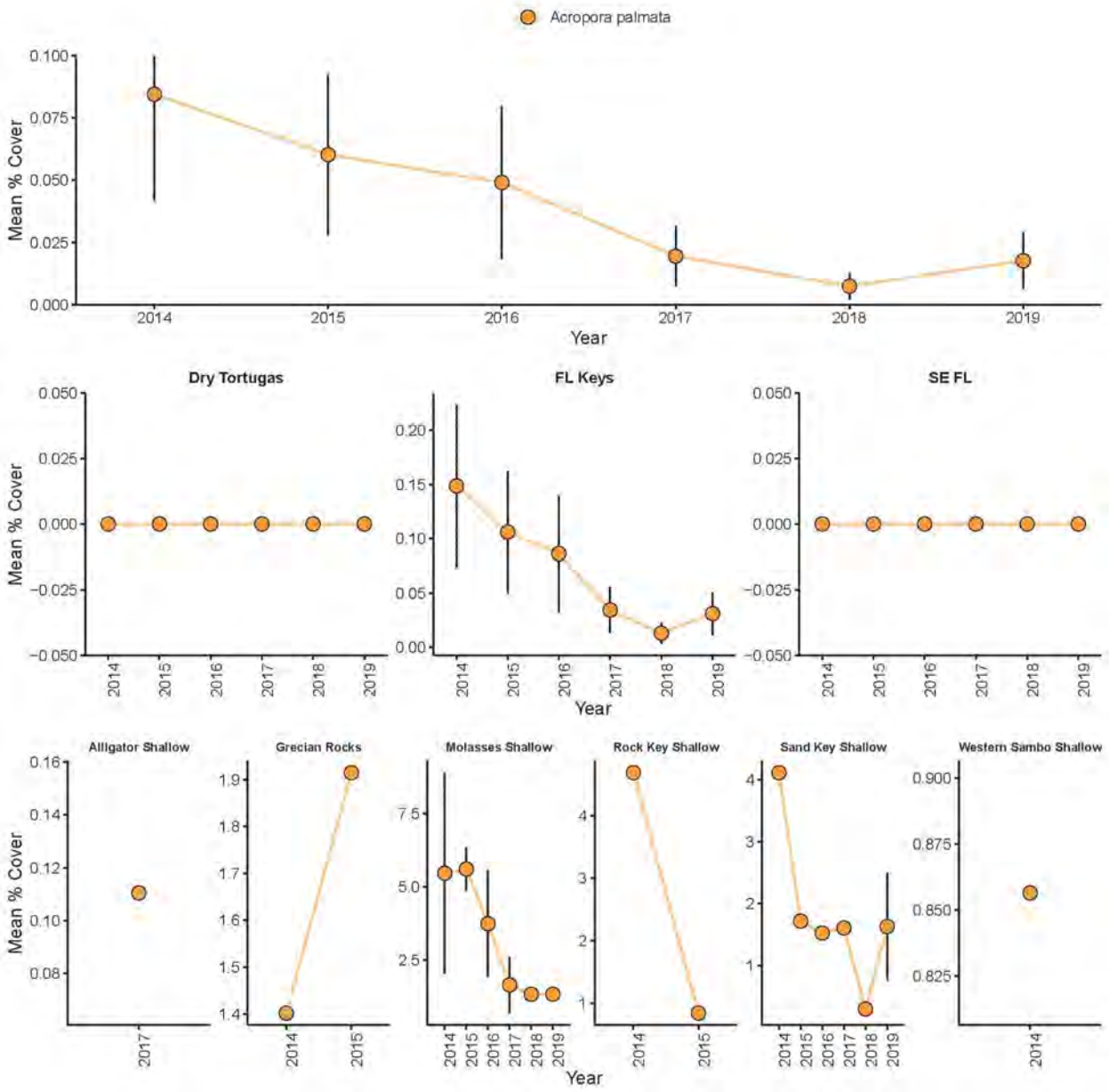

Figure 25. Mean percent cover of *Acropora palmata* from 2014 to 2019: Florida-wide, regional, and individual site patterns. (Top panel) Mean percent cover of *A. palmata* averaged across all transects conducted at Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites). (Middle panels) Mean percent cover of *A. palmata* for each region surveyed by CREMP (DT = 7 sites; FL Keys = 37 sites; SE FL = 21 sites). (Bottom panels) Mean percent cover of *A. palmata* on transects conducted at any Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites) where *A. palmata* was recorded on at least one transect between 2014 – 2019. Data presented are means ±SE. Note different y-axis values for each plot.

Figure 26. Mean percent cover of *Acropora palmata* from 2014 to 2019: monotypic and special habitat sites. Mean percent cover of *A. palmata* averaged across all transects conducted at "Palmata Patch", the only monotypic and special habitat site that this species was observed on any transects during surveys conducted from 2014 to 2019. Data presented are means ±SE.

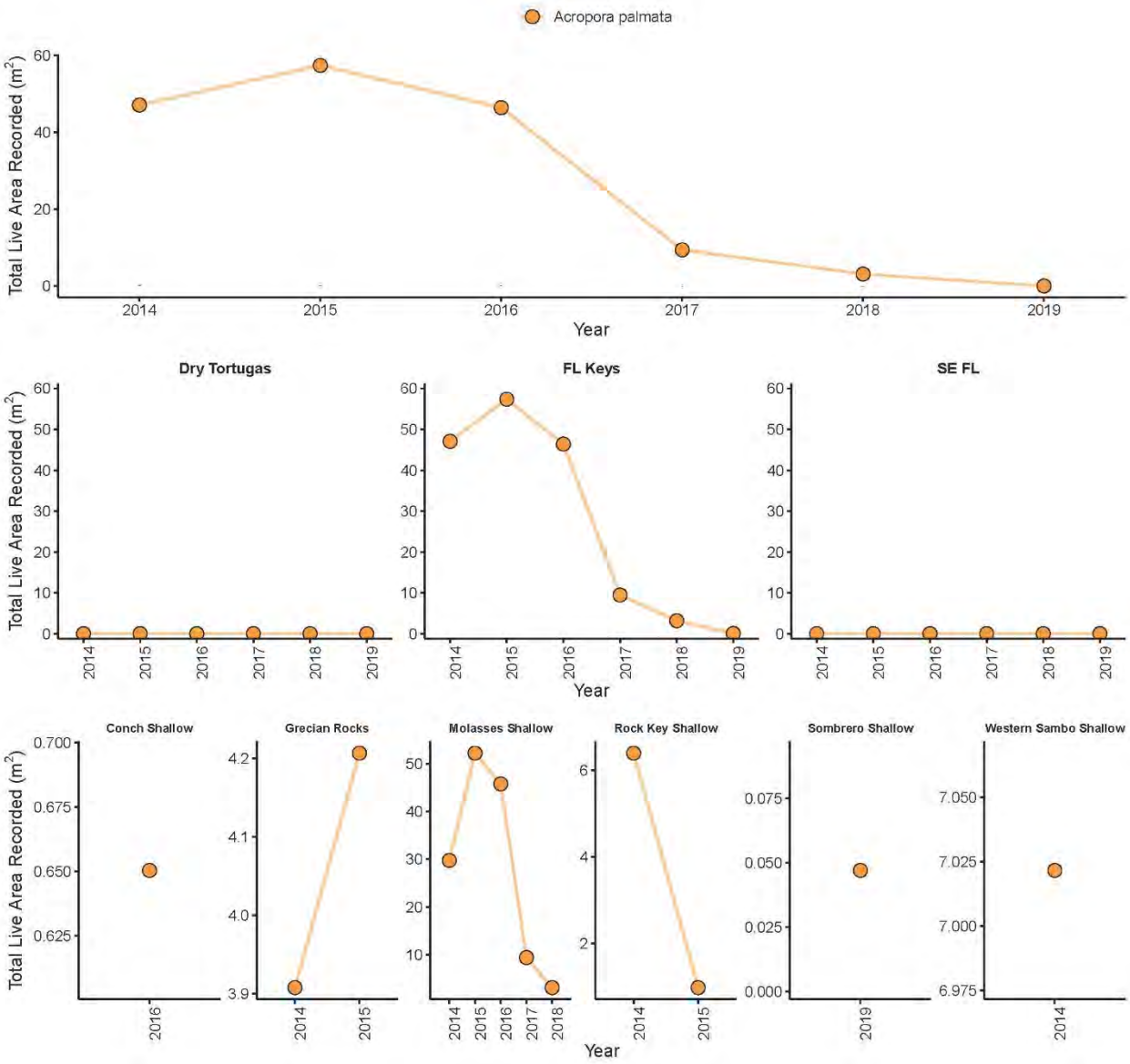

Figure 27. Total live area (m^2) of *Acropora palmata* from 2014 to 2019: Florida-wide, regional, and individual site patterns. (Top panel) Total live area (m^2) of *A. palmata* summed across all transects conducted at Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites). (Middle panels) Total live area (m^2) of *A. palmata* for each region surveyed by CREMP (DT = 7 sites; FL Keys = 37 sites; SE FL = 21 sites). (Bottom panels) Total live area (m^2) of *A. palmata* at any Florida coral reef site surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites) where *A. palmata* was recorded on at least one transect between 2014 – 2019. Note different y-axis values for each plot.

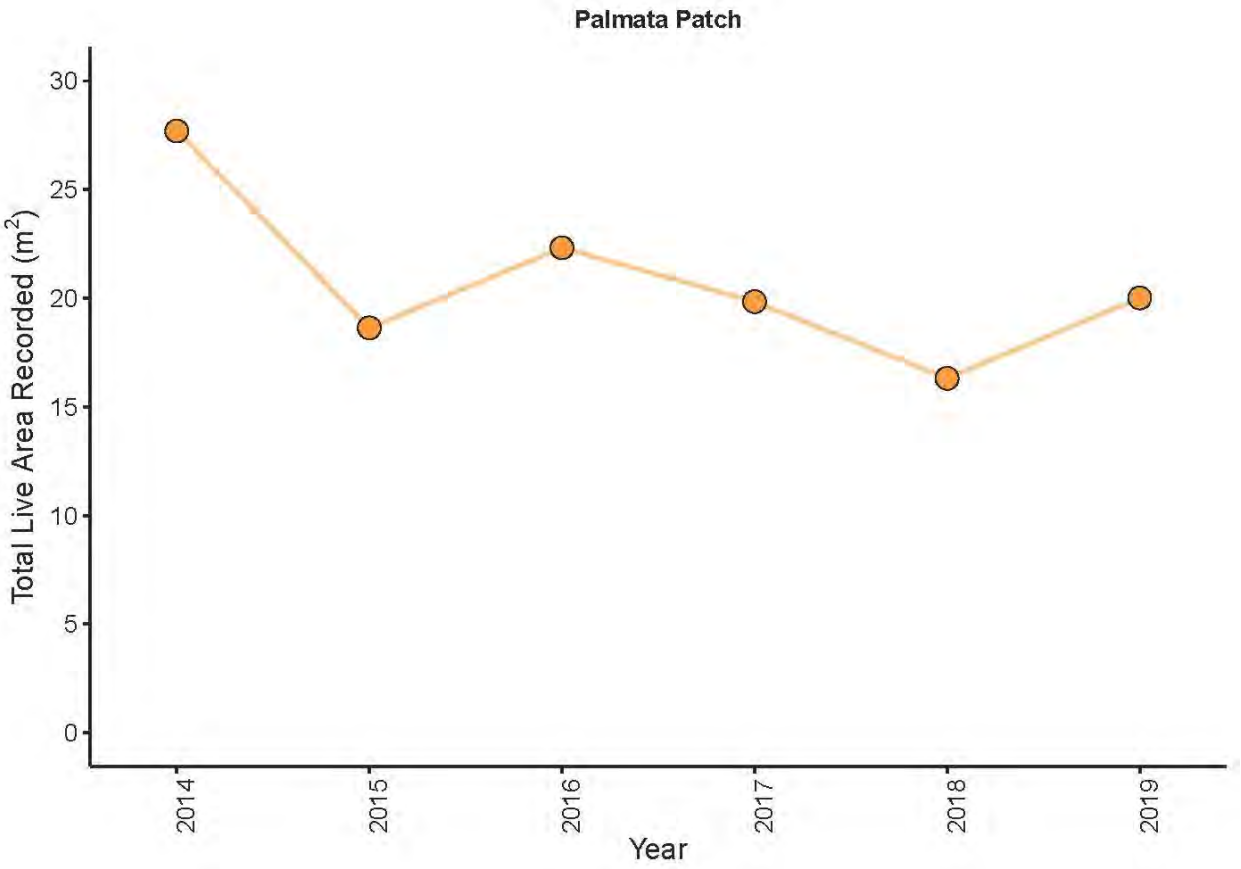

Figure 28. Total live area (m^2) of *Acropora palmata* from 2014 to 2019: monotypic and special habitat sites. Total live area (m^2) of *A. palmata* averaged across all transects conducted at "Palmata Patch", the only monotypic and special habitat site that this species was observed on any transects during surveys conducted from 2014 to 2019. Data presented are means ±SE.

Figure 29. Mean density of *Acropora palmata* colonies from 2014 to 2019: Florida-wide, regional, and individual site patterns. (Top panel) Mean density (colonies m^{-2}) of *A. palmata* colonies averaged across all transects conducted at Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites). (Middle panels) Mean density (colonies m^{-2}) of *A. palmata* colonies for each region surveyed by CREMP and SECREMP (DT = 7 sites; FL Keys = 37 sites; SE FL = 21 sites). (Bottom panels) Mean density (colonies m^{-2}) of *A. palmata* colonies on transects at any Florida coral reef site surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites) where *A. palmata* was recorded on at least one transect between 2014 – 2019. Data presented are means ±SE. Note different y-axis values for each plot.

Figure 30. Mean density (colonies m^{-2}) of *Acropora palmata* colonies from 2014 to 2019: monotypic and special habitat sites. Mean density (colonies m^{-2}) of *A. palmata* averaged across all transects conducted at "Palmata Patch", the only monotypic and special habitat site that this species was observed on any transects during surveys conducted from 2014 to 2019. Data presented are means ±SE.

National Coral Reef Monitoring Program (NCRMP) and the Florida Reef Resilience Program (FRRP) Disturbance Response Monitoring (DRM)

The National Coral Reef Monitoring Program (NCRMP) provides a biennial ecological characterization at a broad spatial scale of general reef condition for reef fishes, corals and benthic habitat (i.e., fish species composition/density/size, benthic cover, and coral density/size/condition). Data collection occurs at stratified random sites where the sampling domain for each region (e.g., Florida, Puerto Rico, U.S. Virgin Islands, Flower Garden Banks National Marine Sanctuary [FGBNMS]) is partitioned by habitat type and depth, sub-regional location (e.g., along-shelf position) and management zone.

The FRRP DRM uses a stratified random sampling design and focuses on bleaching species in <60 ft of water. Two $10m^2$ belt transects (1m width x 10m length) were completed at each site for a total of $20m^2$ surveyed at each site. Because NCRMP and DRM sampling overlaps in the geographic regions they survey and both employ a stratified random sampling design, density, percent cover and coral colony measures (maximum diameter, height, and percent partial mortality) data for these two surveys were combined and presented together.

Table 9. Number of surveys conducted by NCRMP and DRM monitoring programs each year from 2014 to 2020 broken down by each region surveyed. SE FL = Southeast Florida, STTSTJ = St. Thomas and St. John, STX = St. Croix.*In 2018 NCRMP and DRM surveys were conducted together and were not provided as individual data sets.

Year	Region	Survey	No. Surveys		Year	Region	Survey	No. Surveys
2014	Dry Tortugas	DRM	29		2017	Dry Tortugas	DRM	31
2014	Dry Tortugas	NCRMP	105		2017	FL Keys	DRM	18
2014	FL Keys	DRM	86		2017	SE FL	DRM	23
2014	FL Keys	NCRMP	314		2017	STTSTJ	NCRMP	230
2014	SE FL	DRM	41		2017	STX	NCRMP	171
2014	SE FL	NCRMP	49		2018	Dry Tortugas	NCRMP/ DRM*	139
2014	Puerto Rico	NCRMP	103		2018	FL Keys	DRM	95
2015	Dry Tortugas	DRM	20		2018	FL Keys	NCRMP	86
2015	FL Keys	DRM	129		2018	SE FL	DRM	50
2015	SE FL	DRM	100		2018	SE FL	NCRMP	70
2015	STTSTJ	NCRMP	162		2019	Dry Tortugas	DRM	79
2015	STX	NCRMP	133		2019	FL Keys	DRM	123
2016	Dry Tortugas	DRM	29		2019	SE FL	DRM	81
2016	Dry Tortugas	NCRMP	97		2019	Puerto Rico	NCRMP	147
2016	FL Keys	DRM	107		2019	STTSTJ	NCRMP	221
2016	FL Keys	NCRMP	92		2019	STX	NCRMP	245
2016	SE FL	DRM	48		2020	Dry Tortugas	DRM	108
2016	SE FL	NCRMP	93		2020	FL Keys	DRM	165
2016	Puerto Rico	NCRMP	157		2020	SE FL	DRM	116

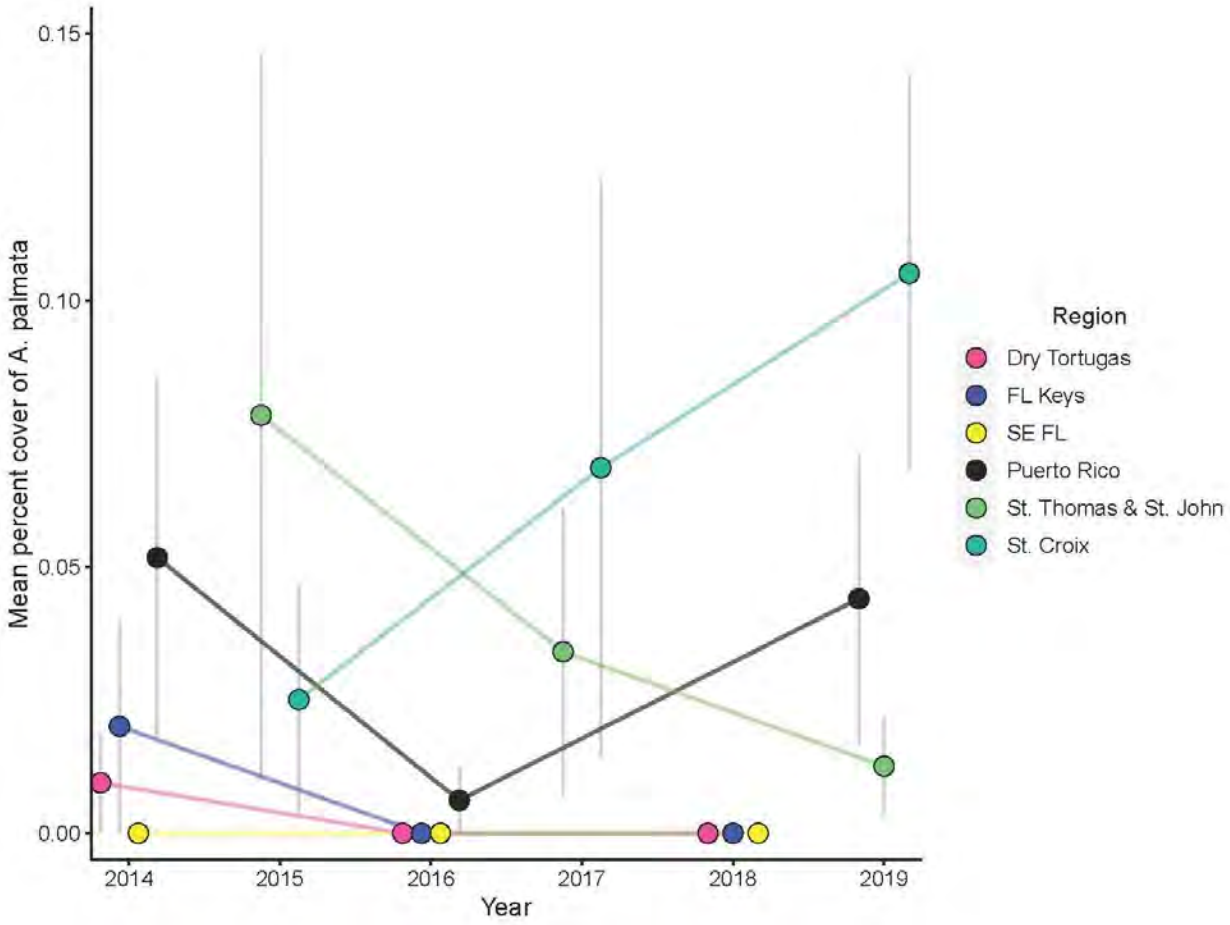

Figure 31. Mean percent cover of *Acropora palmata* for each region surveyed by NCRMP (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

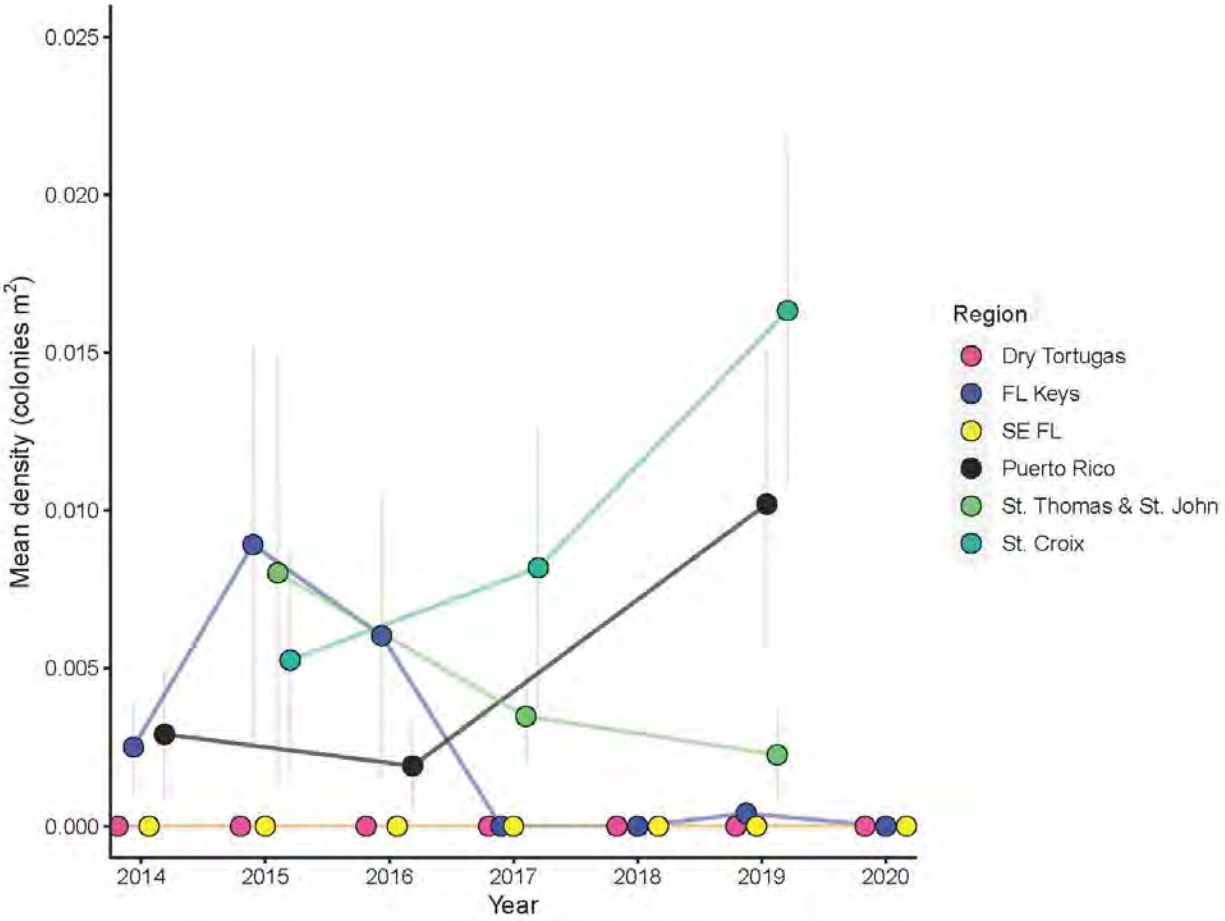

Figure 32. Mean density (colonies m^{-2}) of *Acropora palmata* colonies for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

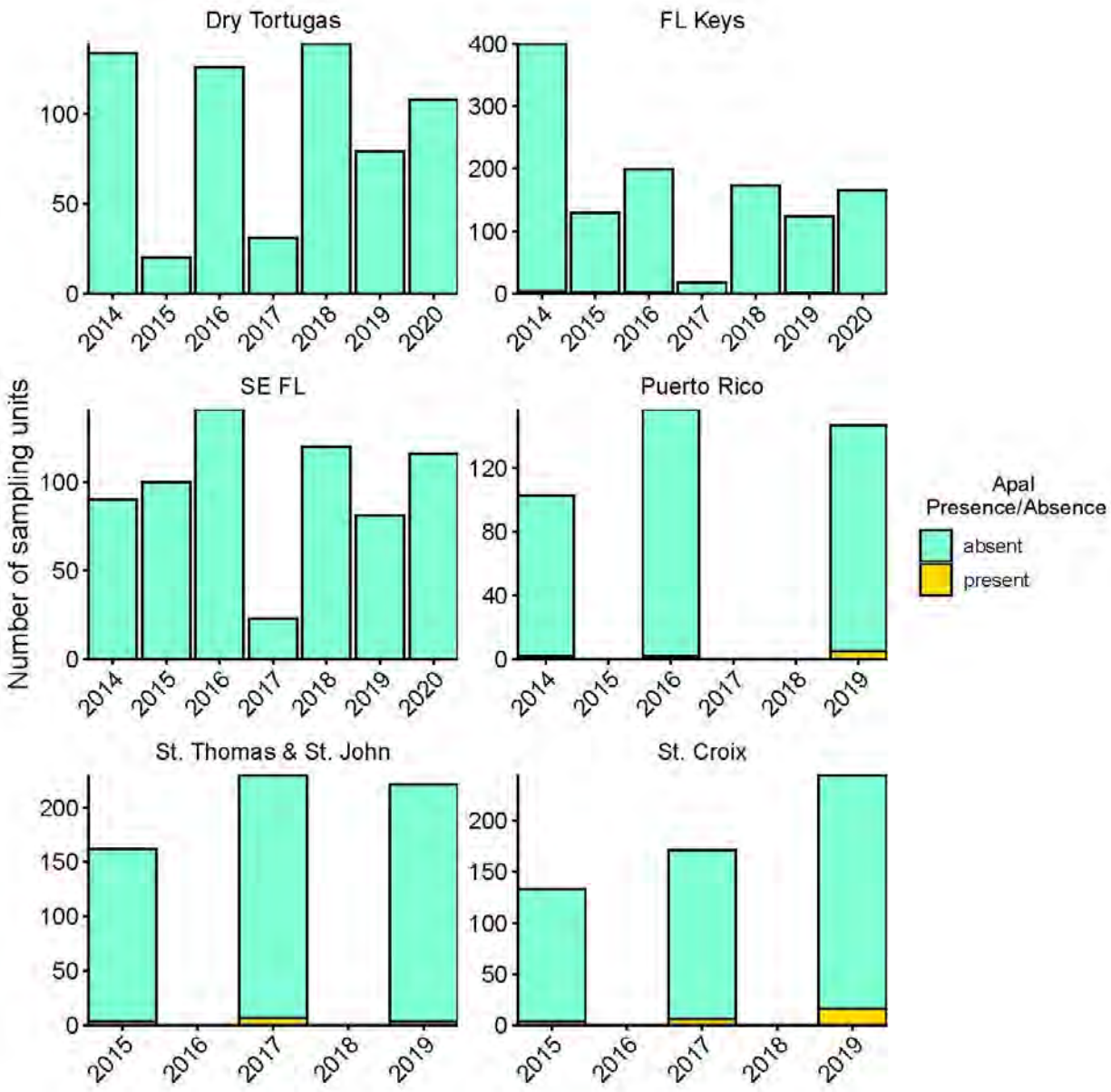

Figure 33. Number of sites where *Acropora palmata* was observed (gold) or absent (teal) for each year and region surveyed by NCRMP and DRM from 2014 to 2020.

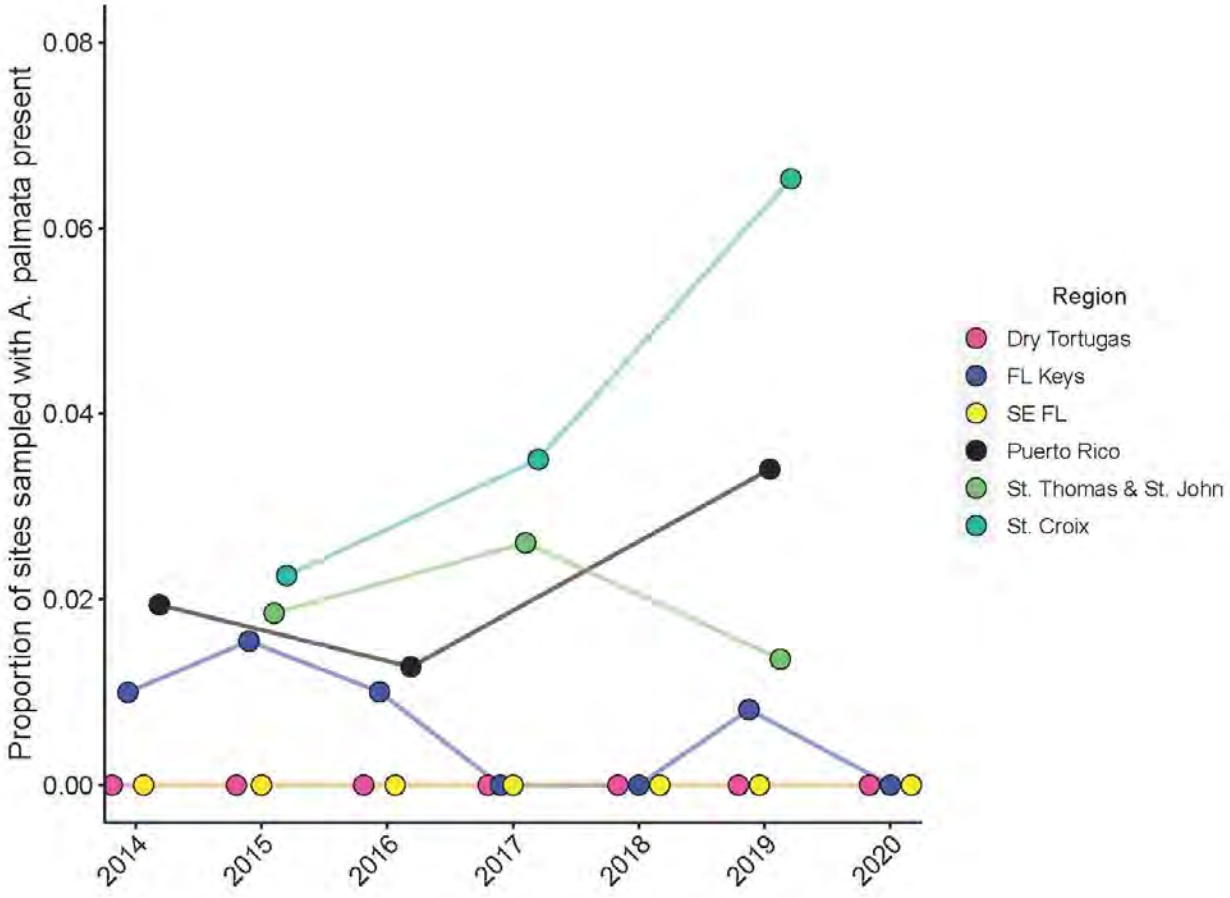

Figure 34. Proportion of all sites surveyed where *Acropora palmata* was present for each year and region surveyed by NCRMP and DRM from 2014 to 2020.

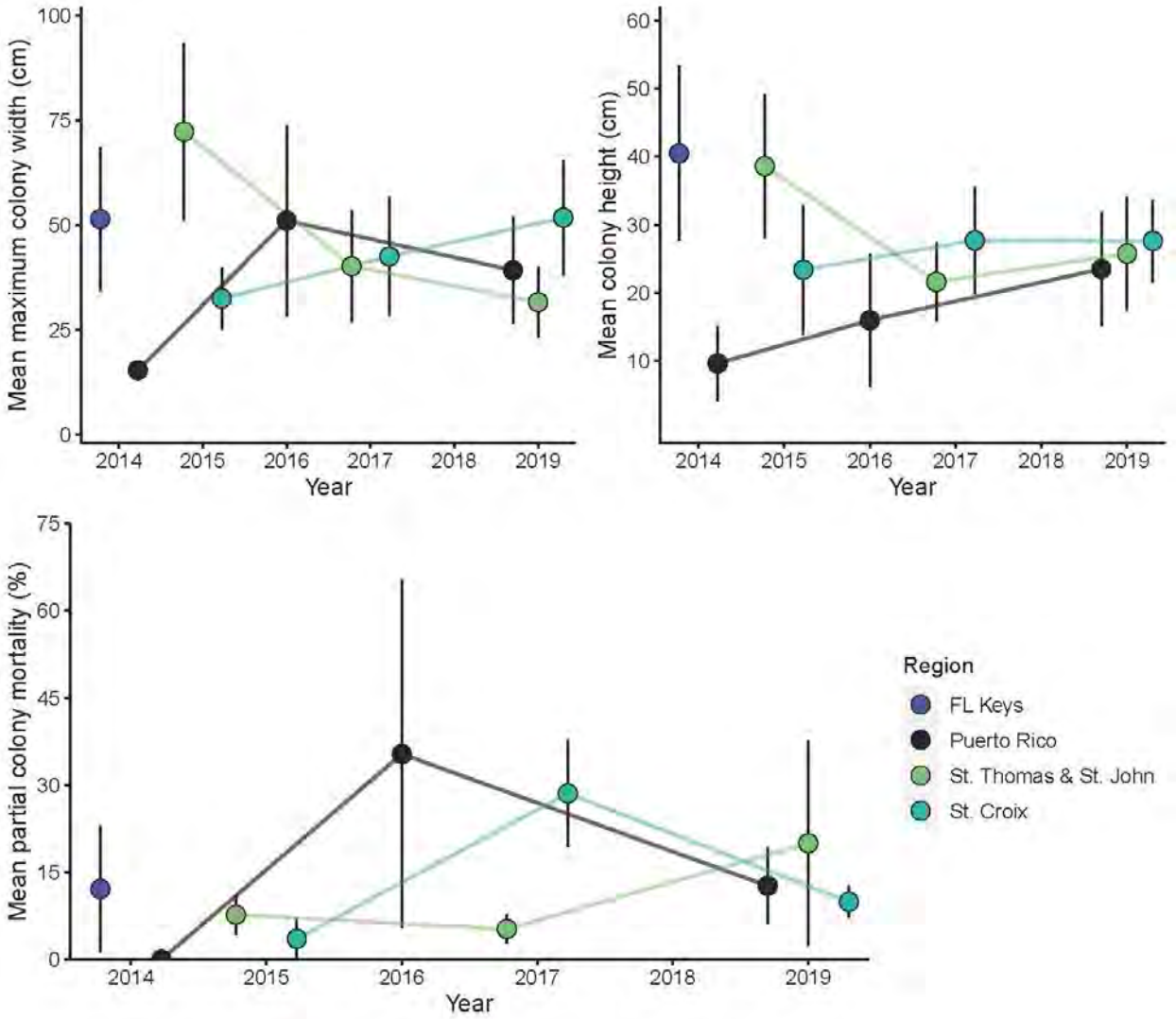

Figure 35. (Top Left) Mean maximum diameter (cm), (Top Right) mean height (cm), and (Bottom) mean partial colony mortality (%) of *Acropora palmata* colonies surveyed on each transect for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

Puerto Rico CREMP (PR CREMP)

Data used in the figures below was provided by The Puerto Rico Coral Reef Monitoring Program (Miguel G Figuerola Hernandez, University of Puerto Rico, to Mark Ladd. Nov 24, 2020) and is publicly available at https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.nodc:0204647.

Benthic data collection and description (Copied from NCEI website): Data files include raw data (by transect) for 86 stations where substrate cover by sessile-benthic categories and fish, and motile megabenthic invertebrate taxonomic composition and densities have been characterized from 1999-2020. At present, 42 permanent stations are surveyed biannually (21 per year). For the benthic characterization, a set of five 10-meter-long permanent transects are surveyed at each station. Sessile-benthic reef communities are characterized by the continuous intercept chain-link method, following the Caribbean Coastal Marine Productivity (CARICOMP) (1994) protocol. The PRCREMP data files also include a site classification spreadsheet with descriptors for each monitoring station, some of which can be used as spatial and temporal factors for statistical analyses. These descriptors include information about depth, habitat type, distance from shore, marine protected areas attributes, coordinates, and other metadata.

Table 10. Number of sites monitored between 2015 and 2020 for the Puerto Rico Coral Reef Monitoring Program (PR CREMP).

Year	Depth Zone	Number of Sites
2015	Very Shallow	8
2015	Shallow	4
2015	Intermediate	7
2015	Mesophotic	2
2016	Very Shallow	6
2016	Shallow	8
2016	Intermediate	6
2016	Mesophotic	1
2017	Very Shallow	8
2017	Shallow	6
2017	Intermediate	6
2017	Mesophotic	1
2018	Very Shallow	6
2018	Shallow	6
2018	Intermediate	7
2018	Mesophotic	2
2019	Very Shallow	8
2019	Shallow	5
2019	Intermediate	7
2019	Mesophotic	1
2020	Shallow	1
2020	Intermediate	1
2020	Mesophotic	1

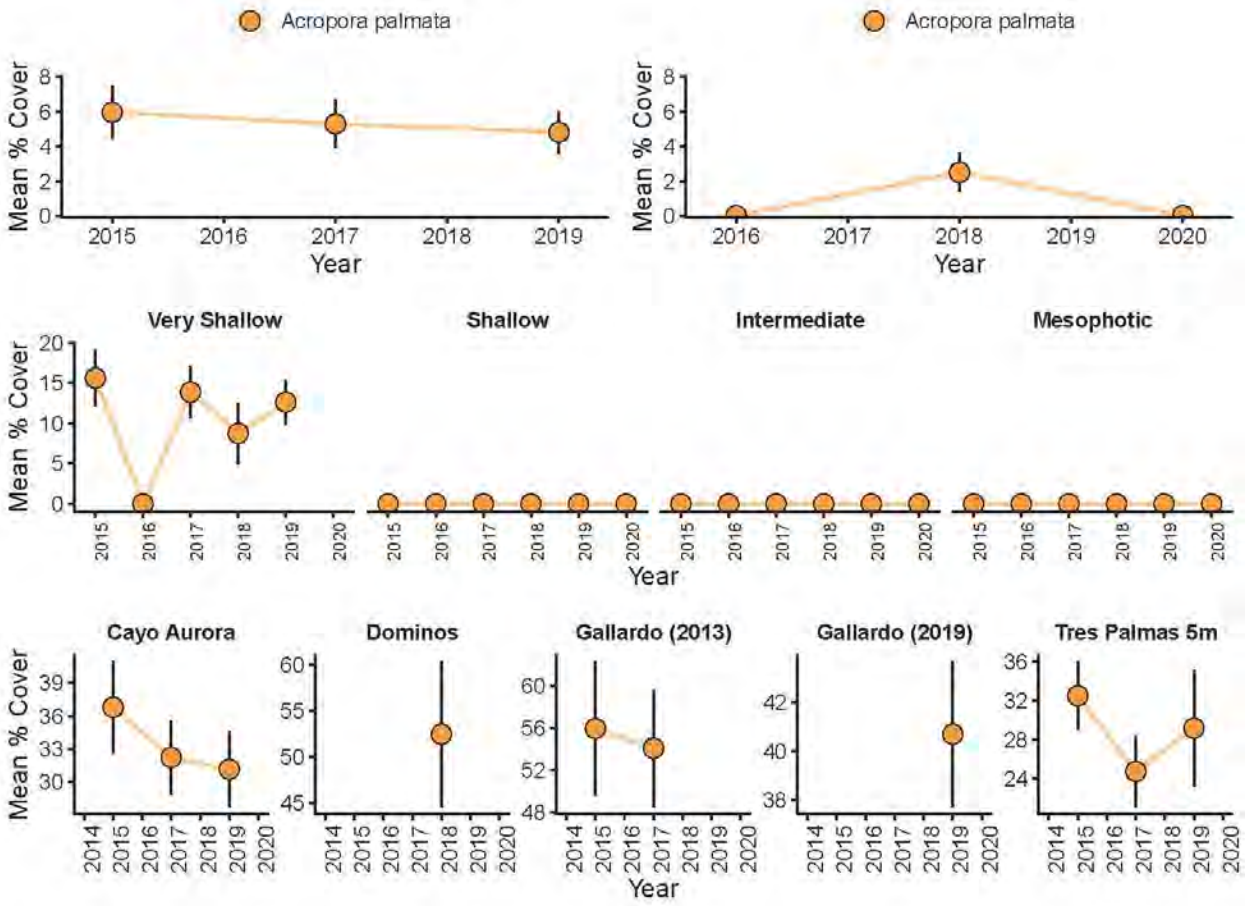

Figure 36. Mean percent cover of *Acropora palmata* from 2015 to 2020 at sites monitored by Puerto Rico CREMP. (Top left panel) Mean percent cover of *A. palmata* averaged across all transects at sites surveyed by PR CREMP in 2015, 2017, and 2019. (Top right panel) Mean percent cover of *A. palmata* averaged across all transects at sites surveyed by PR CREMP in 2016, 2018, and 2020. (21 sites surveyed in 2016 and 2018, only 3 sites included for 2020). (Middle panels) Mean percent cover of *A. palmata* at all sties surveyed by PR CREMP broken down by site depth (21 sites surveyed 2015 to 2019, only 3 sites included for 2020). (Bottom panels) Mean percent cover of *A. palmata* at individual sites where *A. palmata* was recorded on at least one transect between 2015 and 2019 in PR CREMP surveys. For bottom panels data is only presented for years when *A. palmata* was present. Note different y-axis values for each plot. Data presented are means ±SE. 21 sites were surveyed from 2015 to 2019, only data from 3 sites was provided for 2020.

Puerto Rico FEMA surveys

Monitoring was conducted in coral reef habitat at six subregions of Puerto Rico in 2018. These surveys were conducted in March of 2018, following Hurricane Irma, which affected the area in the fall of 2017. Two types of surveys were conducted to collect two types of data: (1) presence-absence data and (2) density data. Both presence-absence and density data were collected via a combination of roving diver surveys and transect surveys. The total number of surveys conducted in 2018 within each subregion of Puerto Rico is provided in the table below. Density surveys were conducted at a subset of sites where presence-absence surveys were conducted. The area covered by roving diver surveys ranged from 157 m^2 to 1,702 m^2, whereas transect areas ranged from 50 m^2 to 1000 m^2.

Table 11. Number of surveys conducted in Puerto Rico in 2018 broken down by Subregion, roving surveys, and transects surveys.

Survey Type	Subregion	Roving surveys	Transect surveys	Total surveys
Presence - Absence Surveys	North	11	9	20
Presence - Absence Surveys	Northeast	52	63	115
Presence - Absence Surveys	Southeast	8	7	15
Presence - Absence Surveys	Southwest	14	11	25
Presence - Absence Surveys	West	16	13	29
Presence - Absence Surveys	Vieques	19	20	39
Presence - Absence Surveys	**Total**	**120**	**123**	**243**
Density Surveys	North	11	9	20
Density Surveys	Northeast	52	56	108
Density Surveys	Southeast	8	7	15
Density Surveys	Southwest	14	10	24
Density Surveys	West	15	12	27
Density Surveys	Vieques	19	18	37
Density Surveys	**Total**	**119**	**112**	**231**

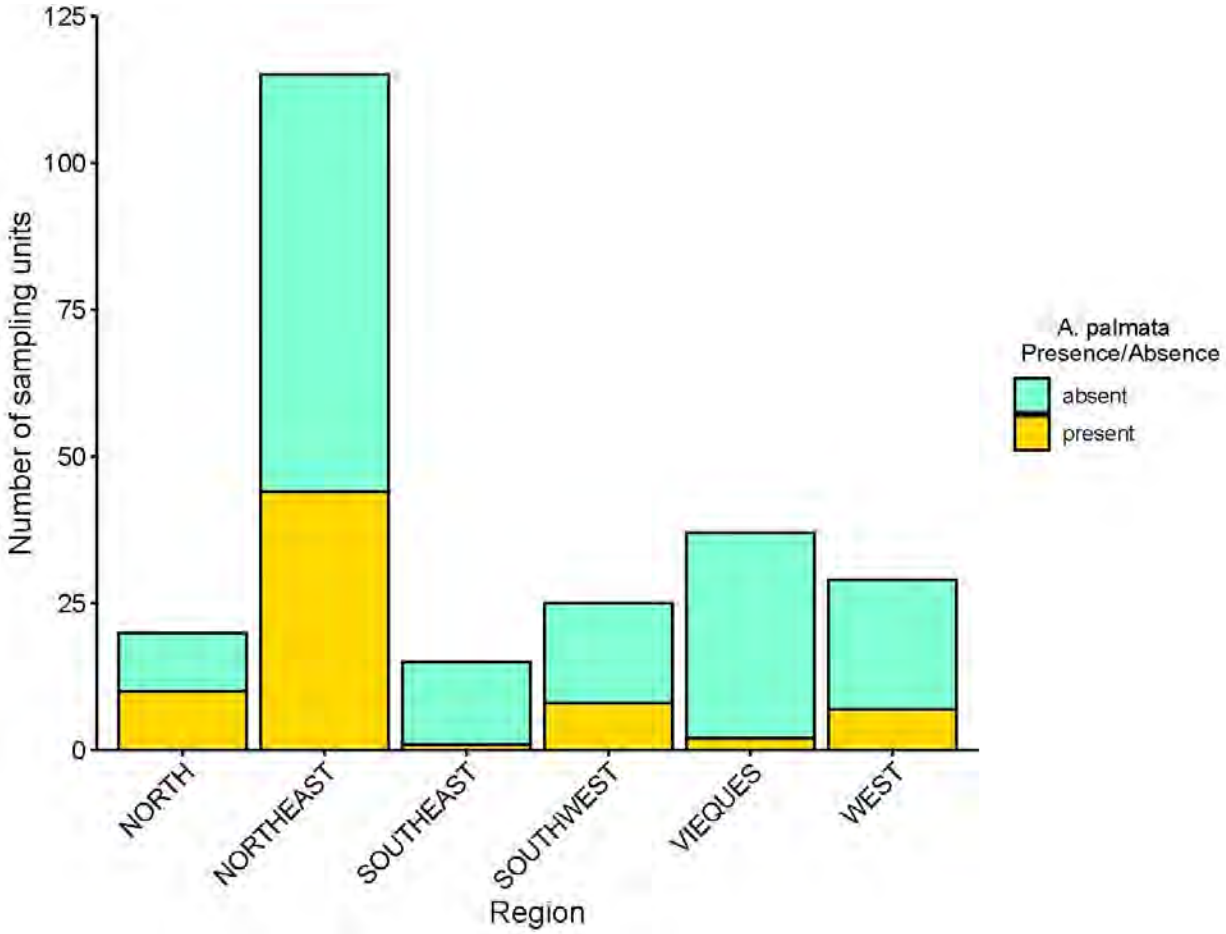

Figure 37. Number of surveys where *Acropora palmata* was present (gold) or absent (teal) in each subregion of Puerto Rico. Surveys were conducted in March of 2018 and were a mix of transect and roving diver surveys.

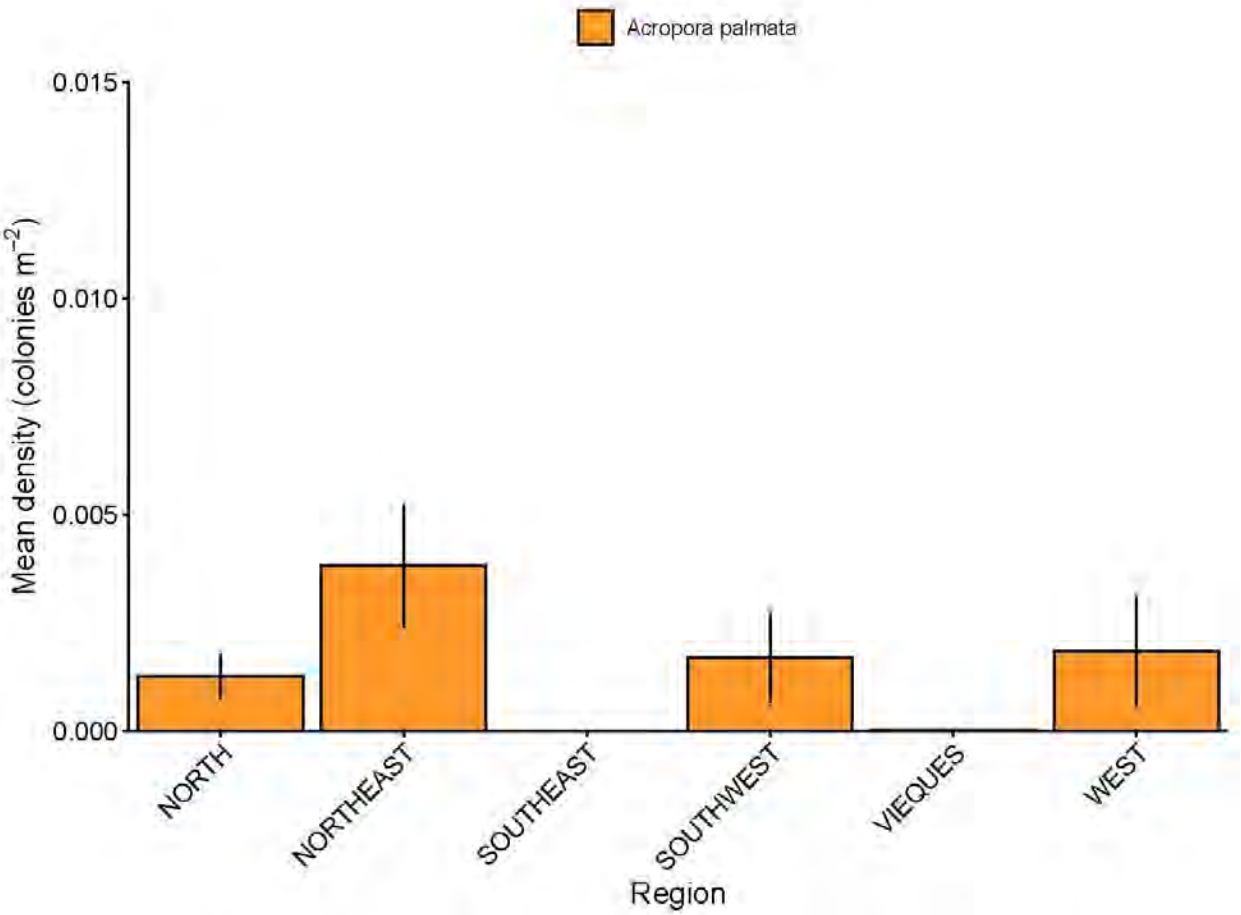

Figure 38. Density of *Acropora palmata* colonies (corals m^{-2}*)* in each subregion of Puerto Rico. Surveys were conducted in March of 2018 and were a mix of transect and roving diver surveys.

USVI CREMP

Benthic cover data collection and description from website**:** At each site, benthic cover surveys are conducted annually along six 10 m long permanent transects marked with steel or brass rods. Video sampling consists of one diver traversing each transect videotaping the benthic cover using a high definition digital video recorder. After taping, images from each transect are captured and imported into RStudio where twenty randomly allocated points are superimposed on each image. Analysis consists of identifying the substrate located under each point. For each transect, the percent cover of coral, epilithic algae (EAC), macroalgae, sponges, gorgonians, and sand/sediment are calculated by dividing the number of random dots falling on that substrate type by the total number of dots for that transect.

The USVI CREMP program monitors 34 sites. However, not all sites were surveyed each year. Number of sites surveyed for each year included in this review were: 2014: n = 33; 2015: n = 33; 2016: n = 32; 2017: n = 11; 2018: n = 34; 2019: n = 33; 2020: n = 19. In 2018 and 2019 some sites were surveyed twice in one year and thus there are 12 instead of 6 transects total for those sites.

NO *A. PALMATA* WAS OBSERVED ON USVI CREMP SURVEYS CONDUCTED BETWEEN 2014 AND 2020

Puerto Rico Department of Natural and Environmental Resources (PR DNER)

Data was obtained from the ESA Coral Database provided data for surveys conducted by the PR DNER a twelve reef sites in 2017. *Acropora palmata* was recorded on transects at three of the twelve sites. Note the number after the site names in the figure below represents the depth of the site (in meters).

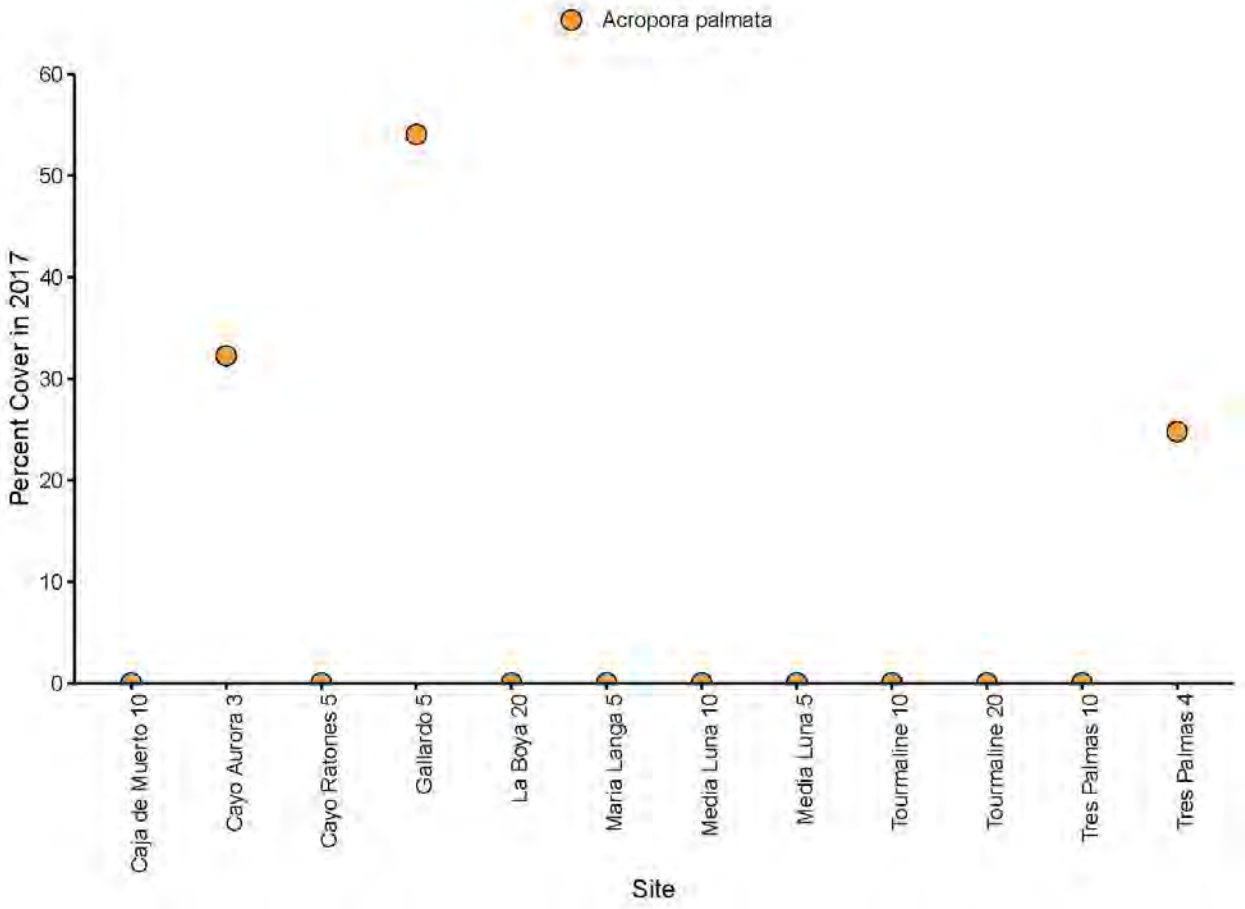

Figure 39. Puerto Rico Department of Natural and Environmental Resources (PR DNER). Data were obtained from the ESA Coral Database provided data for surveys conducted by the PR DNER a twelve reef sites in 2017. *Acropora palmata* was recorded on transects a three of the twelve sites. Note the number after the site names in the figure below represents the depth of the site (in meters).

NOAA Fisheries

The Coral Ecology Unit at the Southeast Fisheries Science Center (SEFSC) in Miami has been monitoring populations of *Acropora palmata* in permanent plots in the Upper Florida Keys since 2004. The following plots were provided by Dr. Dana Williams (pers. comm to Mark Ladd on Jan 7, 2021).

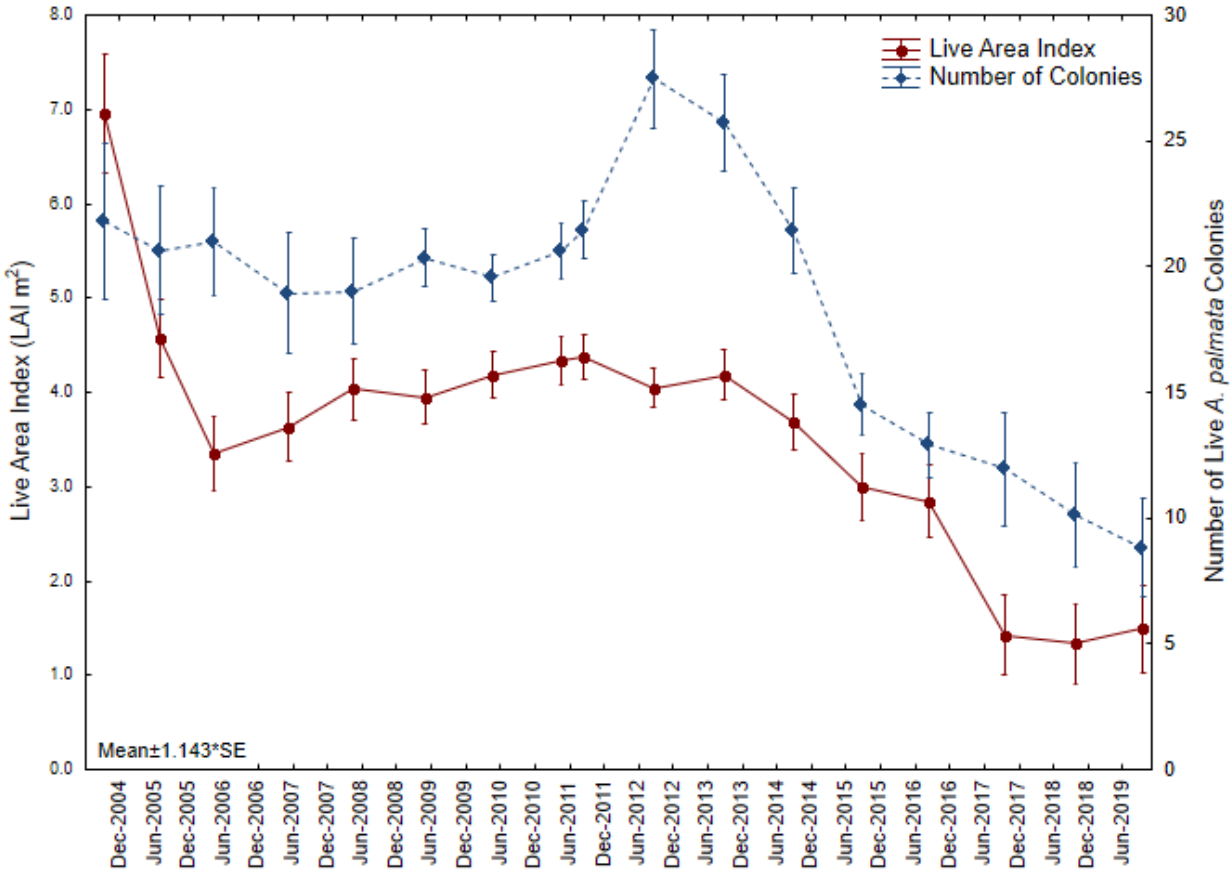

Figure 40. Live area Index (red; left axis) and number of colonies (blue; right axis) for *Acropora palmata* within 150m^2 study plots at all upper Florida Keys monitored sites (number of sites ranges from 12-21). All study plots are averaged and shown with 95% confidence intervals (CI) calculated to better illustrate the within-subject differences (no data available for 2020).

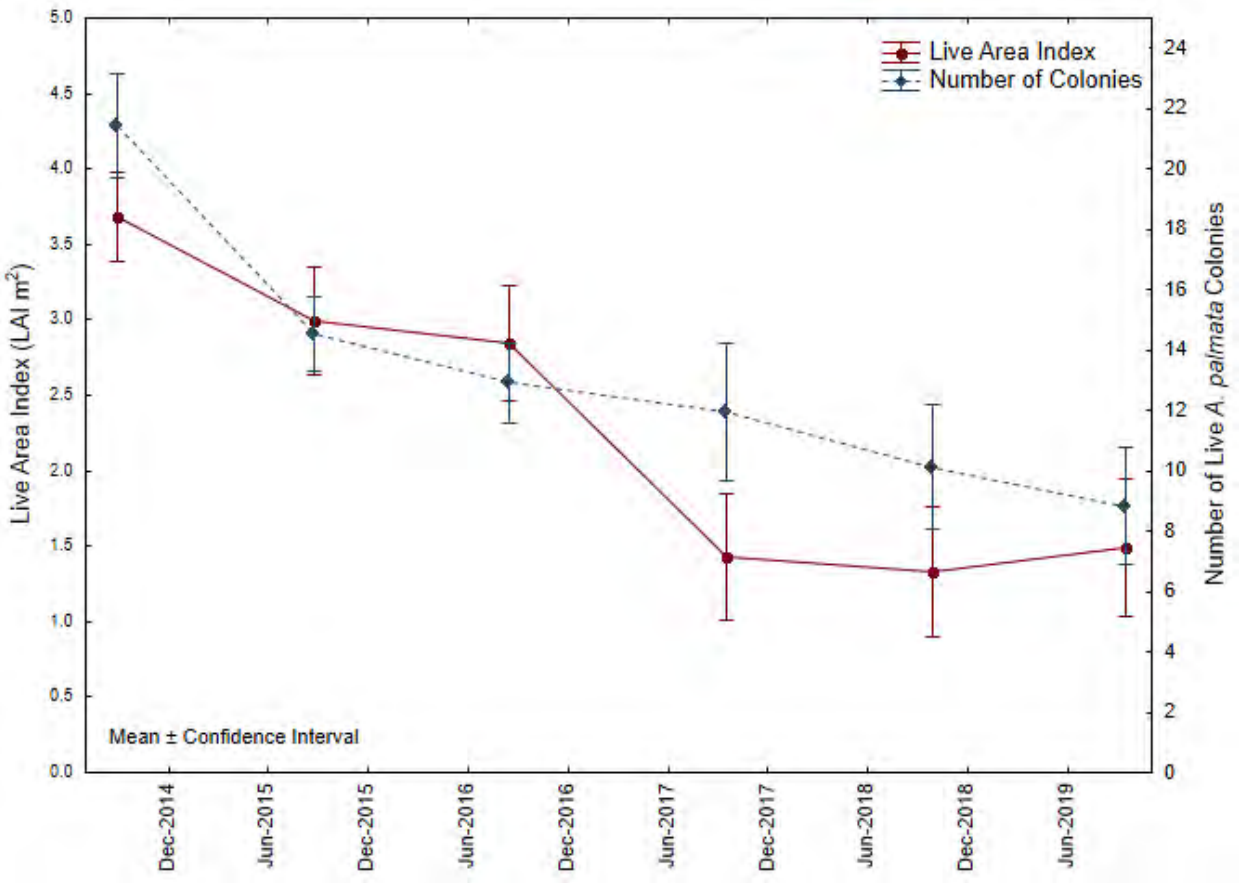

Figure 41. Mean live area index (LAI) of *Acropora palmata* and colony counts from 2014 to 2019.

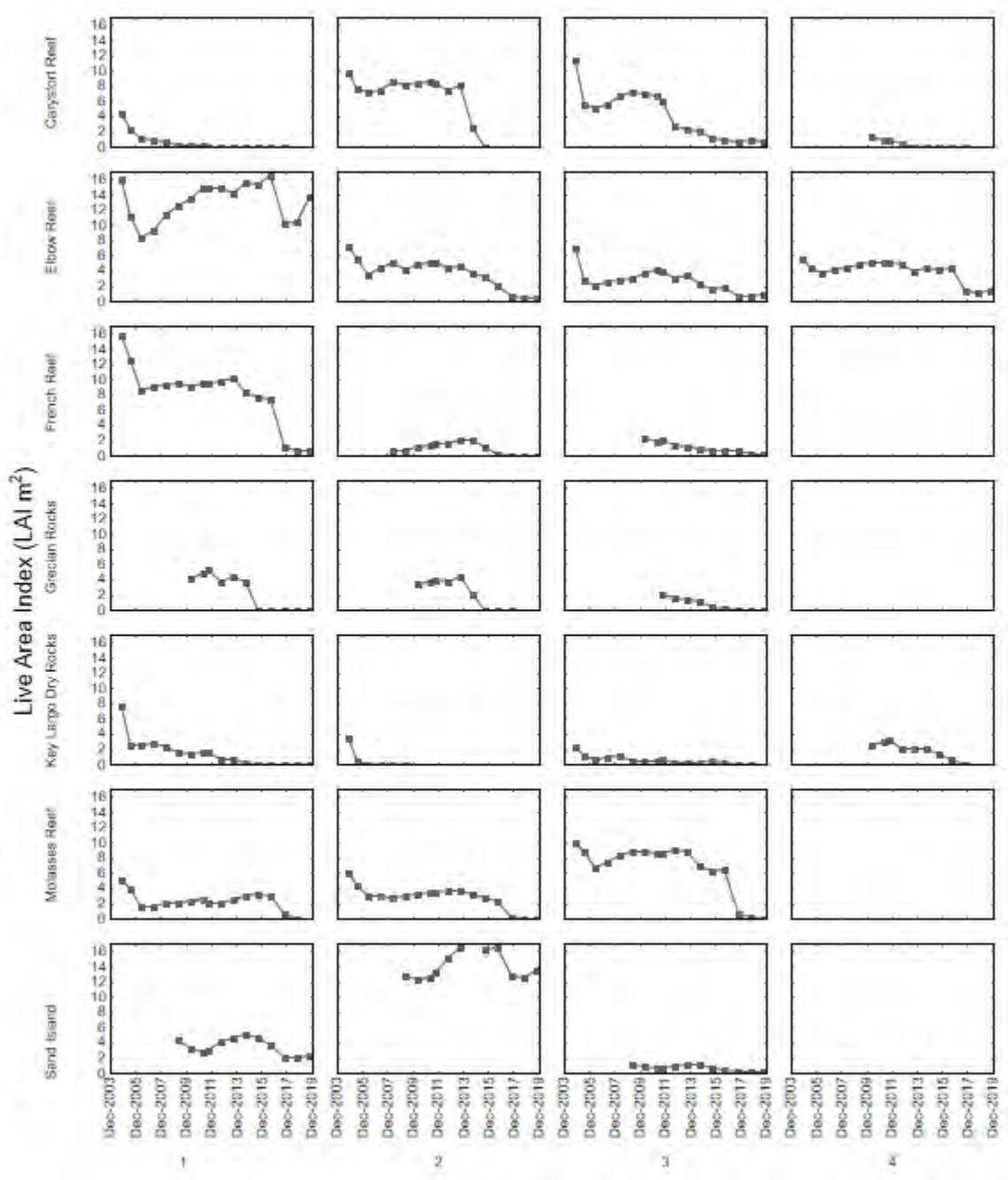

Figure 42. Trends in LAI of *A. palmata* in each study plot on each reef the numbers 1-4 along the bottom axis are individual plot designations. Blank plots in the 4th column indicate reefs that only have 3 study plots.

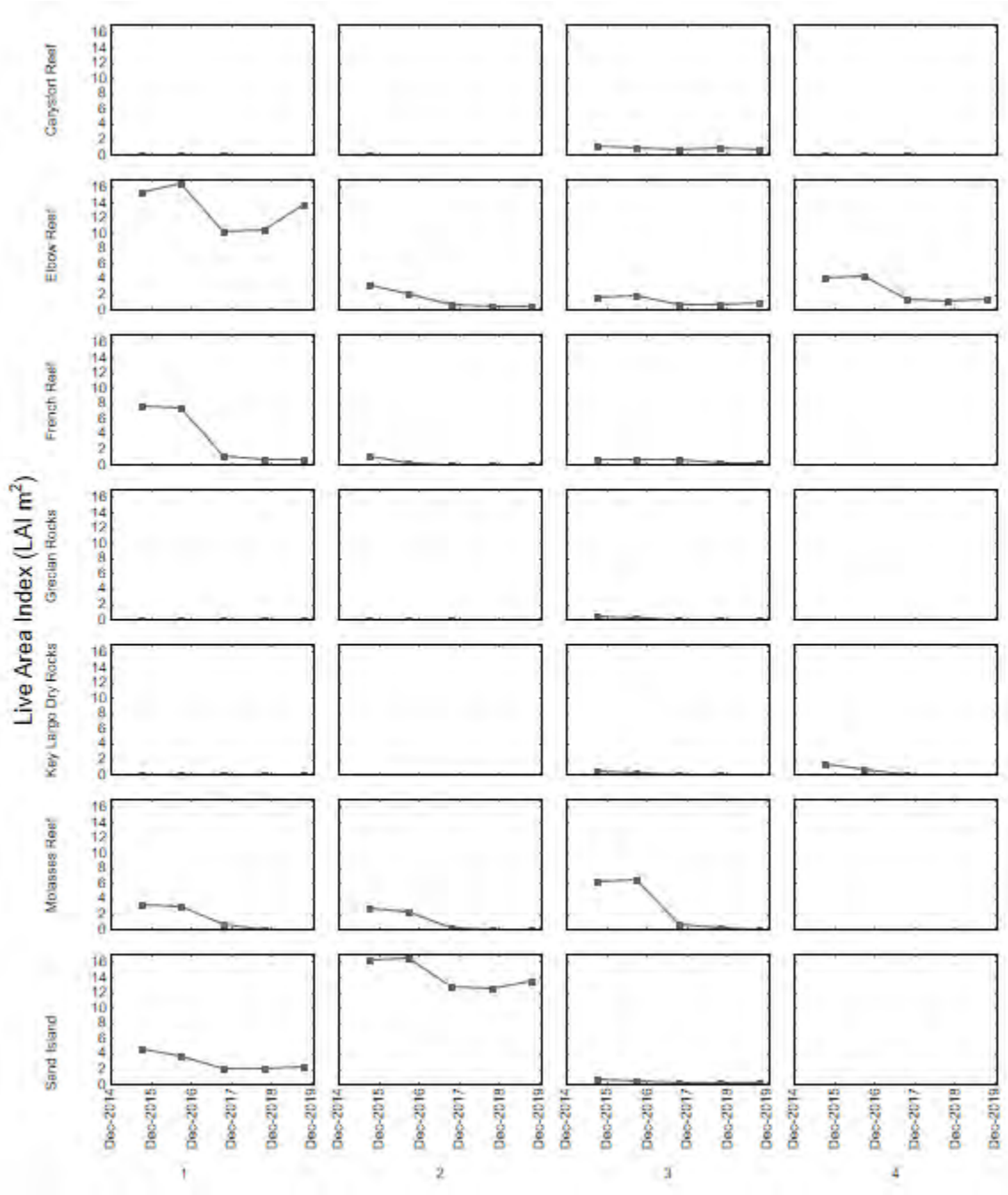

Figure 43. Individual plot LAI trends for the past 5 years. Displaying the data this way illustrates that there are only 2 plots that have a stable patch of *Acropora palmata*.

FWC Surveys in 2014 and 2015

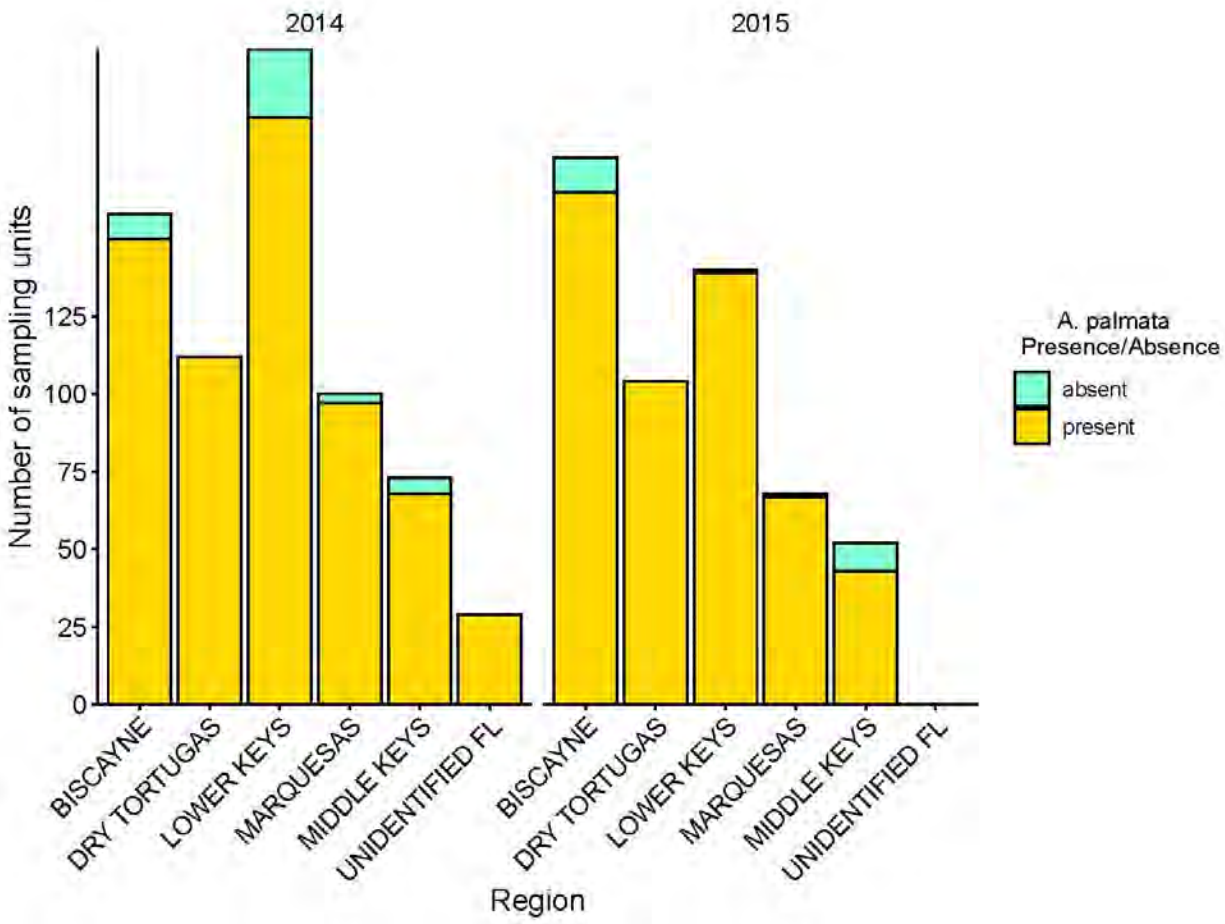

Figure 44. Data from surveys conducted by FWC in 2014 and 2015 (1223 observations) provide observations of presence/absence of *Acropora palmata* colonies at sites across Florida's Reef. Note, n=683 surveys were conducted in 2014; n=540 surveys were conducted in 2015, thus not all sites surveyed in 2014 were re-surveyed in 2015.

Orbicella annularis complex

Table 12. Information on the data sources used to create the figures within this document for the *Orbicella annularis complex* 5 Year Status Review.

DATA SOURCE	LOCATION(S)	YEARS INCLUDED	DATA TYPE(S)
Coral Reef Evaluation and Monitoring Project (CREMP)	Florida Keys, Dry Tortugas	2014 - 2020	Percent cover
Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP)	Southeast Florida	2014 - 2019	Percent cover
Puerto Rico Coral Reef Monitoring Program (PR CRMP)	Puerto Rico	2014 – 2020	Percent cover
Florida Reef Resilience Program's Disturbance Response Monitoring (FRRP DRM)	Southeast Florida, Florida Keys, Dry Tortugas	2014 -2019	Abundance, density, size, mortality
National Coral Reef Monitoring Program (NCRMP) (includes DRM data)	Southeast Florida, Florida Keys, Dry Tortugas, U.S. Virgin Islands, Puerto Rico	2014-2020	Percent cover, density
Puerto Rico Department of Natural and Environmental Resources (PR DNER)	Puerto Rico	2017	Percent cover

OTHER DATA FROM THE ESA CORAL DATABASE FILE

*The ESA Coral Database file did not include any additional entries for *Orbicella annularis* complex (coded as "*Orbicella sp."* in the database) between 2014 and 2020.

Coral Reef Evaluation and Monitoring Project (CREMP) and the Southeast Coral Reef Evaluation and Monitoring Project (SECREMP)

The data used to generate **Figure 45** through **Figure 49** were provided by Florida's Coral Reef Evaluation and Monitoring Project (CREMP) and SECREMP (pers. comm., Mike Colella, Florida Fish and Wildlife Conservation Commission (FWC), to Alison Moulding, Aug. 27, 2020). CREMP in the Florida Keys is funded through the EPA South Florida Water Quality Protection Program and CREMP in the Dry Tortugas is funded through the National Park Service. Both Florida Keys and Dry Tortugas surveys were completed by the Coral Program at the FWC Fish and Wildlife Research Institute (FWRI). SECREMP data is credited to Florida Department of Environmental Protection (FDEP) Coral Reef Conservation Program and Dr. David Gilliam's lab at the National Coral Reef Institute (NCRI) and Nova Southeastern University (NSU).

CREMP and SECREMP surveys were conducted annually in permanent transects across sites (n=4 transects per site) in three regions of Florida: Dry Tortugas (DT), Florida Keys (FL Keys), and Southeast Florida (SE FL) north of the Florida Keys (see Table below for number of sites within each region). This sampling scheme includes eight sites that are located at monospecific coral stands or special habitat areas for the coral species in this status review. Thus, data from these eight sites (DT n = 4 sites, FL Keys n = 3 sites; SE FL n = 1 site) were excluded from the general CREMP data analyses and are presented as separate figures (**Figure 49**). The figures below display Florida-wide, regional and site-specific trends in mean percent coral cover, total or mean live coral area, and total colony counts by species between 2014 and 2019 from CREMP and SECREMP survey data. For these figures means were calculated by using transect as a replicate (n = 260 per year, except for 2017, where n = 258 transects).

Table 13. Number of sites surveyed annually by CREMP and SECREMP programs.

Region	Number of Sites	Number of monospecific or special habitat area sites
Southeast Florida (SE FL)	21	1
Florida Keys	37	3
Dry Tortugas	7	4

CREMP and SECREMP monitoring data summary

Note: Percent cover values provided in the CREMP and SECREMP dataset are categorized as "*Orbicella annularis *complex", rather than individual* Orbicella *species. Live Tissue Area and Density data are broken down by specific* Orbicella *species

PERCENT COVER:

The mean percent cover of *Orbicella annularis* complex across all 260 transects surveyed was highest in 2014 at 1.26% ± 0.21 (mean ±SE) (**Figure 45**) and lowest in 2019 with an average percent cover of 0.84% ± 0.14. In the Dry Tortugas, mean percent cover of O. *annularis complex* remained relatively consistent and ranged from a high of 3.63% ± 0.72 in 2014 to a low of 2.81% ± 0.66 in 2017. In 2014, the mean percent cover of *0. annularis* complex in the Florida Keys (FL Keys) and Southeast Florida (SE FL) was 1.41% ± 0.32 and 0.21% ± 0.08, respectively. By 2019, the mean percent cover of *O. annularis complex* on transects conducted in the Florida Keys (n = 148 per year) and Southeast Florida (n = 84 per year) had declined to 0.88% ±0.19 and 0.04 ± 0.03, respectively. Mean percent cover of *O. annularis* across all 8 monotypic sites monitored remained stable from 2014 to 2019 (**Figure 49**).

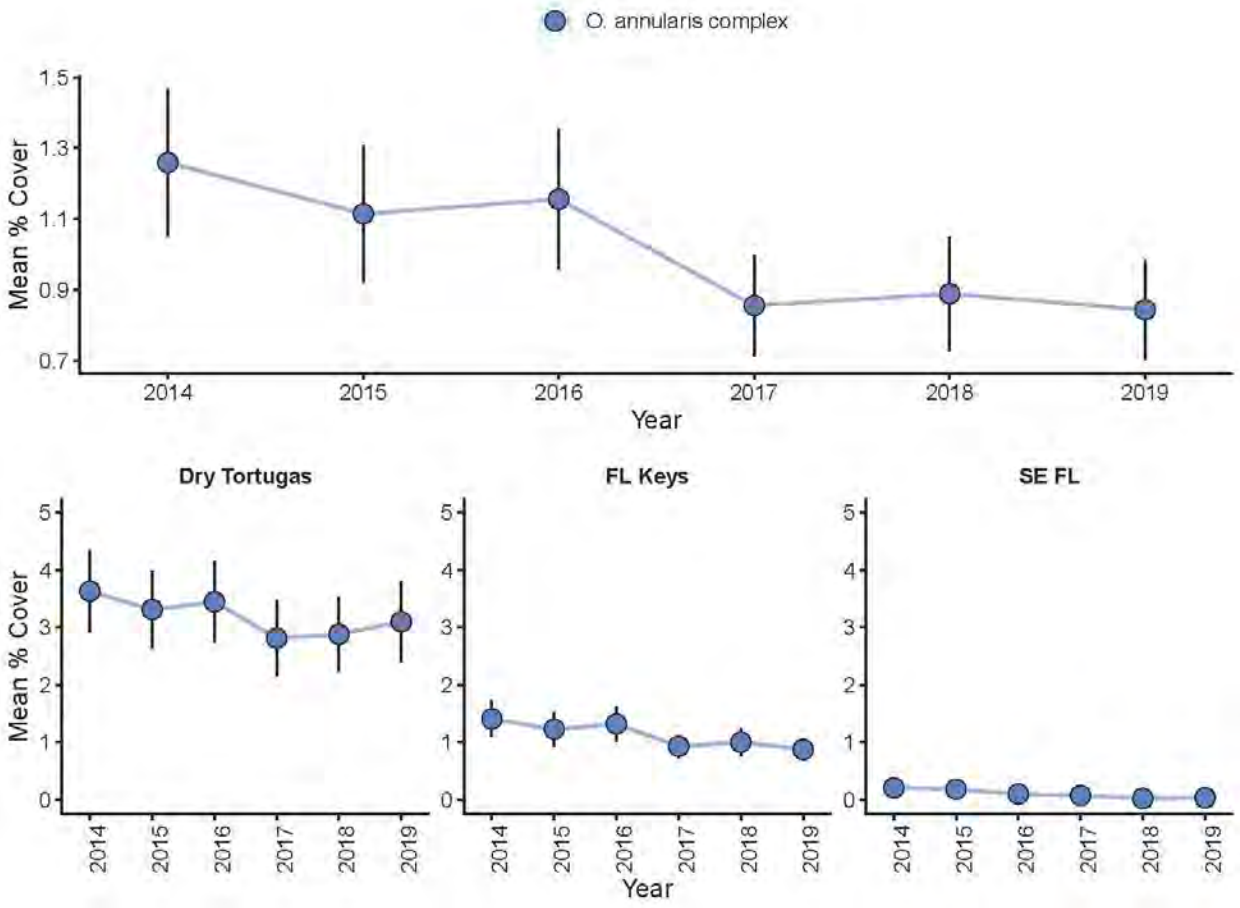

Figure 45. Mean percent cover of *Orbicella annularis complex* from 2014 to 2019: Florida-wide and regional patterns. (Top panel) Mean percent cover of *O. annularis complex* averaged across all transects conducted at Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites). (Bottom panels) Mean percent cover of *O. annularis complex* for each region surveyed by CREMP (DT = 7 sites; FL Keys = 37 sites; SE FL = 21 sites). Data presented are means ±SE. Note different y-axis values for each plot.

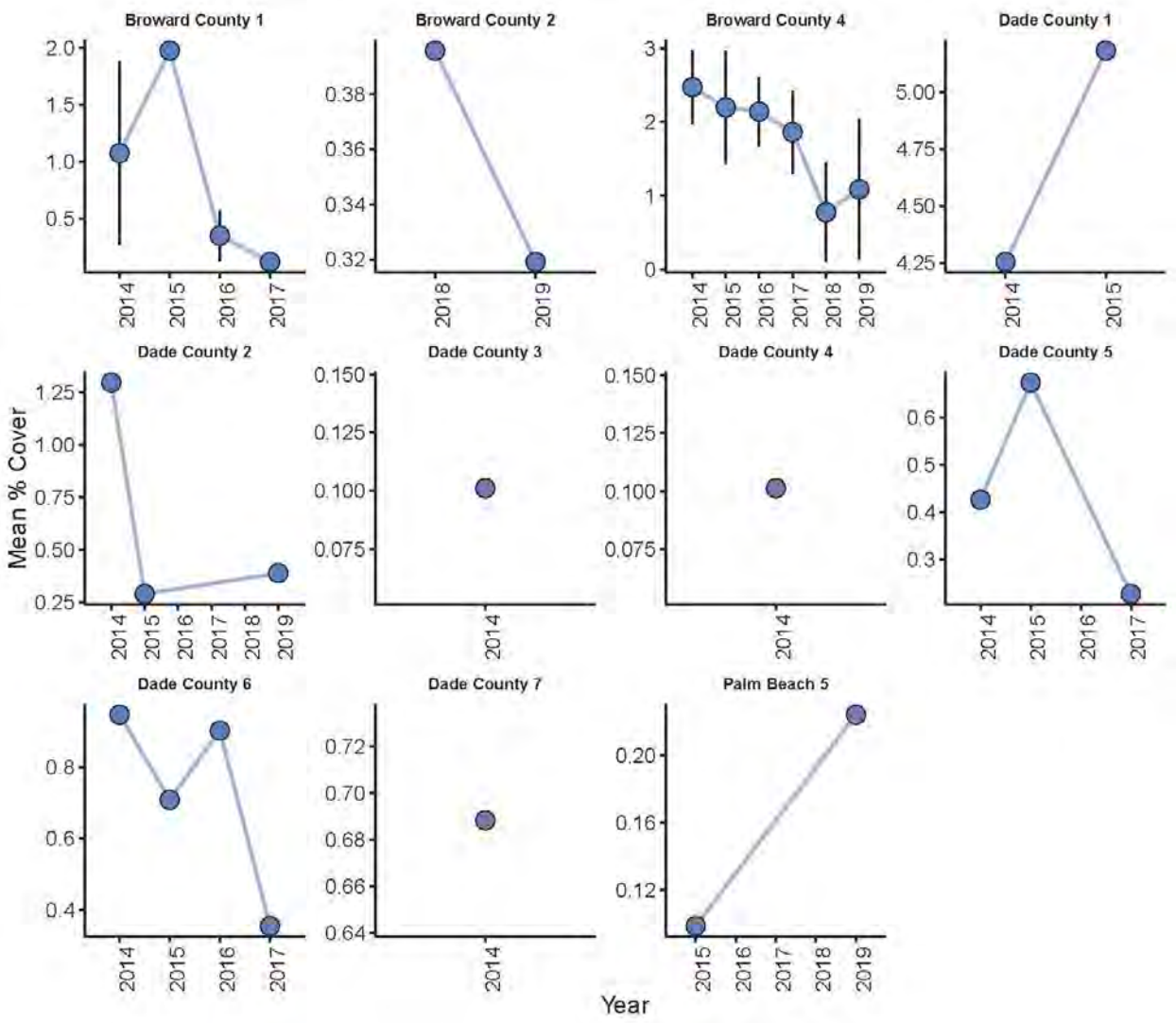

Figure 46. Mean percent cover of *Orbicella annularis complex* from 2014 to 2019: Individual site patterns at sites in Southeast Florida. Mean percent cover of *O. annularis complex* on transects conducted at any Florida coral reef sites in the Southeast Florida subregion surveyed by SECREMP where *O. annularis complex* was recorded on at least one transect between 2014 – 2019. Data presented are means ±SE. Note different y-axis values for each plot.

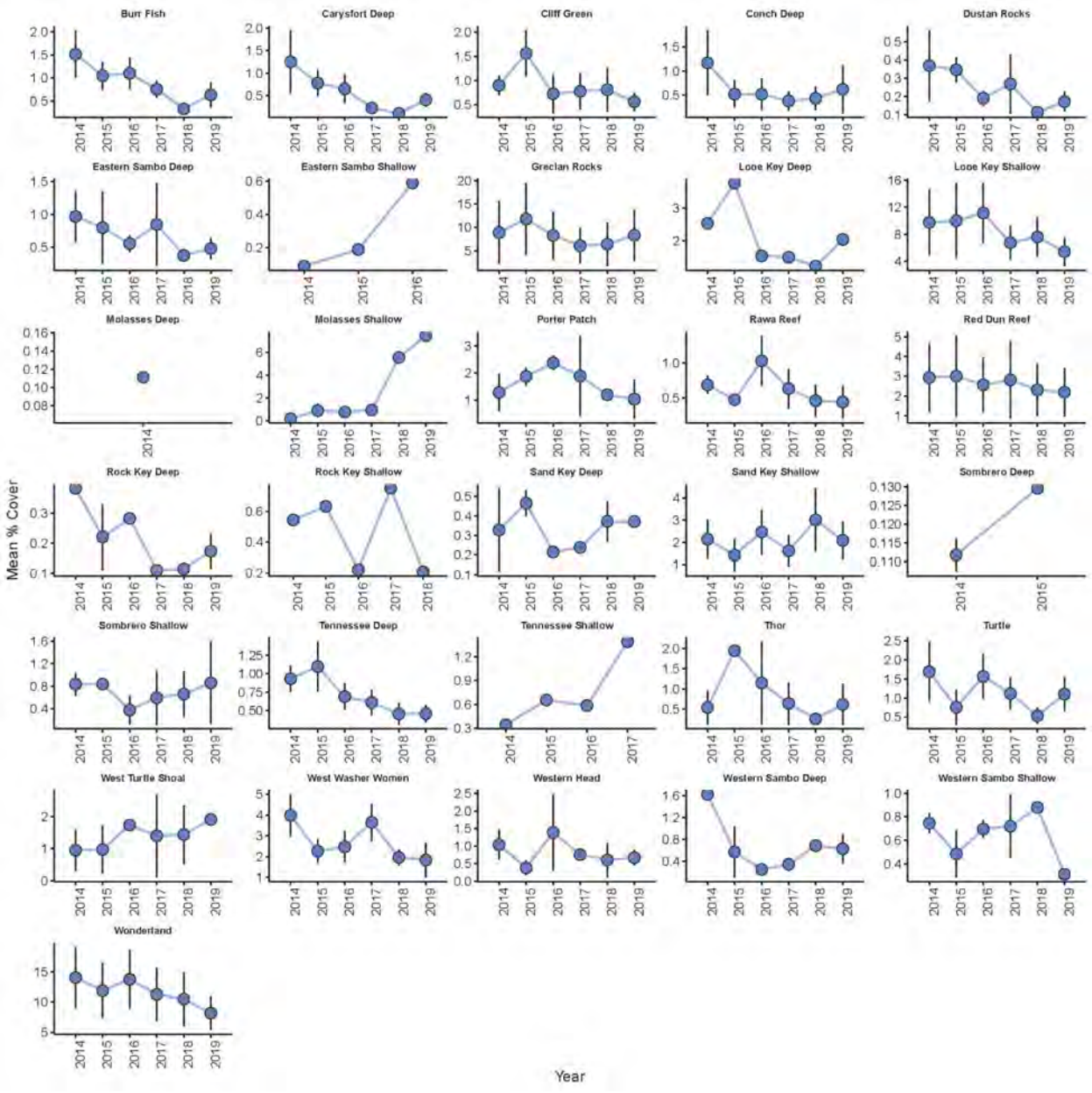

Figure 47. Mean percent cover of *Orbicella annularis complex* from 2014 to 2019: Individual site patterns at sites in the Florida Keys. Mean percent cover of *O. annularis complex* on transects conducted at any Florida coral reef sites in the Florida Keys subregion surveyed by CREMP where *O. annularis complex* was recorded on at least one transect between 2014 – 2019. Data presented are means ±SE. Note different y-axis values for each plot.

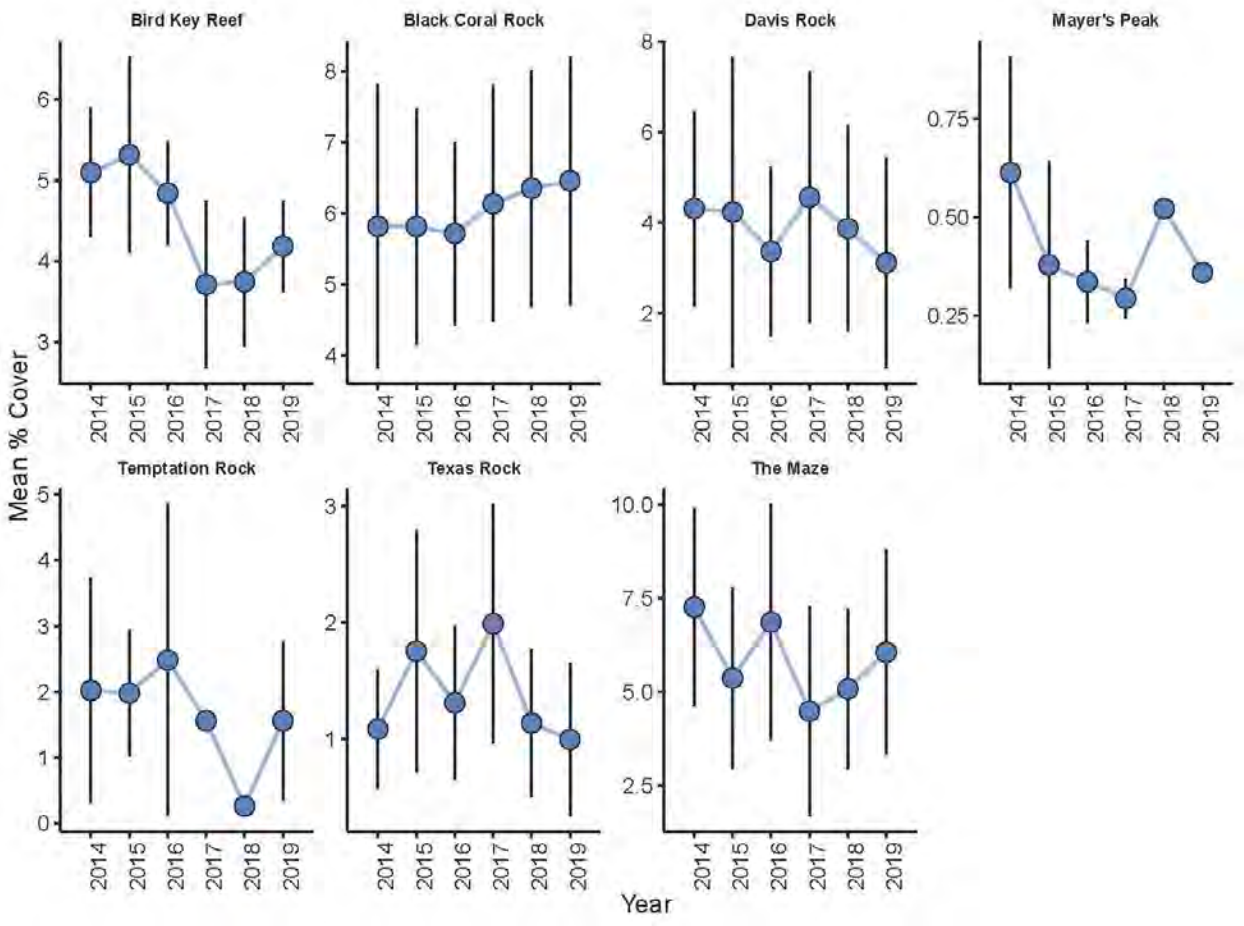

Figure 48. Mean percent cover of *Orbicella annularis complex* from 2014 to 2019: Individual site patterns at sites in the Dry Tortugas. Mean percent cover of *O. annularis complex* on transects conducted at any Florida coral reef sites in the Dry Tortugas subregion surveyed by CREMP where *O. annularis complex* was recorded on at least one transect between 2014 – 2019. Data presented are means ±SE. Note different y-axis values for each plot.

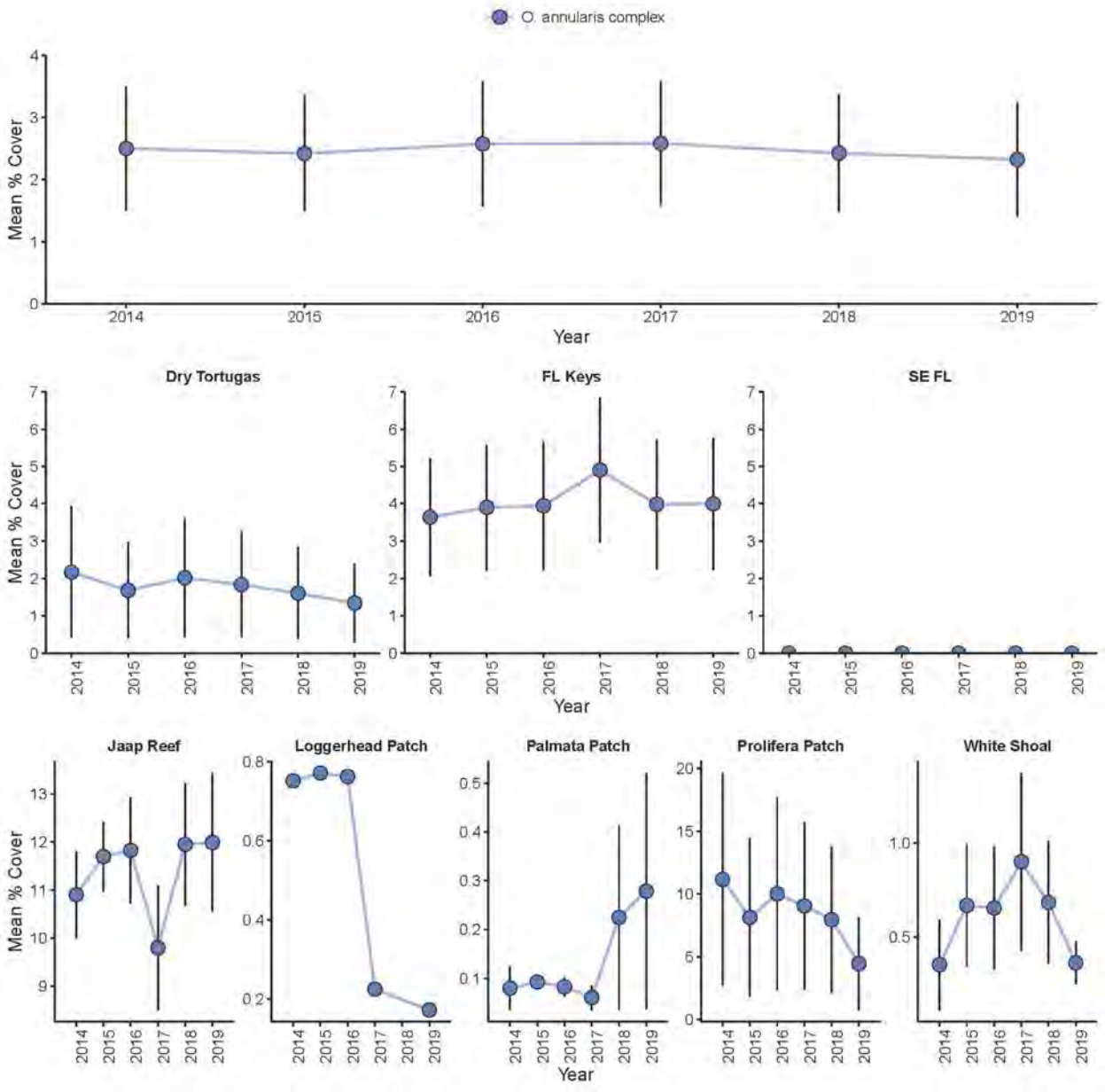

Figure 49. Mean percent cover of *Orbicella annularis complex* from 2014 to 2019: monotpyic and special habitat sites. (Top panel) Mean percent cover of *O. annularis complex* averaged across all transects conducted at monotypic and special habitat Florida coral reef sites surveyed by CREMP and SECREMP (n = 8). (Middle panels) Mean percent cover of *O. annularis complex* at monotpyic and special habitat sites for each region surveyed by CREMP and SECREMP (DT = 4 sites; FL Keys = 3 sites; SE FL = 1 site). (Bottom panels) Mean percent cover of *O. annularis complex* on transects at individual monotypic and special habitat sites where *O. annularis complex* was recorded on at least one transect between 2014 and 2019. For bottom panels data is only presented for years when *O. annularis complex* was present. Note different y-axis values for each plot. Data presented are means ±SE.

National Coral Reef Monitoring program (NCRMP) and the Florida Reef Resilience Program (FRRP) Disturbance Response Monitoring (DRM)

The National Coral Reef Monitoring Program (NCRMP) provides a biennial ecological characterization at a broad spatial scale of general reef condition for reef fishes, corals and benthic habitat (i.e., fish species composition/density/size, benthic cover, and coral density/size/condition). Data collection occurs at stratified random sites where the sampling domain for each region (e.g., Florida, Puerto Rico, U.S. Virgin Islands, Flower Garden Banks National Marine Sanctuary [FGBNMS]) is partitioned by habitat type and depth, sub-regional location (e.g., along-shelf position) and management zone.

The FRRP DRM uses a stratified random sampling design and focuses on bleaching species in <60 ft of water. Two $10m^2$ belt transects (1m width x 10m length) were completed at each site for a total of $20m^2$ surveyed at each site. Because NCRMP and DRM sampling overlaps in the geographic regions they survey and both employ a stratified random sampling design, density, percent cover and coral colony measures (maximum diameter, height, and percent partial mortality) data for these two surveys were combined and presented together.

Table 14. Number of surveys conducted by NCRMP and DRM monitoring programs each year from 2014 to 2020 broken down by each region surveyed. SE FL = Southeast Florida, STTSTJ = St. Thomas and St. John, STX = St. Croix.*In 2018 NCRMP and DRM surveys were conducted together and were not provided as individual data sets

Year	Region	Survey	No. Surveys	Year	Region	Survey	No. Surveys
2014	Dry Tortugas	DRM	29	2017	Dry Tortugas	DRM	31
2014	Dry Tortugas	NCRMP	105	2017	FL Keys	DRM	18
2014	FL Keys	DRM	86	2017	SE FL	DRM	23
2014	FL Keys	NCRMP	314	2017	STTSTJ	NCRMP	230
2014	SE FL	DRM	41	2017	STX	NCRMP	171
2014	SE FL	NCRMP	49	2018	Dry Tortugas	NCRMP/ DRM*	139
2014	Puerto Rico	NCRMP	103	2018	FL Keys	DRM	95
2015	Dry Tortugas	DRM	20	2018	FL Keys	NCRMP	86
2015	FL Keys	DRM	129	2018	SE FL	DRM	50
2015	SE FL	DRM	100	2018	SE FL	NCRMP	70
2015	STTSTJ	NCRMP	162	2019	Dry Tortugas	DRM	79
2015	STX	NCRMP	133	2019	FL Keys	DRM	123
2016	Dry Tortugas	DRM	29	2019	SE FL	DRM	81
2016	Dry Tortugas	NCRMP	97	2019	Puerto Rico	NCRMP	147
2016	FL Keys	DRM	107	2019	STTSTJ	NCRMP	221
2016	FL Keys	NCRMP	92	2019	STX	NCRMP	245
2016	SE FL	DRM	48	2020	Dry Tortugas	DRM	108
2016	SE FL	NCRMP	93	2020	FL Keys	DRM	165
2016	Puerto Rico	NCRMP	157	2020	SE FL	DRM	116

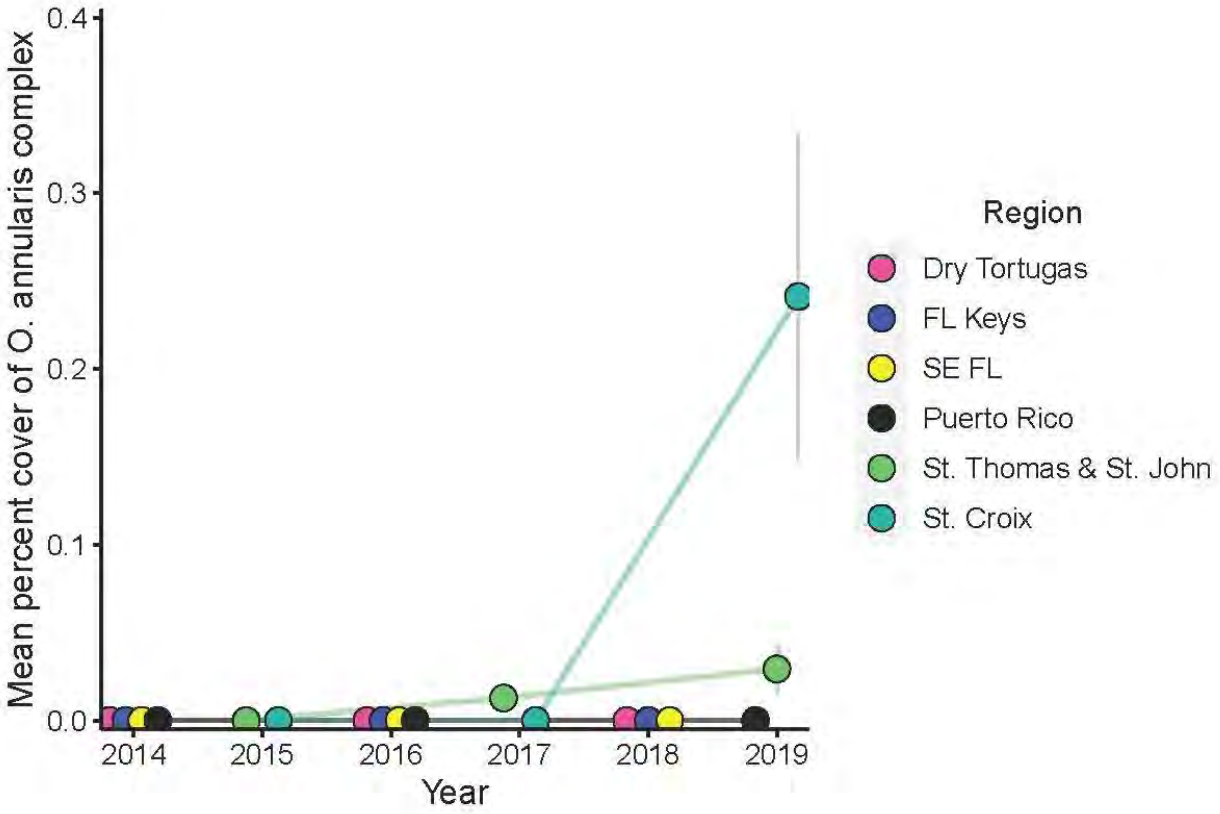

Figure 50. Mean percent cover of *Orbicella annularis* complex for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

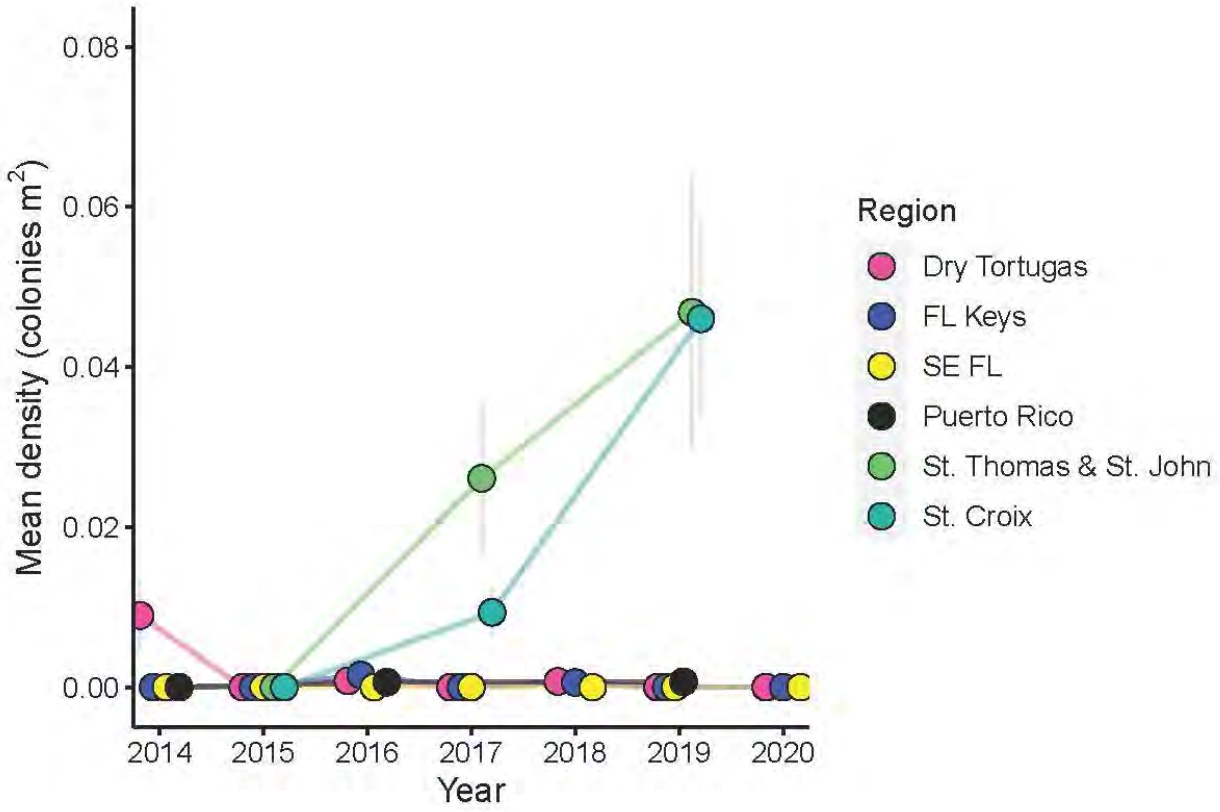

Figure 51. Mean density (colonies m^{-2}) of *Orbicella annularis* complex colonies for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

Figure 52. Number of sites where *Orbicella annularis* complex was observed (gold) or absent (teal) for each year and region surveyed by NCRMP and DRM from 2014 to 2020.

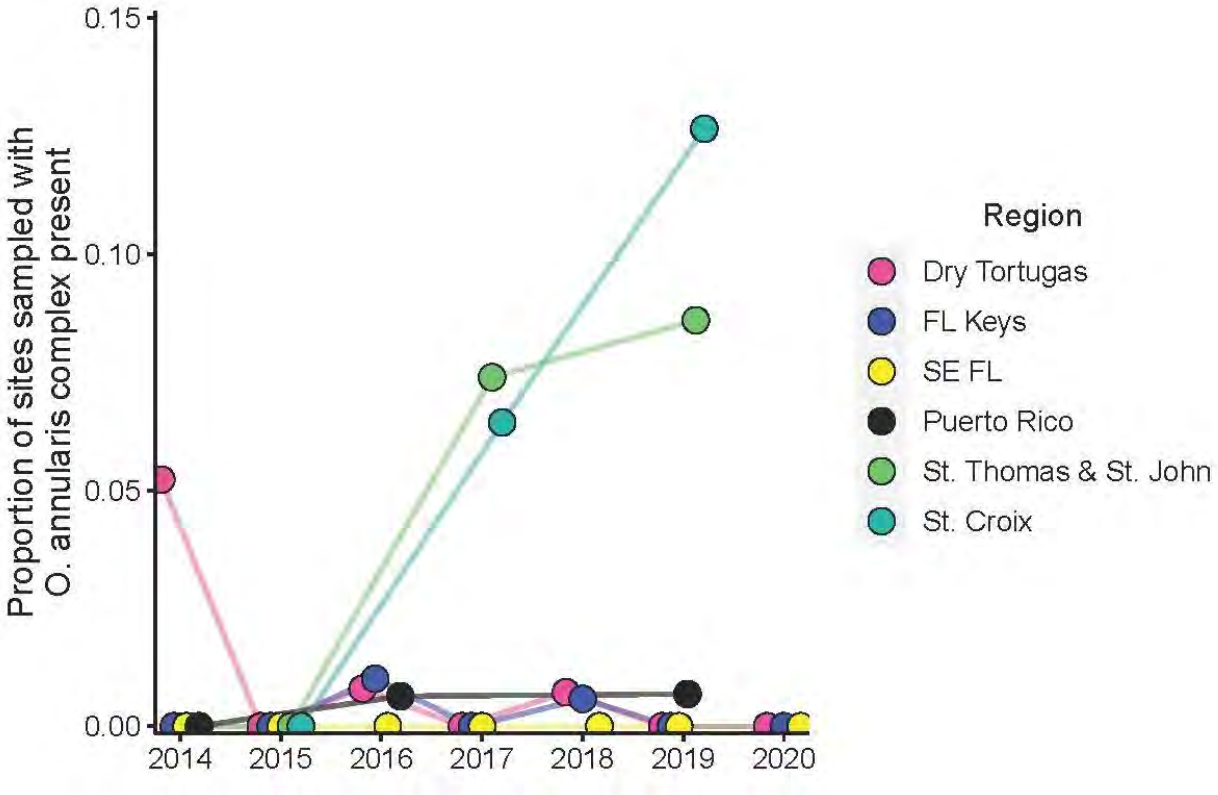

Figure 53. Proportion of all sites surveyed where *Orbicella annularis* complex was present for each year and region surveyed by NCRMP and DRM from 2014 to 2020.

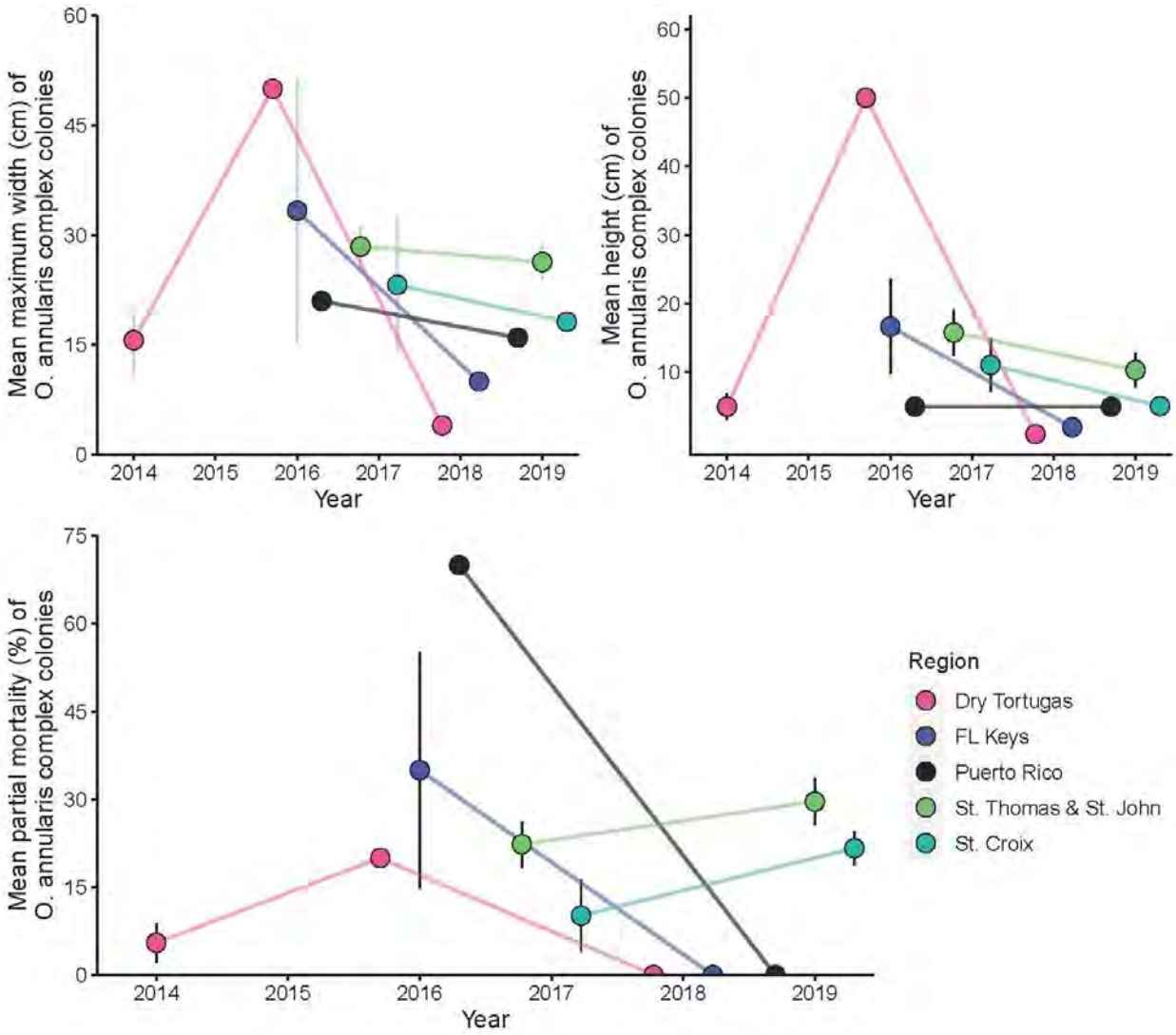

Figure 54. (Top Left) Mean maximum diameter (cm), (Top Right) mean height (cm), and (Bottom) mean partial colony mortality (%) of *Orbicella annularis* complex colonies surveyed on each transect for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

Puerto Rico CREMP (PR CREMP)

Data used in the figures below was provided by The Puerto Rico Coral Reef Monitoring Program (Miguel G Figuerola Hernandez, University of Puerto Rico, to Mark Ladd. Nov 24, 2020) and is publicly available at https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.nodc:0204647.

Benthic data collection and description (Copied from NCEI website): Data files include raw data (by transect) for 86 stations where substrate cover by sessile-benthic categories and fish, and motile megabenthic invertebrate taxonomic composition and densities have been characterized from 1999-2020. At present, 42 permanent stations are surveyed biannually (21 per year). For the benthic characterization, a set of five 10-meter-long permanent transects are surveyed at each station. Sessile-benthic reef communities are characterized by the continuous intercept chain-link method, following the Caribbean Coastal Marine Productivity (CARICOMP) (1994) protocol. The PRCREMP data files also include a site classification spreadsheet with descriptors for each monitoring station, some of which can be used as spatial and temporal factors for statistical analyses. These descriptors include information about depth, habitat type, distance from shore, marine protected areas attributes, coordinates, and other metadata.

Table 15. Number of sites monitored between 2015 and 2020 for the Puerto Rico Coral Reef Monitoring Program (PR CREMP).

Year	Depth Zone	Number of Sites
2015	Very Shallow	8
2015	Shallow	4
2015	Intermediate	7
2015	Mesophotic	2
2016	Very Shallow	6
2016	Shallow	8
2016	Intermediate	6
2016	Mesophotic	1
2017	Very Shallow	8
2017	Shallow	6
2017	Intermediate	6
2017	Mesophotic	1
2018	Very Shallow	6
2018	Shallow	6
2018	Intermediate	7
2018	Mesophotic	2
2019	Very Shallow	8
2019	Shallow	5
2019	Intermediate	7
2019	Mesophotic	1
2020	Shallow	1
2020	Intermediate	1
2020	Mesophotic	1

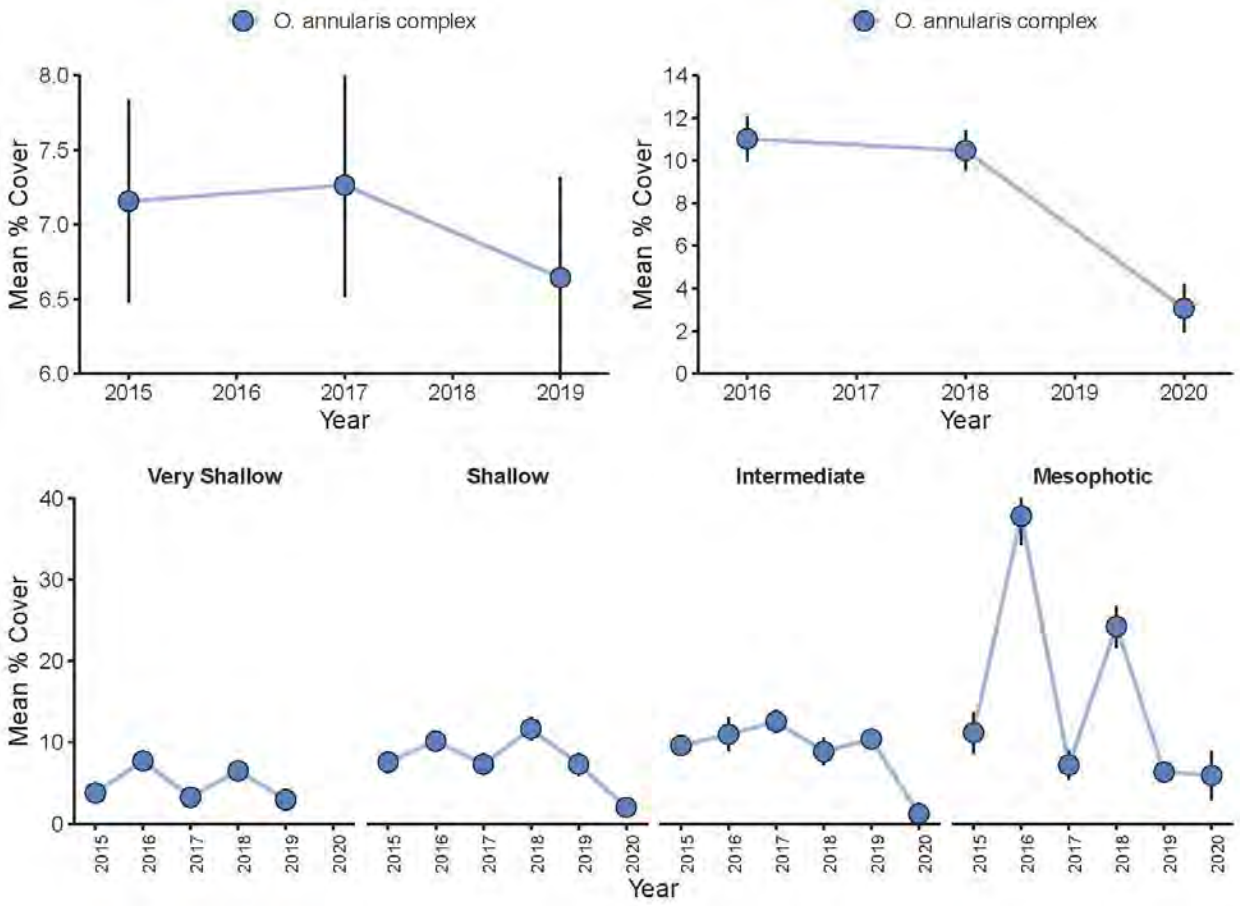

Figure 55. Mean percent cover of *Orbicella annularis* complex from 2015 to 2020 at sites monitored by Puerto Rico CREMP. (Top left panel) Mean percent cover of *O. annularis* complex averaged across all transects at sites surveyed by PR CREMP in 2015, 2017, and 2019. (Top right panel) Mean percent cover of *O. annularis* complex averaged across all transects at sites surveyed by PR CREMP in 2016, 2018, and 2020. (21 sites surveyed in 2016 and 2018, only 3 sites included for 2020). (Bottom panels) Mean percent cover of *O. annularis* complex at all sties surveyed by PR CREMP broken down by site depth (21 sites surveyed 2015 to 2019, only 3 sites included for 2020).

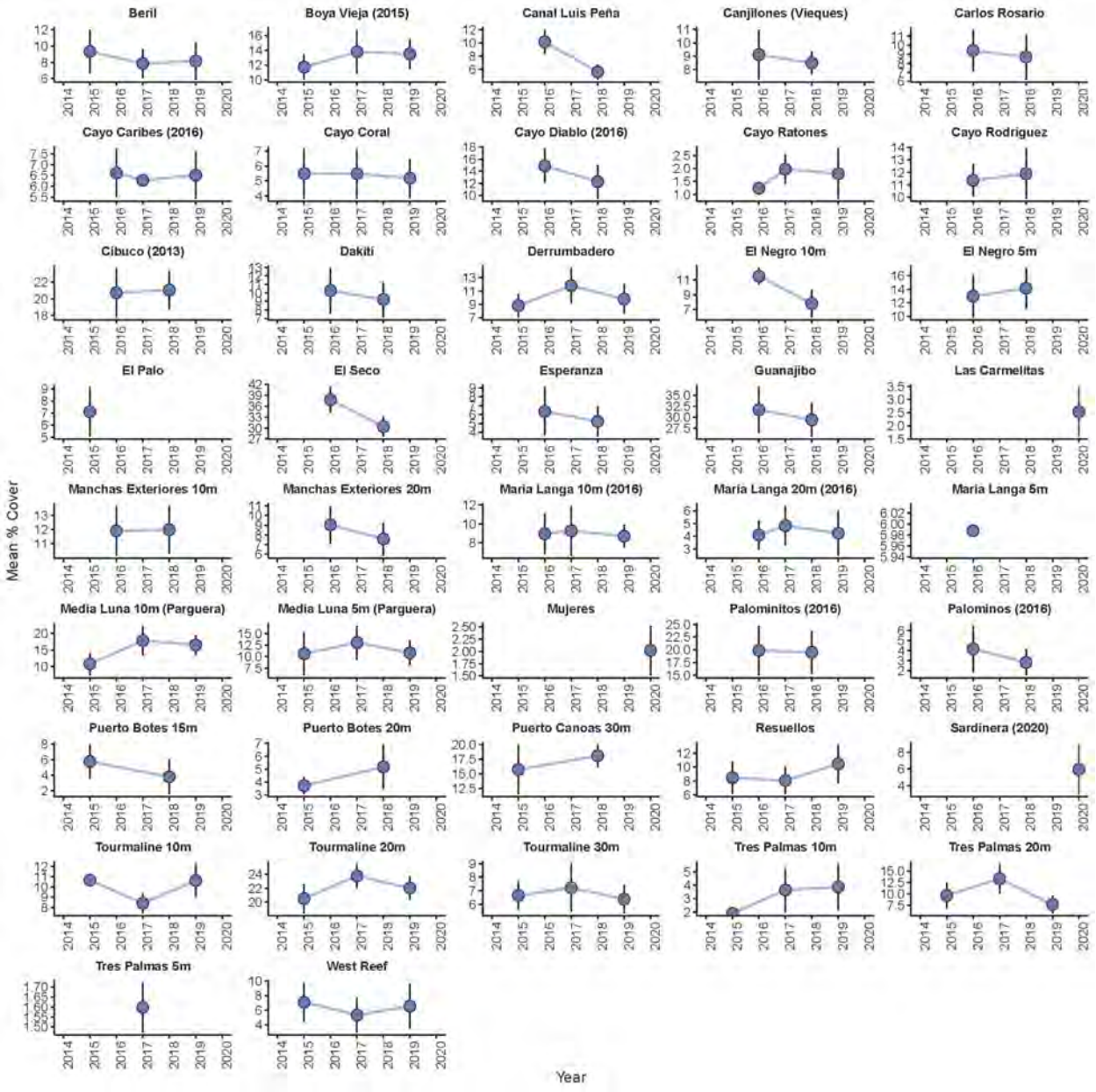

Figure 56. Mean percent cover of *Orbicella annularis* complex at individual sites where *O. annularis* complex was recorded on at least one transect between 2015 and 2019 in PR CREMP surveys. For bottom panels data is only presented for years when *O. annularis* complex was present. Note different y-axis values for each plot. Data presented are means ±SE. 21 sites were surveyed from 2015 to 2019, only data from 3 sites was provided for 2020.

USVI CREMP

Benthic cover data collection and description from website**:** At each site, benthic cover surveys are conducted annually along six 10 m long permanent transects marked with steel or brass rods. Video sampling consists of one diver traversing each transect videotaping the benthic cover using a high definition digital video recorder. After taping, images from each transect are captured and imported into RStudio where twenty randomly allocated points are superimposed on each image. Analysis consists of identifying the substrate located under each point. For each transect, the percent cover of coral, epilithic algae (EAC), macroalgae, sponges, gorgonians, and sand/sediment are calculated by dividing the number of random dots falling on that substrate type by the total number of dots for that transect.

The USVI CREMP program monitors 34 sites. However, not all sites were surveyed each year. Number of sites surveyed for each year included in this review were: 2015: n = 33; 2016: n = 32; 2017: n = 11; 2018: n = 34; 2019: n = 33; 2020: n = 19. In 2018 and 2019 some sites were surveyed twice in one year and thus there are 12 instead of 6 transects total for those sites.

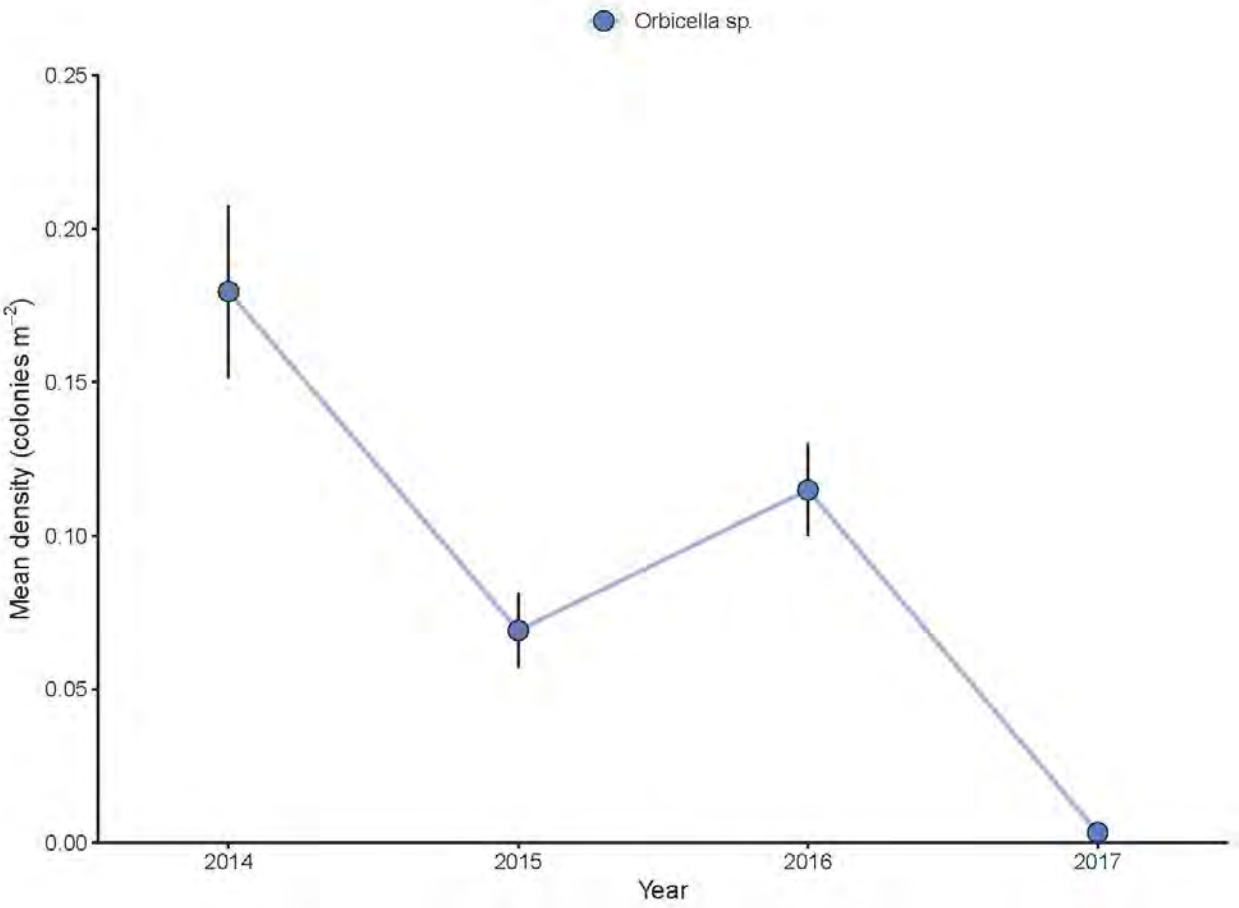

Figure 57. Mean percent cover of *Orbicella annularis* complex from 2015 to 2020 at sites monitored by USVI CREMP. (Top panel) Mean percent cover of *O. annularis* complex averaged across all transects at sites surveyed by USVI CREMP (range: 11 to 34 sites per year). (Middle panels) Mean percent cover of *O. annularis complex* at all sties surveyed by USVI CREMP broken down by site depth. (Bottom panels) Mean percent cover of *O. annularis* complex at individual sites where *O. annularis* complex was recorded on at least one transect between 2015 and 2019. For bottom panels data is only presented for years when *O. annularis* complex was present. Note different y-axis values for each plot. Data presented are means ±SE.

Puerto Rico Department of Natural and Environmental Resources (PR DNER)

Data was obtained from the ESA Coral Database provided data for surveys conducted by the PR DNER a twelve reef sites in 2017. *Orbicella* sp. was recorded on transects at two of the twelve sites. Note the number after the site names in the figure below represents the depth of the site (in meters).

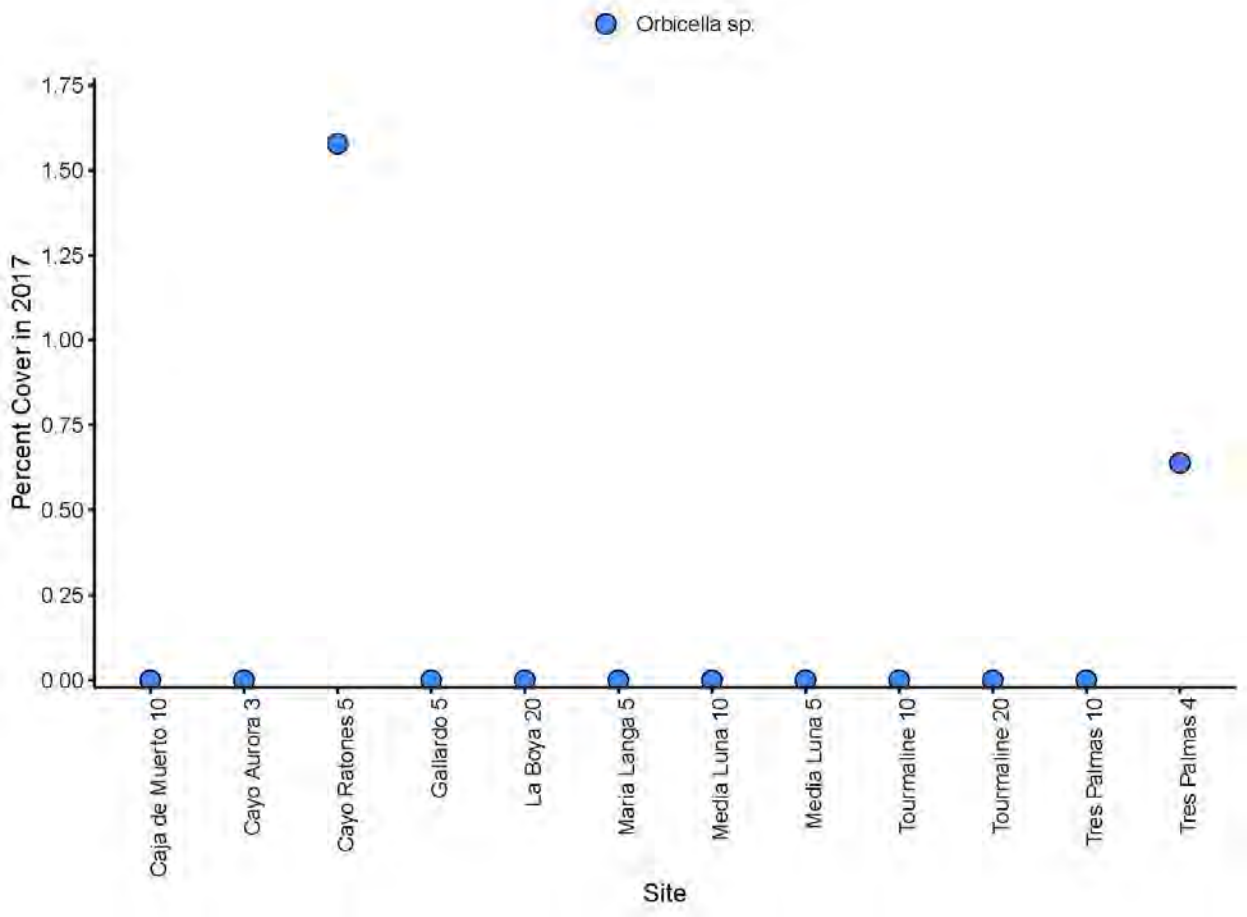

Figure 58. Puerto Rico Department of Natural and Environmental Resources (PR DNER) Data were obtained from the ESA Coral Database provided data for surveys conducted by the PR DNER at twelve reef sites in 2017. *Orbicella annularis* complex was recorded on transects at two of the twelve sites. Note the number after the site names in the figure below represents the depth of the site (in meters).

Orbicella annularis

Table 16. Information on the data sources used to create the figures within this document for the *Orbicella annularis* 5 Year Status Review.

DATA SOURCE	LOCATION(S)	YEARS INCLUDED	DATA TYPE(S)
Coral Reef Evaluation and Monitoring Project (CREMP)	Florida Keys, Dry Tortugas	2014 - 2020	Density, Live Tissue Area
Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP)	Southeast Florida	2014 - 2019	Density, Live Tissue Area
Puerto Rico Coral Reef Monitoring Program (PR CRMP)	Puerto Rico	2014 – 2020	Percent cover
Puerto Rico FEMA monitoring	Puerto Rico	2018	Presence absence, density
US Virgin Island Coral Reef Monitoring Program (USVI CRMP)	U.S. Virgin Islands	2014-2020	Percent cover
Florida Reef Resilience Program's Disturbance Response Monitoring (FRRP DRM)	Southeast Florida, Florida Keys, Dry Tortugas	2014 -2019	Abundance, density, size, mortality
National Coral Reef Monitoring Program (NCRMP) (includes DRM data)	Southeast Florida, Florida Keys, Dry Tortugas, U.S. Virgin Islands, Puerto Rico	2014-2020	Percent cover, density

OTHER DATA FROM THE ESA CORAL DATABASE FILE

*Excluding the above data, the ESA Coral Database file included 33 entries for *Orbicella annularis* between 2014 and 2020. They were:

1. FWC presence-absence data recorded in 2018 (n = 33)

Coral Reef Evaluation and Monitoring Project (CREMP) and the Southeast Coral Reef Evaluation and Monitoring Project (SECREMP)

The data used to generate **Figure 59** through **Figure XX** were provided by Florida's Coral Reef Evaluation and Monitoring Project (CREMP) and SECREMP (pers. comm., Mike Colella, Florida Fish and Wildlife Conservation Commission (FWC), to Alison Moulding, Aug. 27, 2020). CREMP in the Florida Keys is funded through the EPA South Florida Water Quality Protection Program and CREMP in the Dry Tortugas is funded through the National Park Service. Both Florida Keys and Dry Tortugas surveys were completed by the Coral Program at the FWC Fish and Wildlife Research Institute (FWRI). SECREMP data is credited to Florida Department of Environmental Protection (FDEP) Coral Reef Conservation Program and Dr. David Gilliam's lab at the National Coral Reef Institute (NCRI) and Nova Southeastern University (NSU).

CREMP and SECREMP surveys were conducted annually in permanent transects across sites (n=4 transects per site) in three regions of Florida: Dry Tortugas (DT), Florida Keys (FL Keys), and Southeast Florida (SE FL) north of the Florida Keys (see Table below for number of sites within each region). This sampling scheme includes eight sites that are located at monospecific coral stands or special habitat areas for the coral species in this status review. Thus, data from these eight sites (DT n = 4 sites, FL Keys n = 3 sites; SE FL n = 1 site) were excluded from the general CREMP data analyses and are presented as separate figures (Figures 61, 6, and 9). The figures below display Florida-wide, regional and site-specific trends in mean percent coral cover, total or mean live coral area, and total colony counts by species between 2014 and 2019 from CREMP and SECREMP survey data. For these figures means were calculated by using transect as a replicate (n = 260 per year, except for 2017, where n = 258 transects).

Table 17. Number of sites surveyed annually by CREMP and SECREMP programs.

Region	Number of Sites	Number of monospecific or special habitat area sites
Southeast Florida (SE FL)	21	1
Florida Keys	37	3
Dry Tortugas	7	4

CREMP and SECREMP monitoring data summary

Note: Percent cover values provided in the CREMP and SECREMP dataset are categorized as "*Orbicella annularis* complex", rather than individual Orbicella species. Live Tissue Area and Density data are broken down by specific *Orbicella* species

LIVE TISSUE AREA: The total amount of live tissue area of *Orbicella annularis* (estimated area; m^2) across all 260 transects surveyed was highest in 2014 when an estimated total of 263.59 m^2 was recorded, and then slowly declined to the lowest value in 2018 when 62.28 m^2 of live tissue was recorded (**Figure 59**). Total live tissue area for *O. annularis* was consistently low (<1 m^2) in the Dry Tortugas region from 2014 to 2019. In the Florida Keys region, total live tissue area for *O. annularis* decreased from a high of 260.57 m^2 in 2014 to a low of 62.28 m^2 in 2018. In the Southeast Florida region, *O. annularis* was only observed in 2014 and 2015, and was absent in surveys between 2016 and 2019. *Orbicella annularis* was only detected at monotypic sites in the Dry Tortugas, where the total amount of live tissue area decreased from 2014 to 2019, from a high 91.51 m^2 in 2014 (**Figure 61**), with the largest drop from 43.46 in 2018 to 1.22 m^2 in 2019.

DENSITY: The mean density of *Orbicella annularis* colonies across all 260 transects surveyed was highest in 2014 at 0.04 ± 0.007 colonies m^{-2} (mean ±SE; **Figure 62**), and lowest in 2018 with an average density of at 0.014 ± 0.004 colonies m^{-2}. In the Dry Tortugas, *O. annularis* was only detected in surveys in 2015 and 2016, and was only detected in 2014 and 2015 in surveys conducted in the Southeast Florida region. At sites in the Florida Keys, the mean density of *O. annularis* colonies was highest in 2014 (0.068 ± 0.012 colonies m^{-2}) and lowest in 2019 (0.029 ± 0.01 colonies m^{-2}). The density of *O. annularis* colonies at monotypic sites was highest in 2014 (0.078 ± 0.063 colonies m^{-2}) and lowest in 2019 (0.018 ± 0.013 colonies m^{-2}; **Figure 64**).

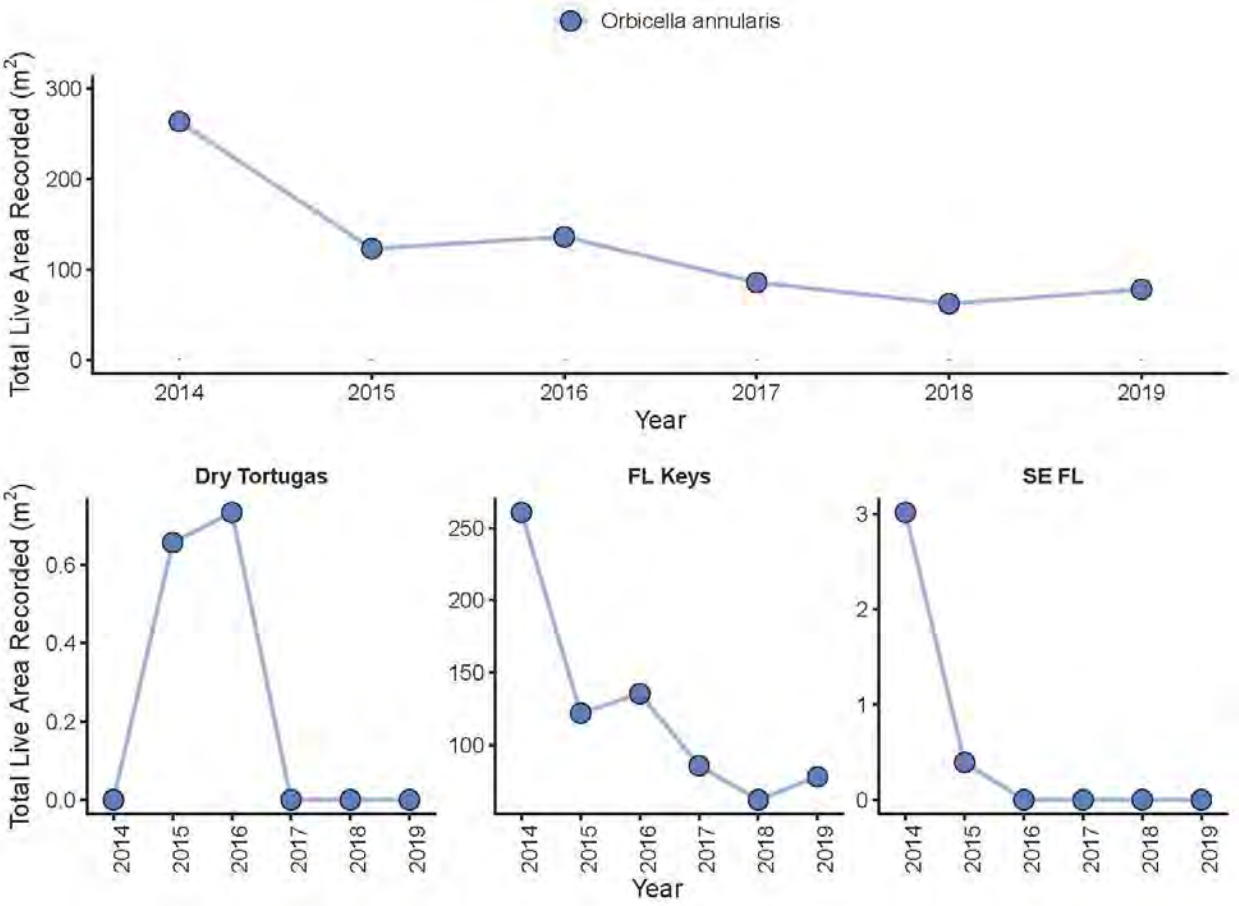

Figure 59. **Total live area (m^2) of *Orbicella annularis* from 2014 to 2019: Florida-wide and regional patterns.** (Top panel) Total live area (m^2) of *O. annularis* summed across all transects conducted at Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites). (Bottom panels Total live area (m^2) of *O. annularis* for each region surveyed by CREMP (DT = 7 sites; FL Keys = 37 sites; SE FL = 21 sites). Note different y-axis values for each plot.

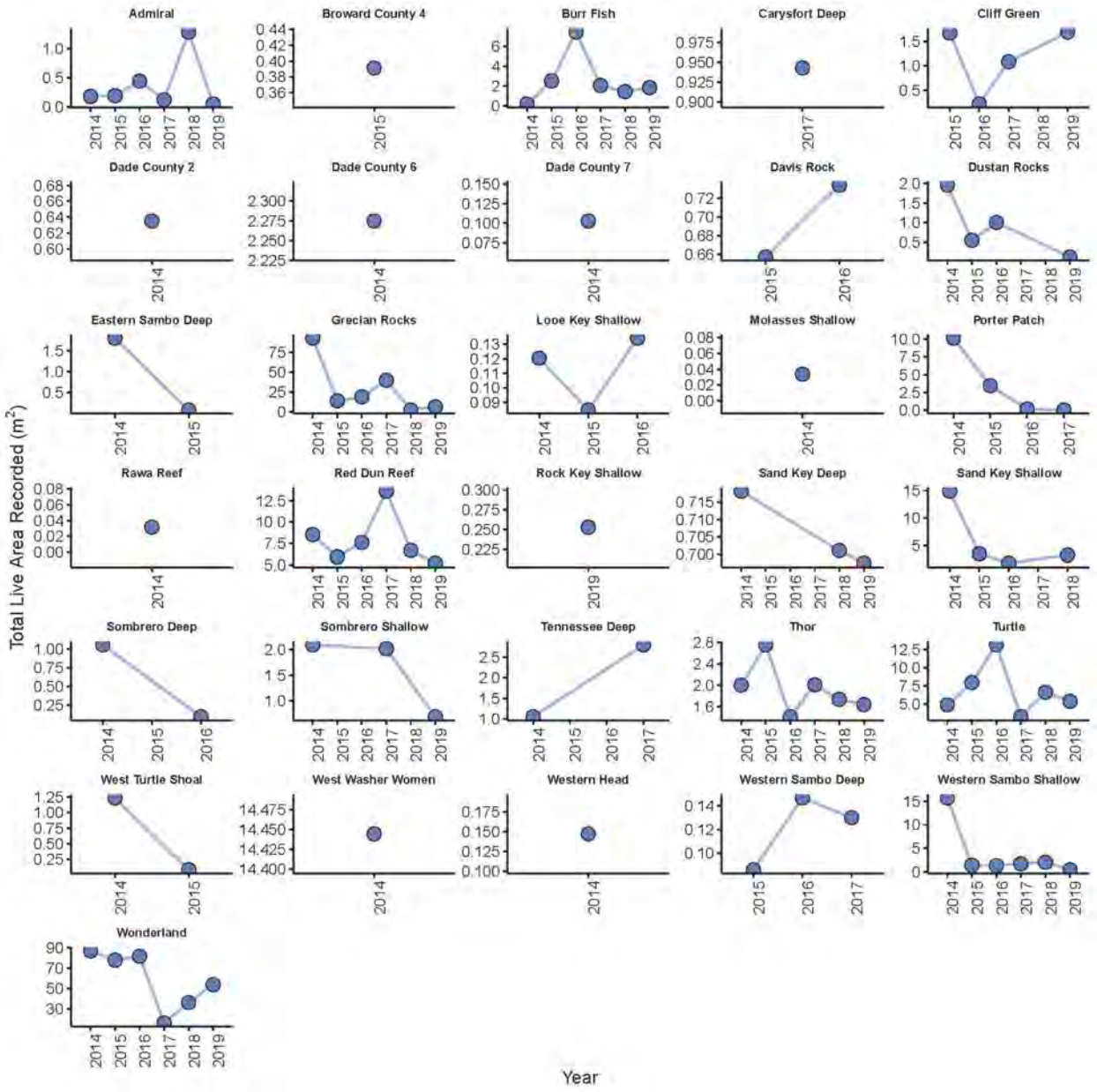

Figure 60. **Total live area (m^2) of *Orbicella annularis* from 2014 to 2019: Individual site patterns.** Mean percent cover of *O. annularis* on transects conducted at any Florida coral reef sites surveyed by SECREMP where *O. annularis* was recorded on at least one transect between 2014 – 2019. Note different y-axis values for each plot.

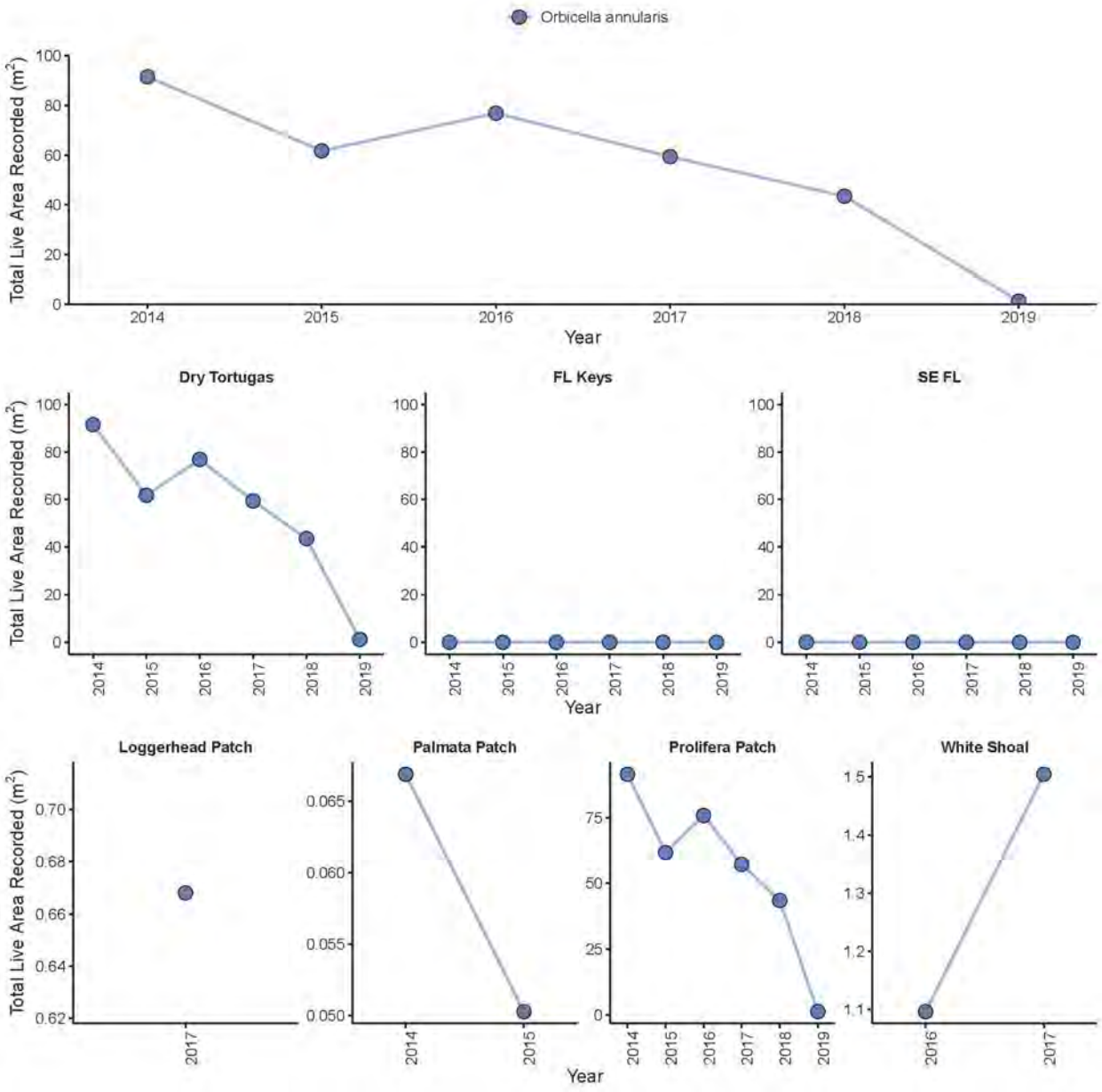

Figure 61. **Total live area (m^2) of *Orbicella annularis* from 2014 to 2019: Florida-wide and regional patterns at monotypic and special habitat sites.** Total live area (m^2) of *O. annularis* across all transects conducted at monotypic and special habitat Florida coral reef sites surveyed by CREMP and SECREMP (n = 8). (Middle panels) Total live area (m^2) of *O. annularis* at monotypic and special habitat sites for each region surveyed by CREMP and SECREMP (DT = 4 sites; FL Keys = 3 sites; SE FL = 1 site). No data was reported for *O. annularis lata* at monotypic sites in the Dry Tortuguas in 2017 or in the Florida Keys in 2014. (Bottom panels) Total live area (m^2) of *O. annularis* at individual monotypic and special habitat sites (n=8) where *O. faveolata* was recorded on at least one transect between 2014 and 2019. Data is only presented for years when *O. annularis* was present. Note different y-axis values for each plot.

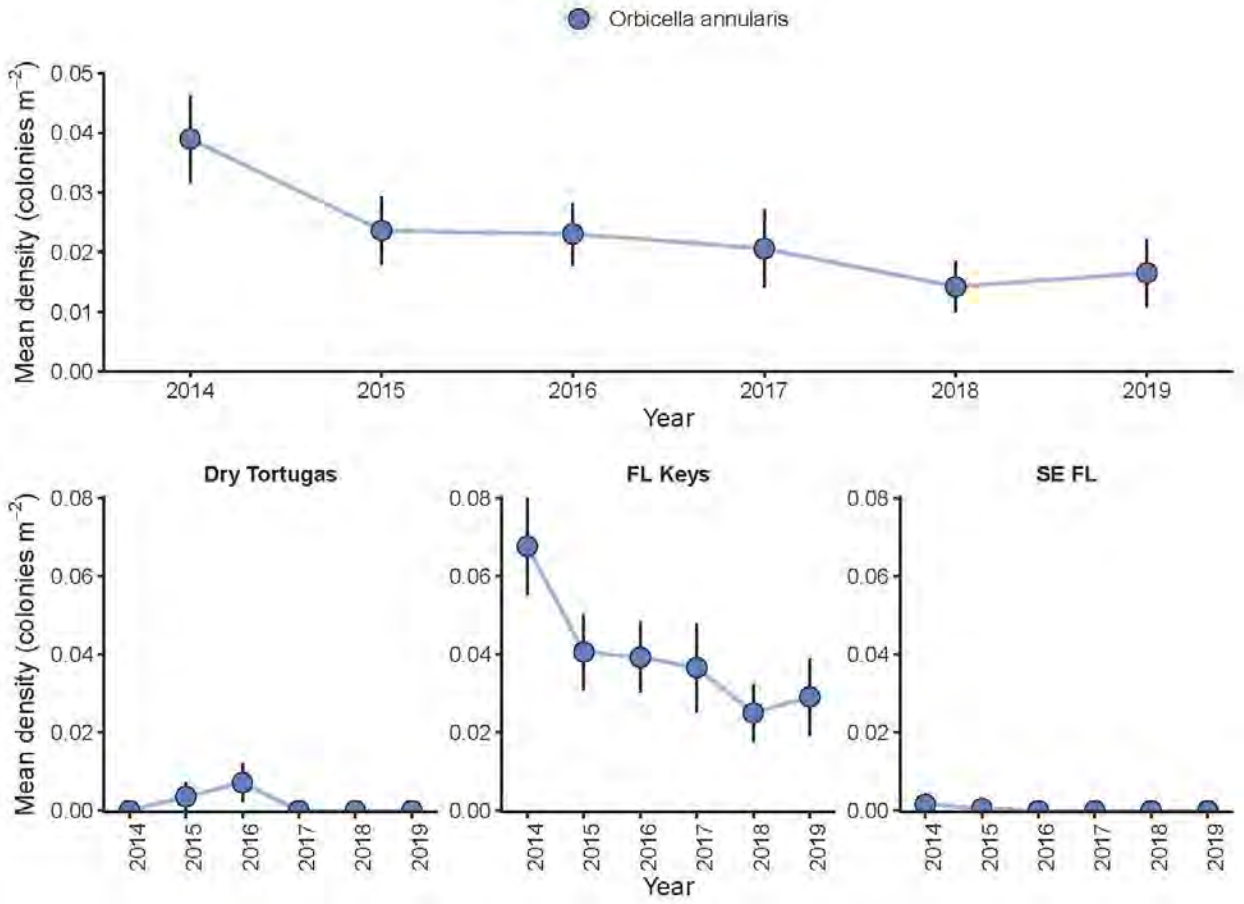

Figure 62. Mean density of *Orbicella annularis* colonies from 2014 to 2019: Florida-wide and regional patterns. (Top panel) Mean density (colonies m^{-2}) of *O. annularis* colonies averaged across all transects conducted at Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites). (Bottom panels) Mean density (colonies m^{-2}) of *O. annularis* colonies for each region surveyed by CREMP and SECREMP (DT = 7 sites; FL Keys = 37 sites; SE FL = 21 sites). Data presented are means ±SE. Note different y-axis values for each plot.

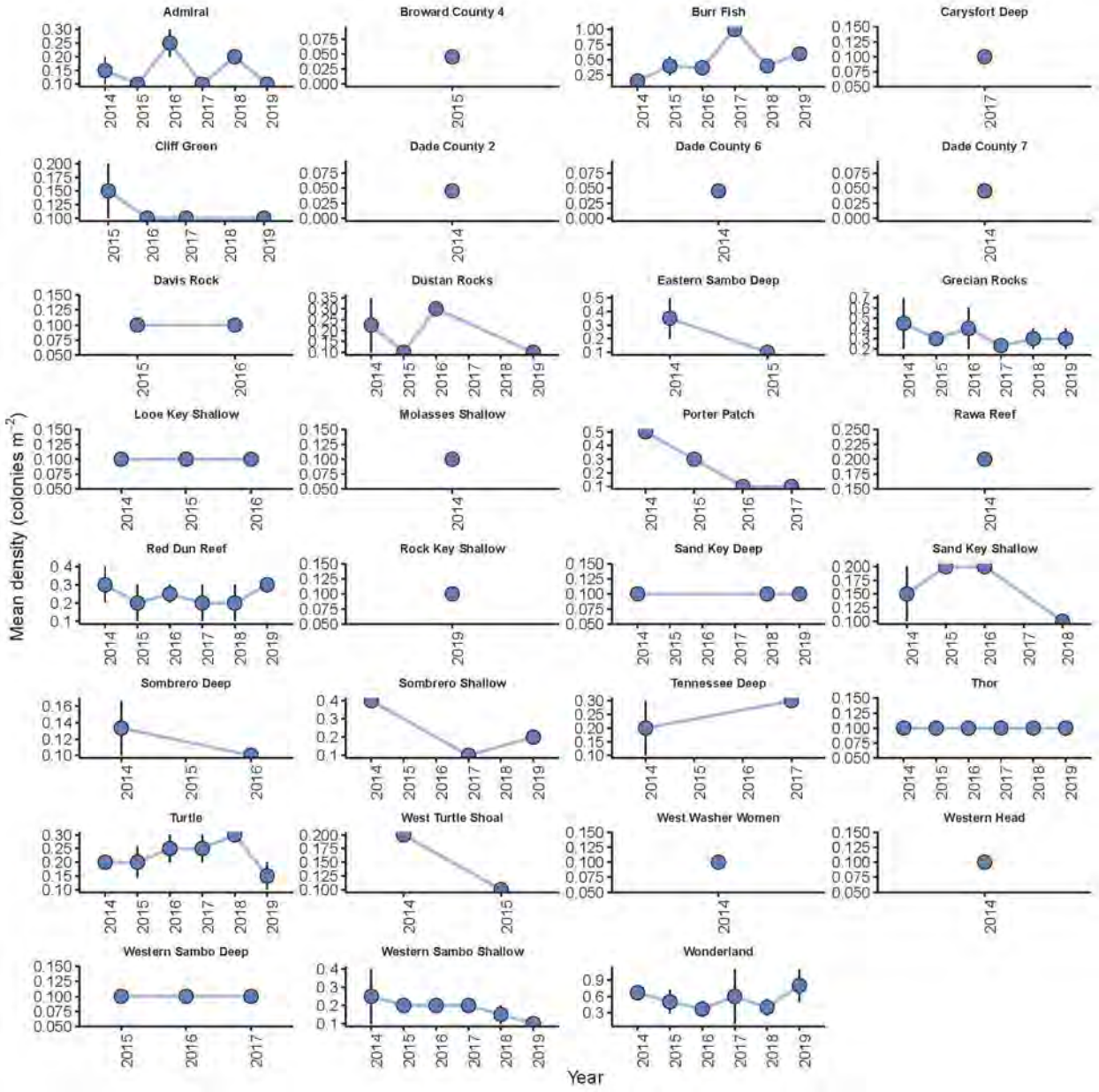

Figure 63. Mean density of *Orbicella annularis* colonies from 2014 to 2019: Individual site patterns. Mean density (colonies m^{-2}) of *O. annularis* colonies on transects at any Florida coral reef site surveyed where *O. annularis* was recorded on at least one transect between 2014 – 2019. Data presented are means ±SE. Note different y-axis values for each plot.

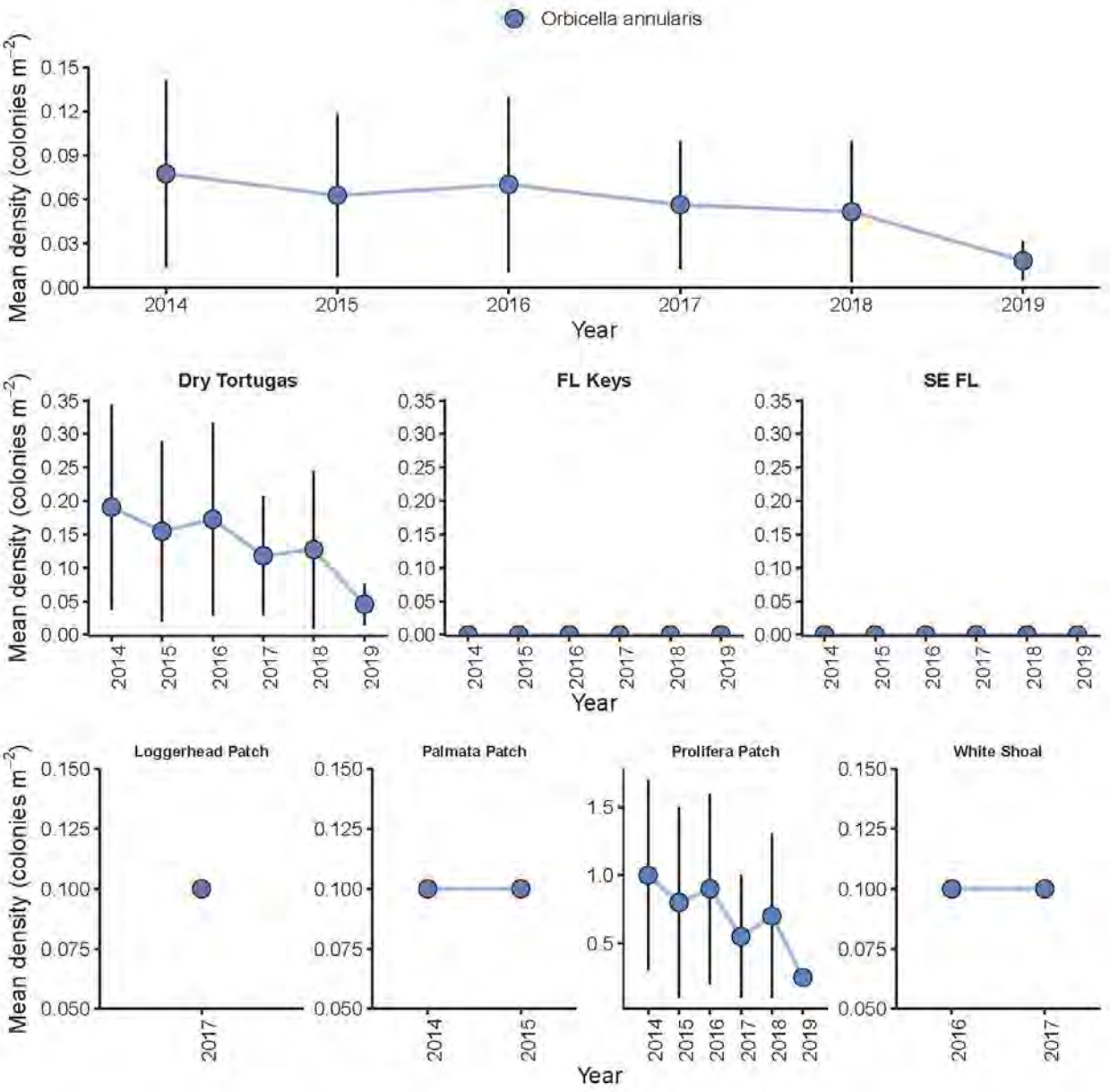

Figure 64. **Mean density of *Orbicella annularis* from 2014 to 2019: Florida-wide and regional patterns at monotypic and special habitat sites.** Mean density (colonies m^{-2}) of *O. annularis* across all transects conducted at monotypic and special habitat Florida coral reef sites surveyed by CREMP and SECREMP (n = 8). (Middle panels) Mean density (colonies m^{-2}) of *O. annularis* at monotypic and special habitat sites for each region surveyed by CREMP and SECREMP (DT = 4 sites; FL Keys = 3 sites; SE FL = 1 site). (Bottom panels) Mean density (colonies m^{-2}) of *O. annularis* at individual monotypic and special habitat sites (n=8) where *O. annularis* was recorded on at least one transect between 2014 and 2019. Data is only presented for years when *O. annularis* was present. Data presented are means ±SE. Note different y-axis values for each plot.

National Coral Reef Monitoring program (NCRMP) and the Florida Reef Resilience Program (FRRP) Disturbance Response Monitoring (DRM)

The National Coral Reef Monitoring Program (NCRMP) provides a biennial ecological characterization at a broad spatial scale of general reef condition for reef fishes, corals and benthic habitat (i.e., fish species composition/density/size, benthic cover, and coral density/size/condition). Data collection occurs at stratified random sites where the sampling domain for each region (e.g., Florida, Puerto Rico, U.S. Virgin Islands, Flower Garden Banks National Marine Sanctuary [FGBNMS]) is partitioned by habitat type and depth, sub-regional location (e.g., along-shelf position) and management zone.

The FRRP DRM uses a stratified random sampling design and focuses on bleaching species in <60 ft of water. Two $10m^2$ belt transects (1m width x 10m length) were completed at each site for a total of $20m^2$ surveyed at each site. Because NCRMP and DRM sampling overlaps in the geographic regions they survey and both employ a stratified random sampling design, density, percent cover and coral colony measures (maximum diameter, height, and percent partial mortality) data for these two surveys were combined and presented together.

Table 18. Number of surveys conducted by NCRMP and DRM monitoring programs each year from 2014 to 2020 broken down by each region surveyed. SE FL = Southeast Florida, STTSTJ = St. Thomas and St. John, STX = St. Croix.*In 2018 NCRMP and DRM surveys were conducted together and were not provided as individual data sets.

Year	Region	Survey	No. Surveys	Year	Region	Survey	No. Surveys
2014	Dry Tortugas	DRM	29	2017	Dry Tortugas	DRM	31
2014	Dry Tortugas	NCRMP	105	2017	FL Keys	DRM	18
2014	FL Keys	DRM	86	2017	SE FL	DRM	23
2014	FL Keys	NCRMP	314	2017	STTSTJ	NCRMP	230
2014	SE FL	DRM	41	2017	STX	NCRMP	171
2014	SE FL	NCRMP	49	2018	Dry Tortugas	NCRMP/ DRM*	139
2014	Puerto Rico	NCRMP	103	2018	FL Keys	DRM	95
2015	Dry Tortugas	DRM	20	2018	FL Keys	NCRMP	86
2015	FL Keys	DRM	129	2018	SE FL	DRM	50
2015	SE FL	DRM	100	2018	SE FL	NCRMP	70
2015	STTSTJ	NCRMP	162	2019	Dry Tortugas	DRM	79
2015	STX	NCRMP	133	2019	FL Keys	DRM	123
2016	Dry Tortugas	DRM	29	2019	SE FL	DRM	81
2016	Dry Tortugas	NCRMP	97	2019	Puerto Rico	NCRMP	147
2016	FL Keys	DRM	107	2019	STTSTJ	NCRMP	221
2016	FL Keys	NCRMP	92	2019	STX	NCRMP	245
2016	SE FL	DRM	48	2020	Dry Tortugas	DRM	108
2016	SE FL	NCRMP	93	2020	FL Keys	DRM	165
2016	Puerto Rico	NCRMP	157	2020	SE FL	DRM	116

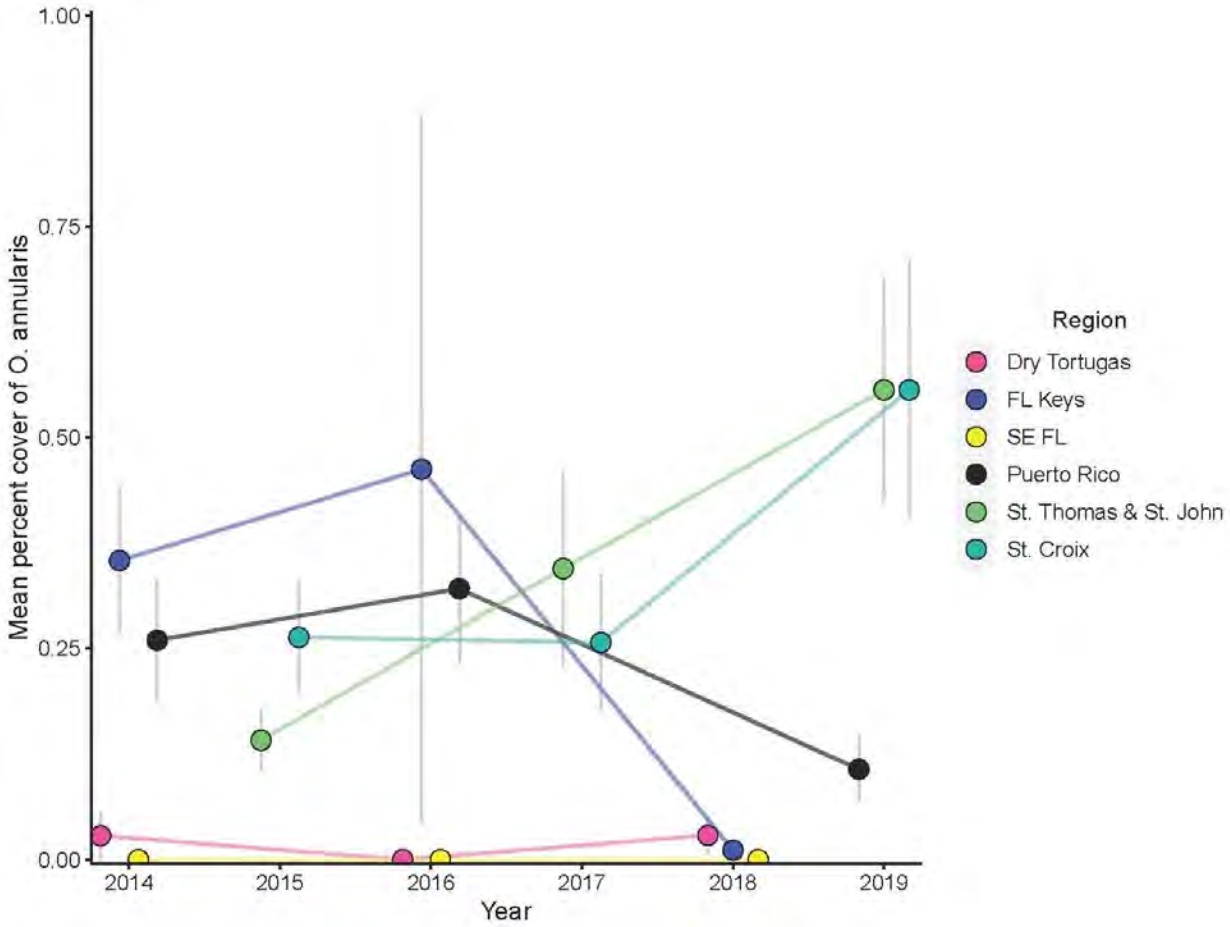

Figure 65. Mean percent cover of *Orbicella annularis* for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

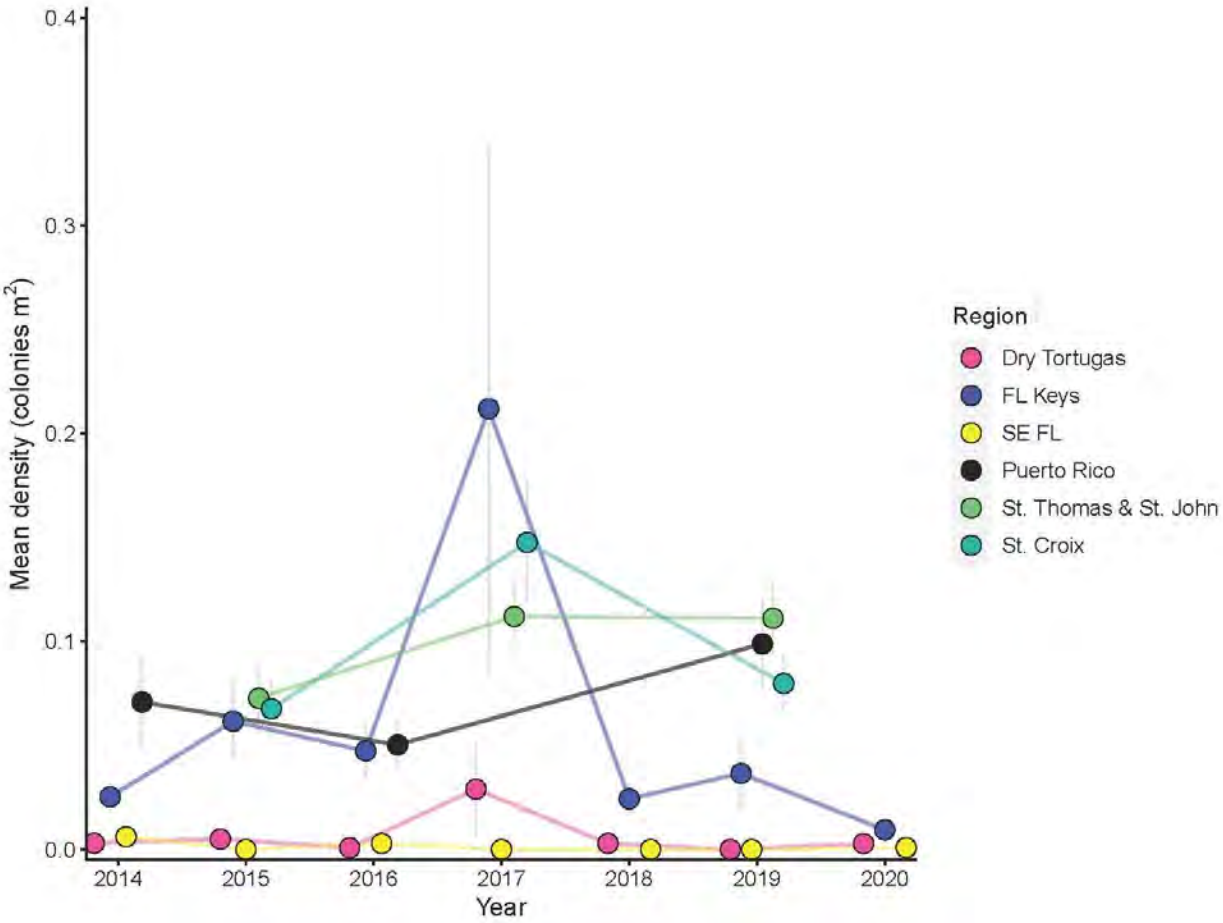

Figure 66. Mean density (colonies m^{-2}) of *Orbicella annularis* colonies for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

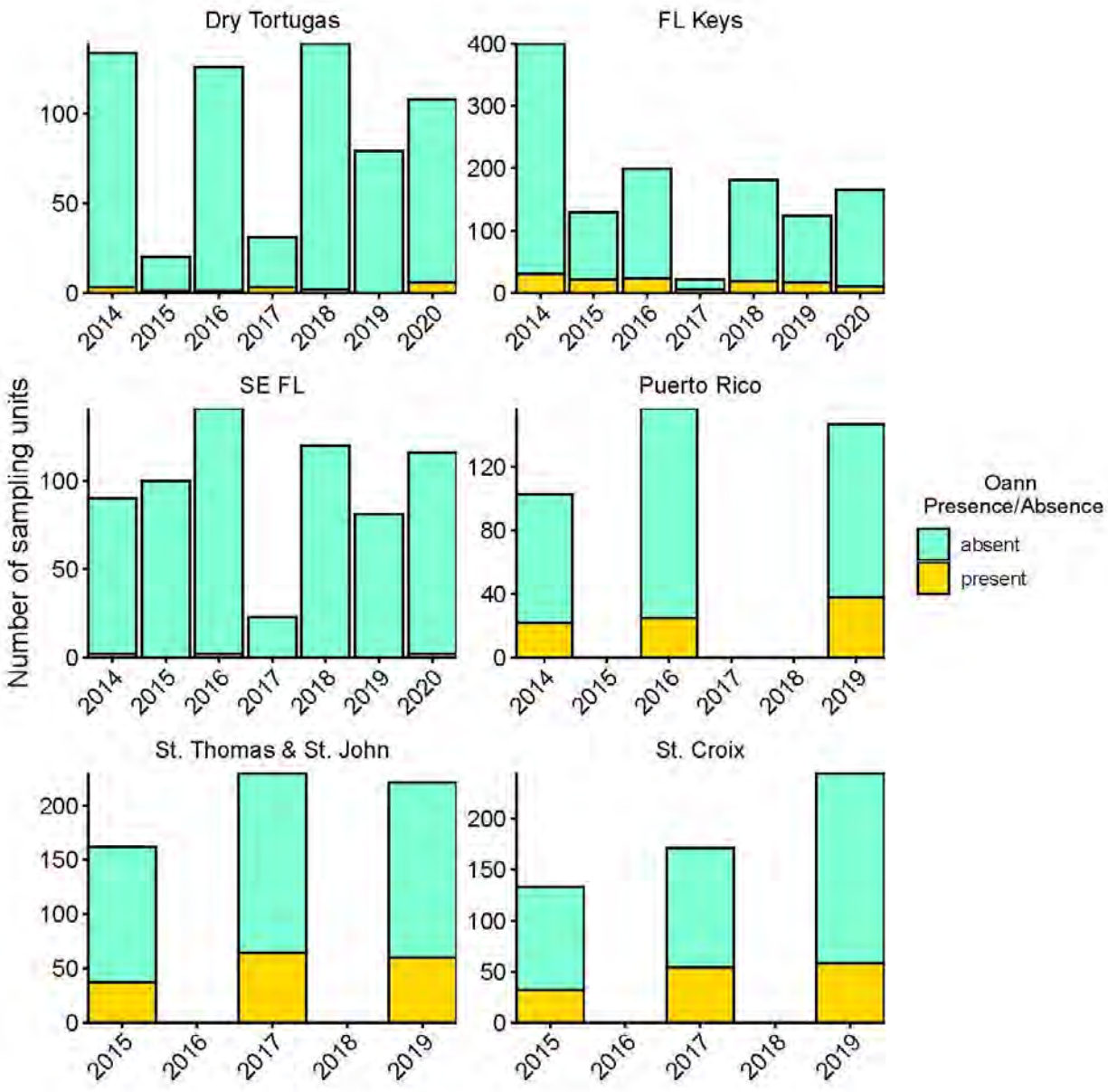

Figure 67. Number of sites where *Orbicella annularis* was observed (gold) or absent (teal) for each year and region surveyed by NCRMP and DRM from 2014 to 2020.

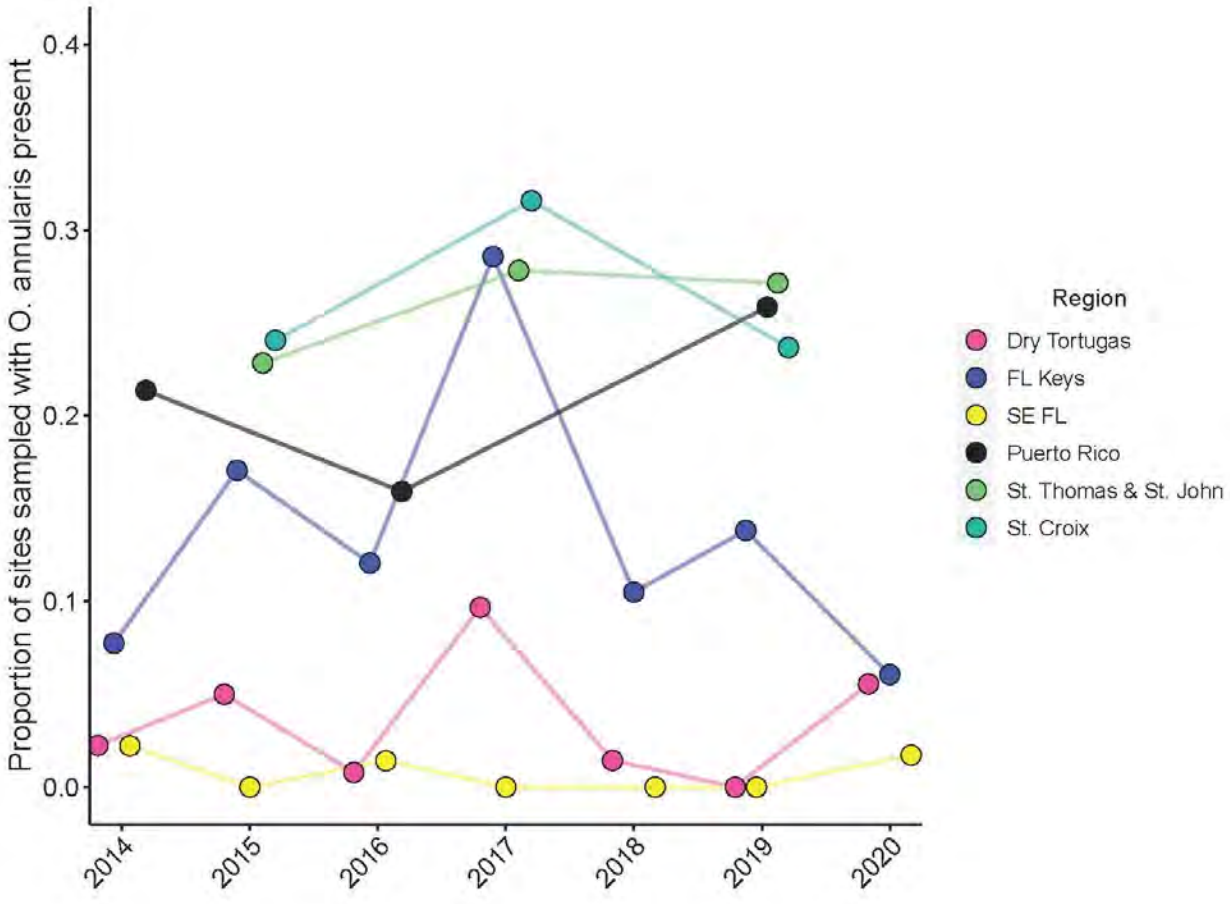

Figure 68. Proportion of all sites surveyed where *Orbicella annularis* was present for each year and region surveyed by NCRMP and DRM from 2014 to 2020.

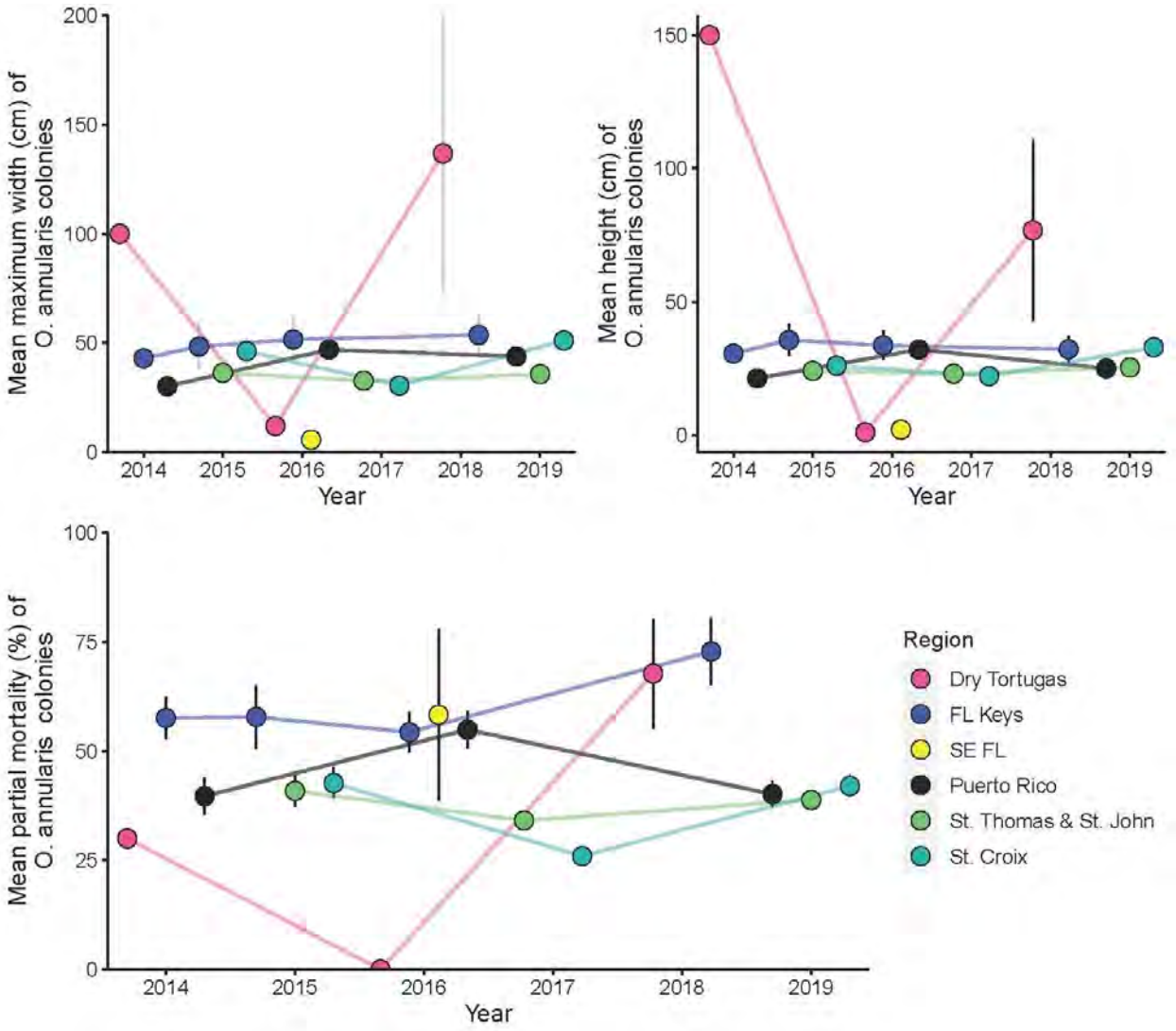

Figure 69. (Top Left) Mean maximum diameter (cm), (Top Right) mean height (cm), and (Bottom) mean partial colony mortality (%) of *Orbicella annularis* colonies surveyed on each transect for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

Puerto Rico CREMP (PR CREMP)

Data used in the figures below was provided by The Puerto Rico Coral Reef Monitoring Program (Miguel G Figuerola Hernandez, University of Puerto Rico, to Mark Ladd. Nov 24, 2020) and is publicly available at https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.nodc:0204647.

Benthic data collection and description (Copied from NCEI website): Data files include raw data (by transect) for 86 stations where substrate cover by sessile-benthic categories and fish, and motile megabenthic invertebrate taxonomic composition and densities have been characterized from 1999-2020. At present, 42 permanent stations are surveyed biannually (21 per year). For the benthic characterization, a set of five 10-meter-long permanent transects are surveyed at each station. Sessile-benthic reef communities are characterized by the continuous intercept chain-link method, following the Caribbean Coastal Marine Productivity (CARICOMP) (1994) protocol. The PRCREMP data files also include a site classification spreadsheet with descriptors for each monitoring station, some of which can be used as spatial and temporal factors for statistical analyses. These descriptors include information about depth, habitat type, distance from shore, marine protected areas attributes, coordinates, and other metadata.

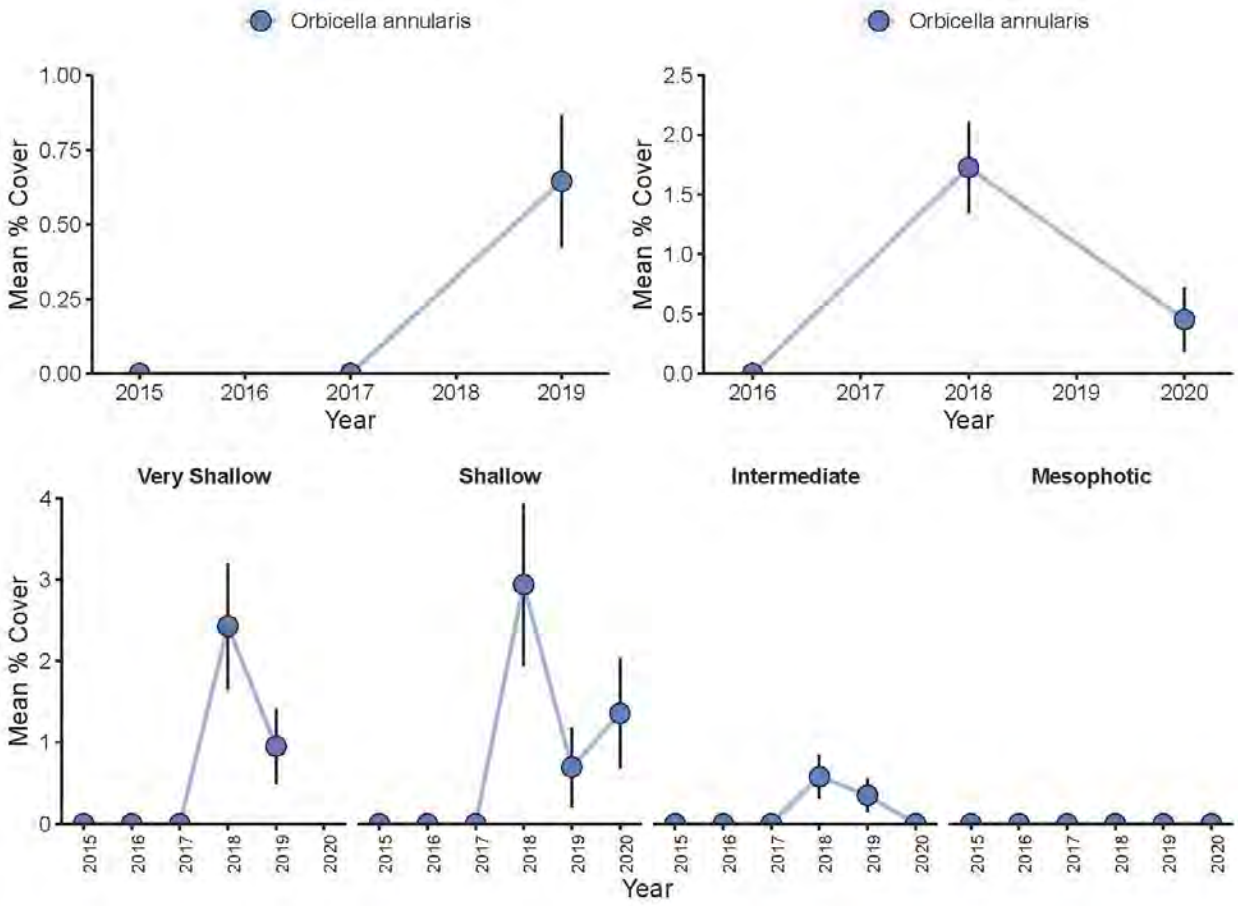

Figure 70. **Mean percent cover of *Orbicella annularis* from 2015 to 2020 at sites monitored by Puerto Rico CREMP.** (Top left panel) Mean percent cover of *O. annularis* averaged across all transects at sites surveyed by PR CREMP in 2015, 2017, and 2019. (Top right panel) Mean percent cover of *O. annularis* averaged across all transects at sites surveyed by PR CREMP in 2016, 2018, and 2020 (21 sites surveyed in 2016 and 2018, only 3 sites included for 2020). (Bottom panels) Mean percent cover of *O. annularis* at all sties surveyed by PR CREMP broken down by site depth (21 sites surveyed 2015 to 2019, only 3 sites included for 2020).

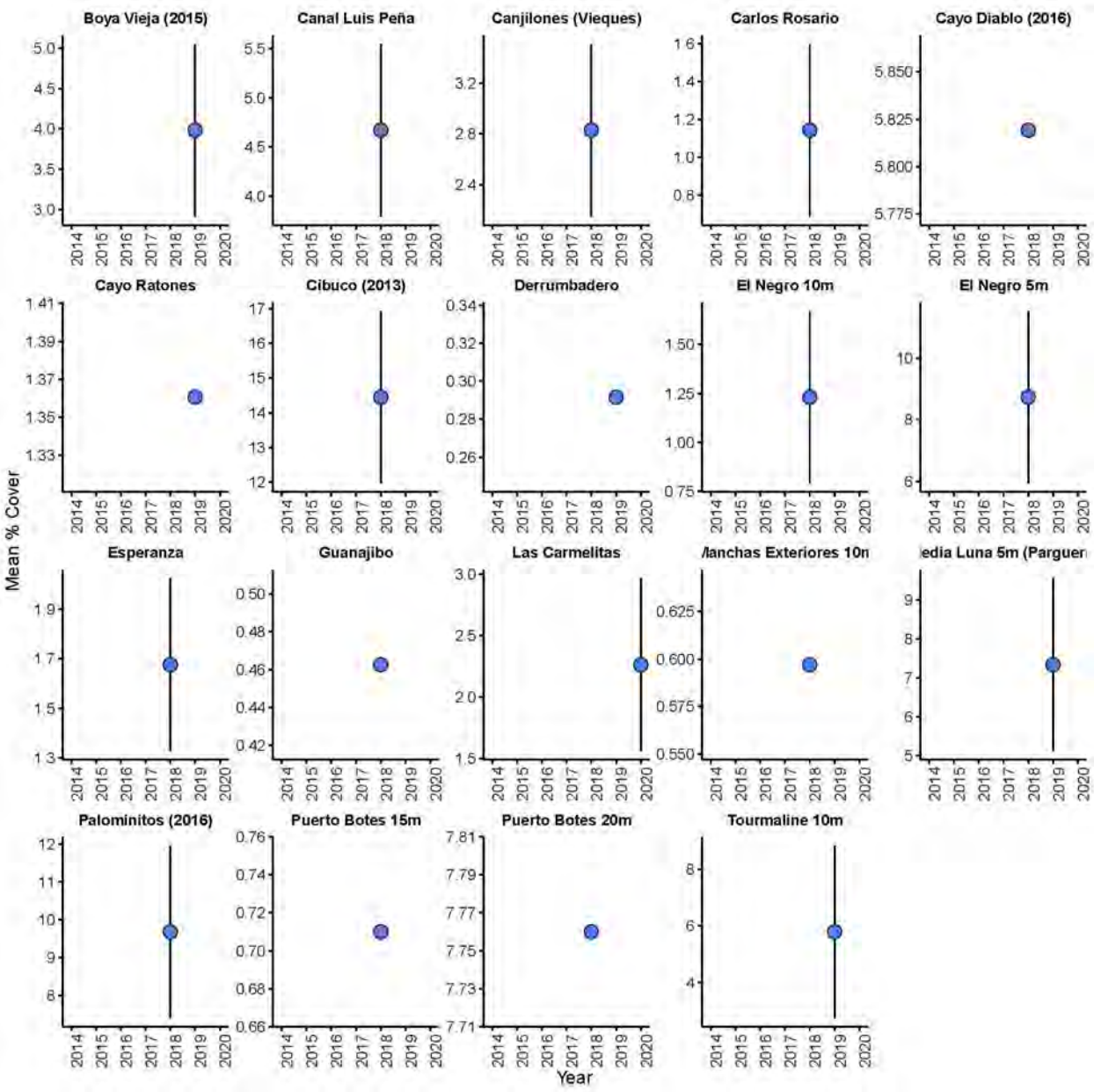

Figure 71. **Mean percent cover of *Orbicella annularis* at individual sites where *O. annularis* was recorded on at least one transect between 2015 and 2019 in PR CREMP surveys**. For bottom panels data are only presented for years when *O. annularis* was present. Note different y-axis values for each plot. Data presented are means ±SE. 21 sites were surveyed from 2015 to 2019, only data from 3 sites were provided for 2020.

Puerto Rico FEMA surveys

Monitoring was conducted in coral reef habitat at six subregions of Puerto Rico in 2018. These surveys were conducted in March of 2018, following Hurricane Irma, which affected the area in the fall of 2017. Two types of surveys were conducted to collect two types of data: (1) presence-absence data and (2) density data. Both presence-absence and density data were collected via a combination of roving diver surveys and transect surveys. The total number of surveys conducted in 2018 within each subregion of Puerto Rico is provided in the table below. Density surveys were conducted at a subset of sites where presence-absence surveys were conducted. The area covered by roving diver surveys ranged from 157 m^2 to 1,702 m^2, whereas transect areas ranged from 50 m^2 to 1000 m^2.

Table 19. Number of surveys conducted in Puerto Rico in 2018 broken down by Subregion, roving surveys, and transects surveys.

Survey Type	Subregion	Roving surveys	Transect surveys	Total surveys
Presence - Absence Surveys	North	11	9	20
Presence - Absence Surveys	Northeast	52	68	120
Presence - Absence Surveys	Southeast	8	7	15
Presence - Absence Surveys	Southwest	14	12	26
Presence - Absence Surveys	West	16	14	30
Presence - Absence Surveys	Vieques	19	20	39
Presence - Absence Surveys	**Total**	**120**	**120**	**250**
Density Surveys	North	11	9	20
Density Surveys	Northeast	52	56	108
Density Surveys	Southeast	8	7	15
Density Surveys	Southwest	14	10	24
Density Surveys	West	15	12	27
Density Surveys	Vieques	19	18	37
Density Surveys	**Total**	**119**	**112**	**231**

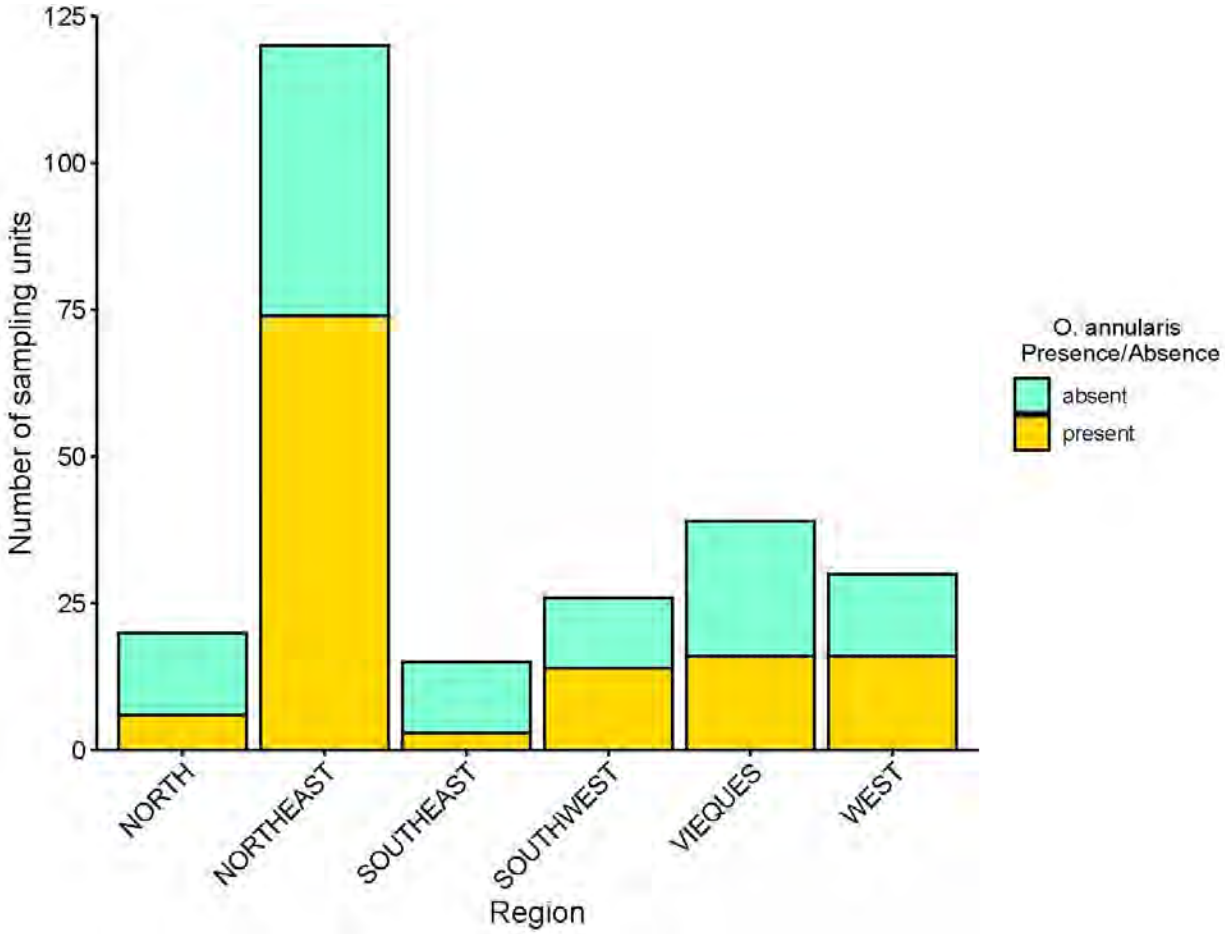

Figure 72. Number of surveys where *Orbicella annularis* was present (gold) or absent (teal) in each subregion of Puerto Rico. Surveys were conducted in March of 2018 and were a mix of transect and roving diver surveys.

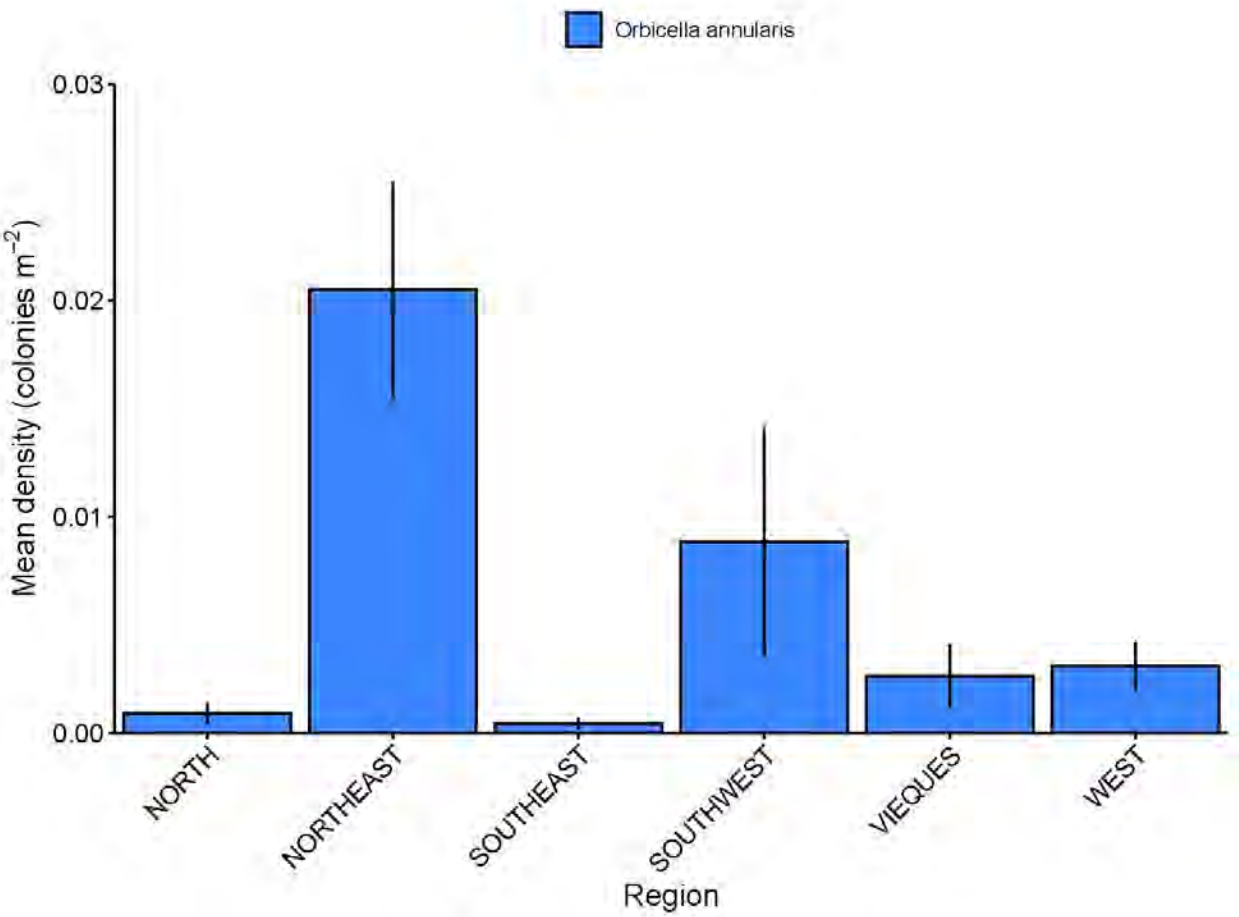

Figure 73. Density of O*rbicella annularis* colonies (corals m^{-2}*)* in each subregion of Puerto Rico. Surveys were conducted in March of 2018 and were a mix of transect and roving diver surveys.

USVI CREMP

Benthic cover data collection and description from website: At each site, benthic cover surveys are conducted annually along six 10 m long permanent transects marked with steel or brass rods. Video sampling consists of one diver traversing each transect videotaping the benthic cover using a high definition digital video recorder. After taping, images from each transect are captured and imported into RStudio where twenty randomly allocated points are superimposed on each image. Analysis consists of identifying the substrate located under each point. For each transect, the percent cover of coral, epilithic algae (EAC), macroalgae, sponges, gorgonians, and sand/sediment are calculated by dividing the number of random dots falling on that substrate type by the total number of dots for that transect.

The USVI CREMP program monitors 34 sites. However, not all sites were surveyed each year. Number of sites surveyed for each year included in this review were: 2015: n = 33; 2016: n = 32; 2017: n = 11; 2018: n = 34; 2019: n = 33; 2020: n = 19. In 2018 and 2019 some sites were surveyed twice in one year and thus there are 12 instead of 6 transects total for those sites.

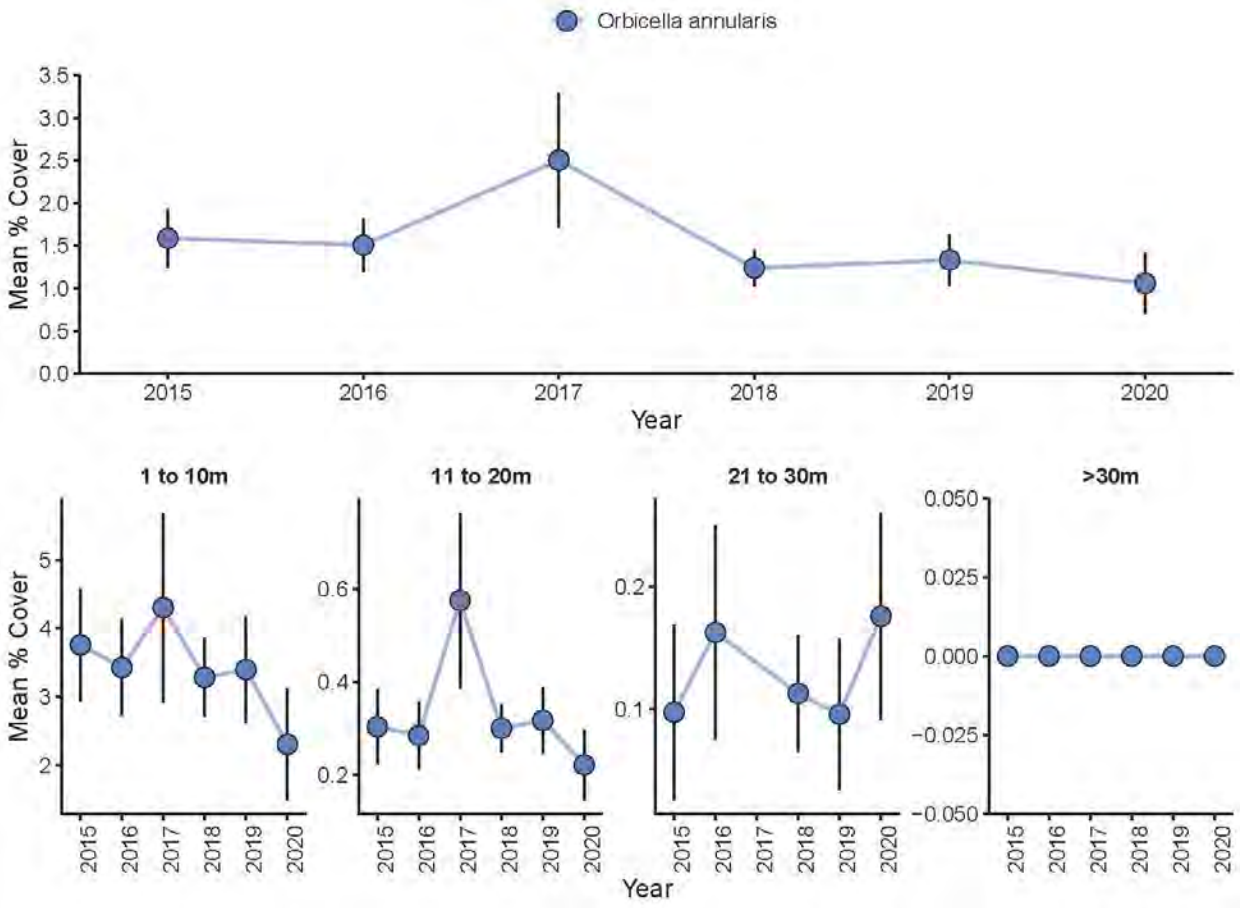

Figure 74. Mean percent cover of *Orbicella annularis* from 2015 to 2020 at sites monitored by USVI CREMP. (Top panel) Mean percent cover of *O. annularis* averaged across all transects at sites surveyed by USVI CREMP (range: 11 to 34 sites per year). (Bottom panels) Mean percent cover of *O. annularis* at all sites surveyed by USVI CREMP broken down by site depth.

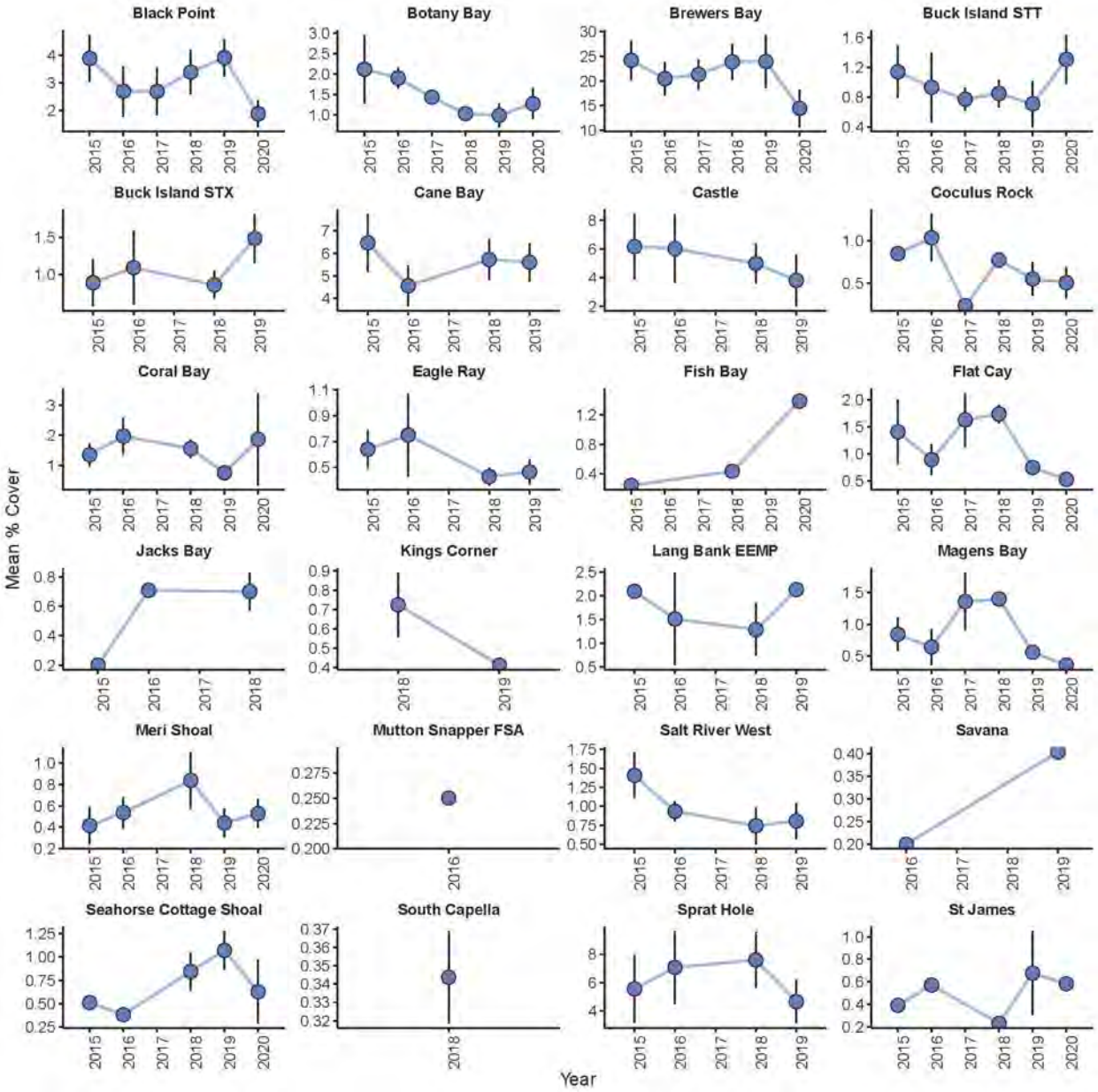

Figure 75. **Mean percent cover of *Orbicella annularis* at sites monitored by USVI CREMP at individual sites where *O. annularis* was recorded on at least one transect between 2015 and 2019.** Data are only presented for years when *O. annularis* was present. Note different y-axis values for each plot. Data presented are means ±SE.

Orbicella faveolata

Table 20. Information on the data sources used to create the figures within this document for the *Orbicella faveolata* 5 Year Status Review.

DATA SOURCE	LOCATION(S)	YEARS INCLUDED	DATA TYPE(S)
Coral Reef Evaluation and Monitoring Project (CREMP)	Florida Keys, Dry Tortugas	2014 - 2020	Density, Live Tissue Area
Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP)	Southeast Florida	2014 - 2019	Density, Live Tissue Area
Puerto Rico Coral Reef Monitoring Program (PR CRMP)	Puerto Rico	2014 – 2020	Percent cover
Puerto Rico FEMA monitoring	Puerto Rico	2018	Presence absence, density
US Virgin Island Coral Reef Monitoring Program (USVI CRMP)	U.S. Virgin Islands	2014-2020	Percent cover
Florida Reef Resilience Program's Disturbance Response Monitoring (FRRP DRM)	Southeast Florida, Florida Keys, Dry Tortugas	2014 -2019	Abundance, density, size, mortality
National Coral Reef Monitoring Program (NCRMP) (includes DRM data)	Southeast Florida, Florida Keys, Dry Tortugas, U.S. Virgin Islands, Puerto Rico	2014-2020	Percent cover, density

OTHER DATA FROM THE ESA CORAL DATABASE FILE

*Excluding the above data, the ESA Coral Database did not include additional entries for *Orbicella faveolata* between 2014 and 2020.

Coral Reef Evaluation and Monitoring Project (CREMP) and the Southeast Coral Reef Evaluation and Monitoring Project (SECREMP)

The data used to generate **Figure 76** through **Figure 85** (below) were provided by Florida's Coral Reef Evaluation and Monitoring Project (CREMP) and SECREMP (pers. comm., Mike Colella, Florida Fish and Wildlife Conservation Commission (FWC), to Alison Moulding, Aug. 27, 2020). CREMP in the Florida Keys is funded through the EPA South Florida Water Quality Protection Program and CREMP in the Dry Tortugas is funded through the National Park Service. Both Florida Keys and Dry Tortugas surveys were completed by the Coral Program at the FWC Fish and Wildlife Research Institute (FWRI). SECREMP data is credited to Florida Department of Environmental Protection (FDEP) Coral Reef Conservation Program and Dr. David Gilliam's lab at the National Coral Reef Institute (NCRI) and Nova Southeastern University (NSU).

CREMP and SECREMP surveys were conducted annually in permanent transects across sites (n=4 transects per site) in three regions of Florida: Dry Tortugas (DT), Florida Keys (FL Keys), and Southeast Florida (SE FL) north of the Florida Keys (see Table below for number of sites within each region). This sampling scheme includes eight sites that are located at monospecific coral stands or special habitat areas for the coral species in this status review. Thus, data from these eight sites (DT n = 4 sites, FL Keys n = 3 sites; SE FL n = 1 site) were excluded from the general CREMP data analyses and are presented as separate figures (**Figures 80** and **85**). The figures below display Florida-wide, regional and site-specific trends in mean percent coral cover, total or mean live coral area, and total colony counts by species between 2014 and 2019 from CREMP and SECREMP survey data. For these figures means were calculated by using transect as a replicate (n = 260 per year, except for 2017, where n = 258 transects).

Table 21. Number of sites surveyed annually by CREMP and SECREMP programs.

Region	Number of Sites	Number of monospecific or special habitat area sites
Southeast Florida (SE FL)	21	1
Florida Keys	37	3
Dry Tortugas	7	4

CREMP and SECREMP monitoring data summary

Note: Percent cover values provided in the CREMP and SECREMP dataset are categorized as "*Orbicella annularis* complex", rather than individual Orbicella species. Live Tissue Area and Density data are broken down by specific Orbicella species

LIVE TISSUE AREA: The total amount of live tissue area of *Orbicella faveolata* (estimated area; m2) across all 260 transects surveyed was highest in 2015 when an estimated total of 1010.74 m^2 was recorded, and then slowly declined to the lowest value in 2019 when 658.87 m^2 of live tissue was recorded (**Figure 76**). Total live tissue area for *O. faveolata* remained relatively stable from 2014 to 2019 in the Dry Tortugas region (max: 288.37 m^2 in 2015, min 208.08 m^2 in 2016), but declined in the Florida Keys region from a high of 644.88 m^2 in 2016 to a low of 391.11 m^2 in 2019. In the Southeast Florida region, the total amount of live tissue area of *O. faveolata* ranged from 58.46 m^2 (2015) to 7.76 m^2 (2018; **Figure 76**). In the Dry Tortugas region, total live tissue area of *O. faveolata* at monotypic sites increased from 1.65 m^2 in 2014 to 39.11 m^2 in 2019. In the Florida Keys region, total live tissue area of *O. faveolata* remained relatively stable between 2015 and 2019 (**Figure 80**).

DENSITY: The mean density of *Orbicella faveolata* colonies across all 260 transects surveyed was highest in 2015 at 0.121 ± 0.016 colonies m^{-2} (mean ±SE; **Figure 81**), and lowest in 2019 with an average density of at 0.079 ± 0.008 colonies m^{-2}. In the Dry Tortugas, the density of *O. faveolata* decreased from a high of 0.368 ± 0.097 colonies^{-2} in 2015 to a low of 0.168 ± 0.026 colonies^{-2} in 2019. The mean density of *O. faveolata* colonies observed on transects in the Florida Keys was lower than in the Dry Tortugas, but remained relatively stable from 2014 to 2019. The density of *O. faveolata* colonies at monotypic sites was lowest in 2014 (0.007 ± 0.005 colonies m^{-2}) and highest in 2019 (0.089 ± 0.052 colonies m^{-2}; **Figure 85**).

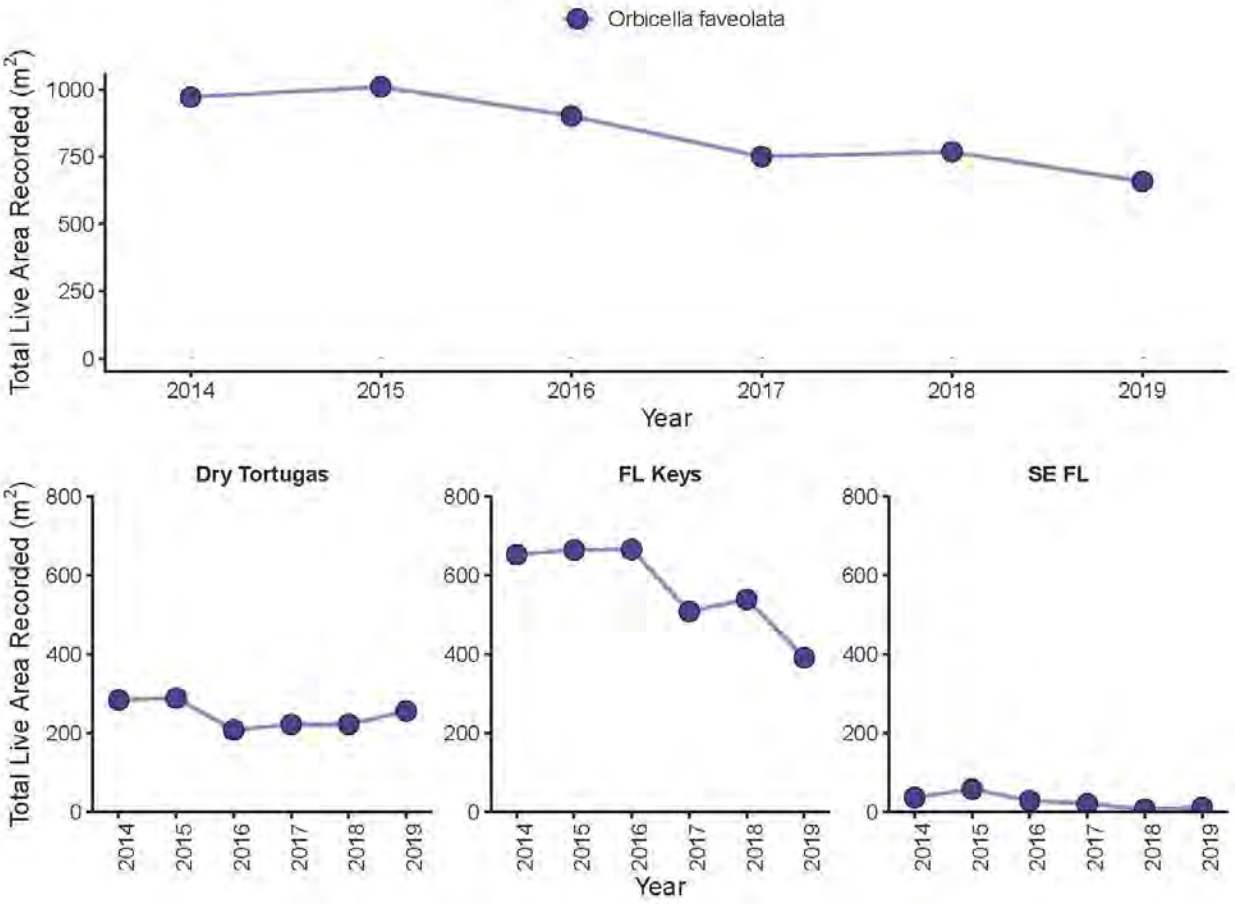

Figure 76. **Total live area (m2) of *Orbicella faveolata* from 2014 to 2019: Florida-wide and regional patterns.** (Top panel) Total live area (m2) of *O. faveolata* summed across all transects conducted at Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites). (Bottom panels Total live area (m2) of *O. faveolata* for each region surveyed by CREMP (DT = 7 sites; FL Keys = 37 sites; SE FL = 21 sites). Note different y-axis values for each plot.

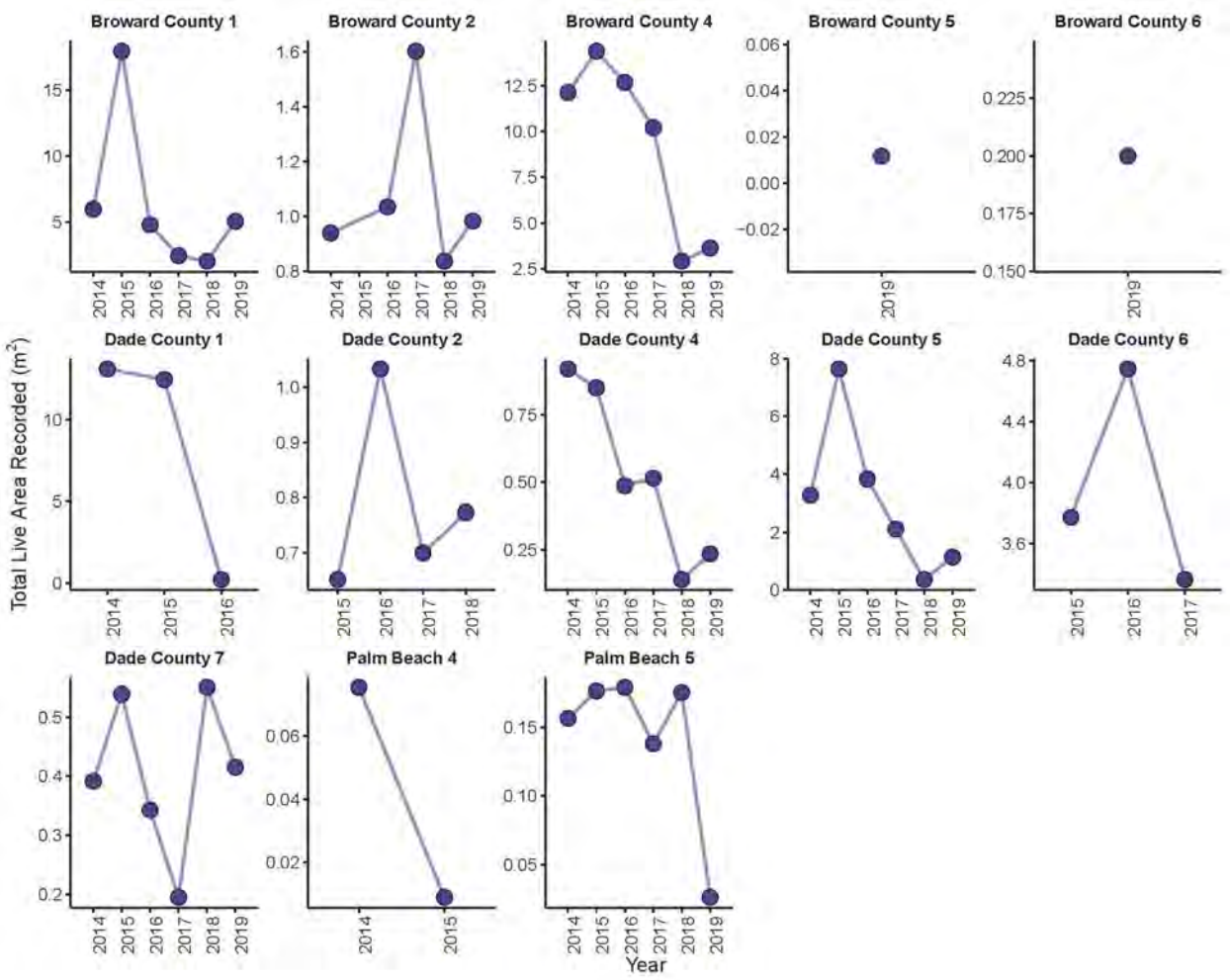

Figure 77. **Total live area (m2) of *Orbicella faveolata* from 2014 to 2019: Individual site patterns at sites in Southeast Florida.** Total live area of *O. faveolata* on transects conducted at any Florida coral reef sites in the Southeast Florida subregion (n = 21) surveyed by SECREMP where *O. faveolata* was recorded on at least one transect between 2014 – 2019. Note different y-axis values for each plot.

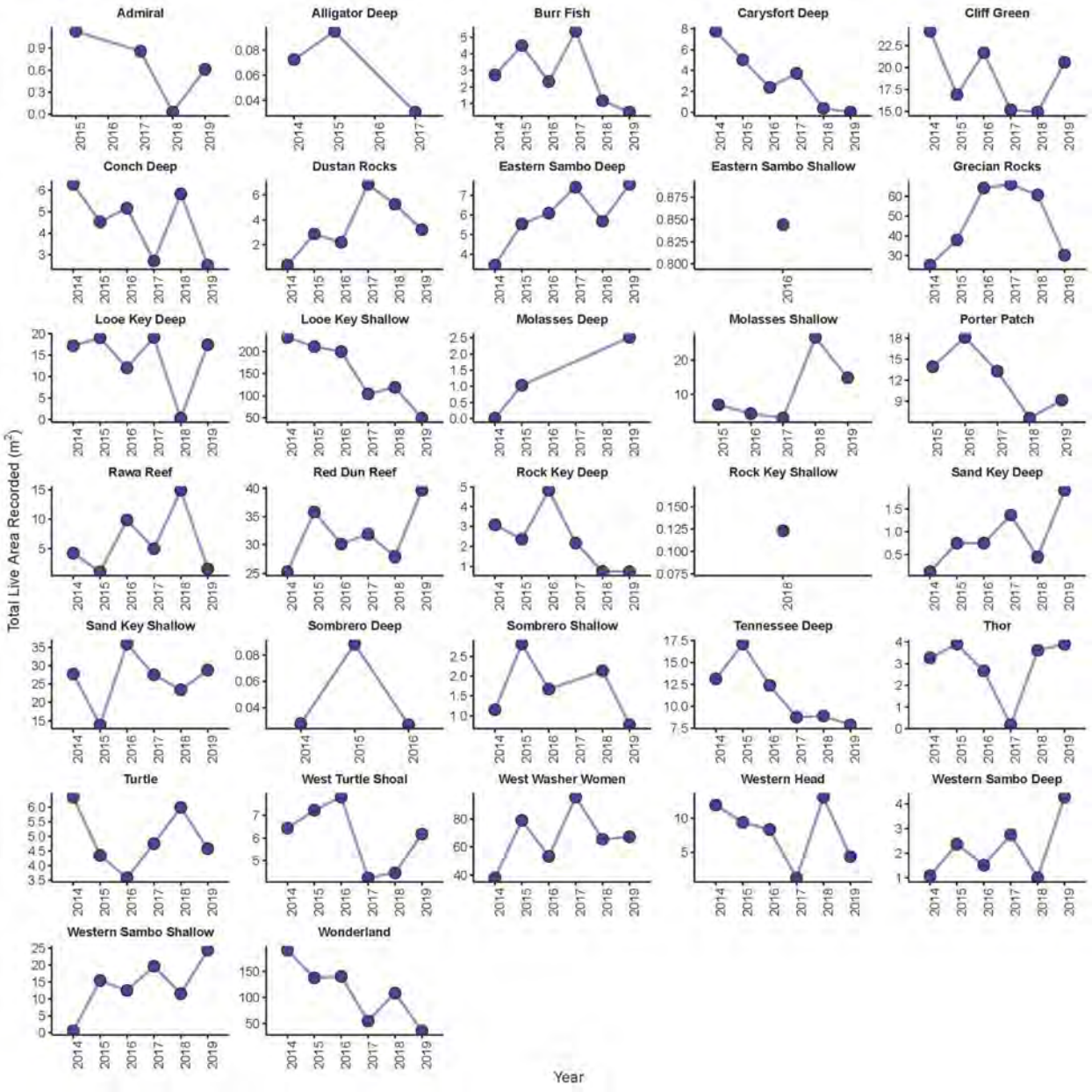

Figure 78. Total live area (m^2) of *Orbicella faveolata* from 2014 to 2019: Individual site patterns at sites in the Florida Keys. Total live area (m^2) of *O. faveolata* on transects conducted at any Florida coral reef sites in the Florida Keys subregion (n = 37) surveyed by CREMP where *O. faveolata* was recorded on at least one transect between 2014 – 2019. Note different y-axis values for each plot.

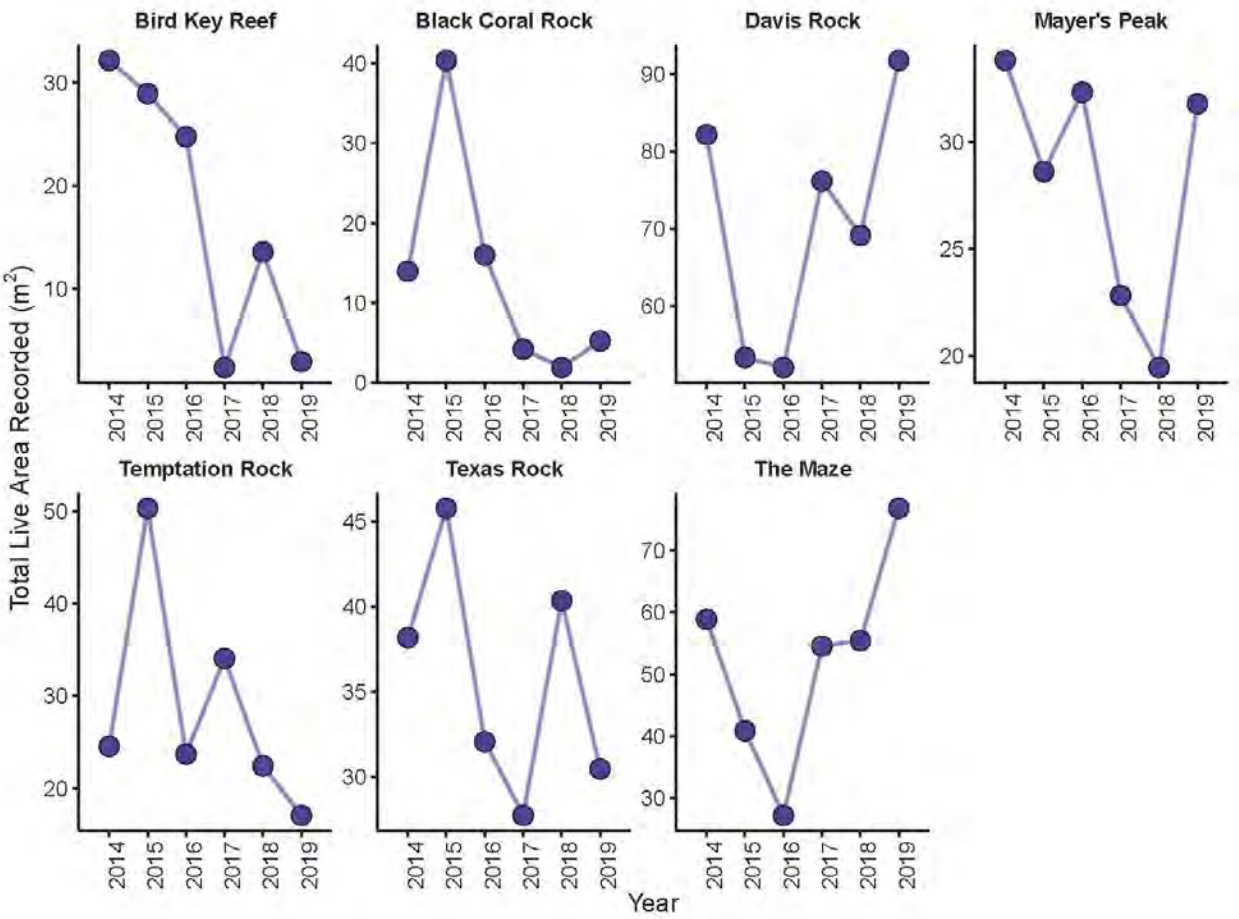

Figure 79. Total live area (m^2) of *Orbicella faveolata* from 2014 to 2019: Individual site patterns at sites in the Dry Tortugas. Total live area (m^2) of *O. faveolata* on transects conducted at any Florida coral reef sites in the Dry Tortugas subregion (n = 7) surveyed by CREMP where *O. faveolata* was recorded on at least one transect between 2014 – 2019. Note different y-axis values for each plot.

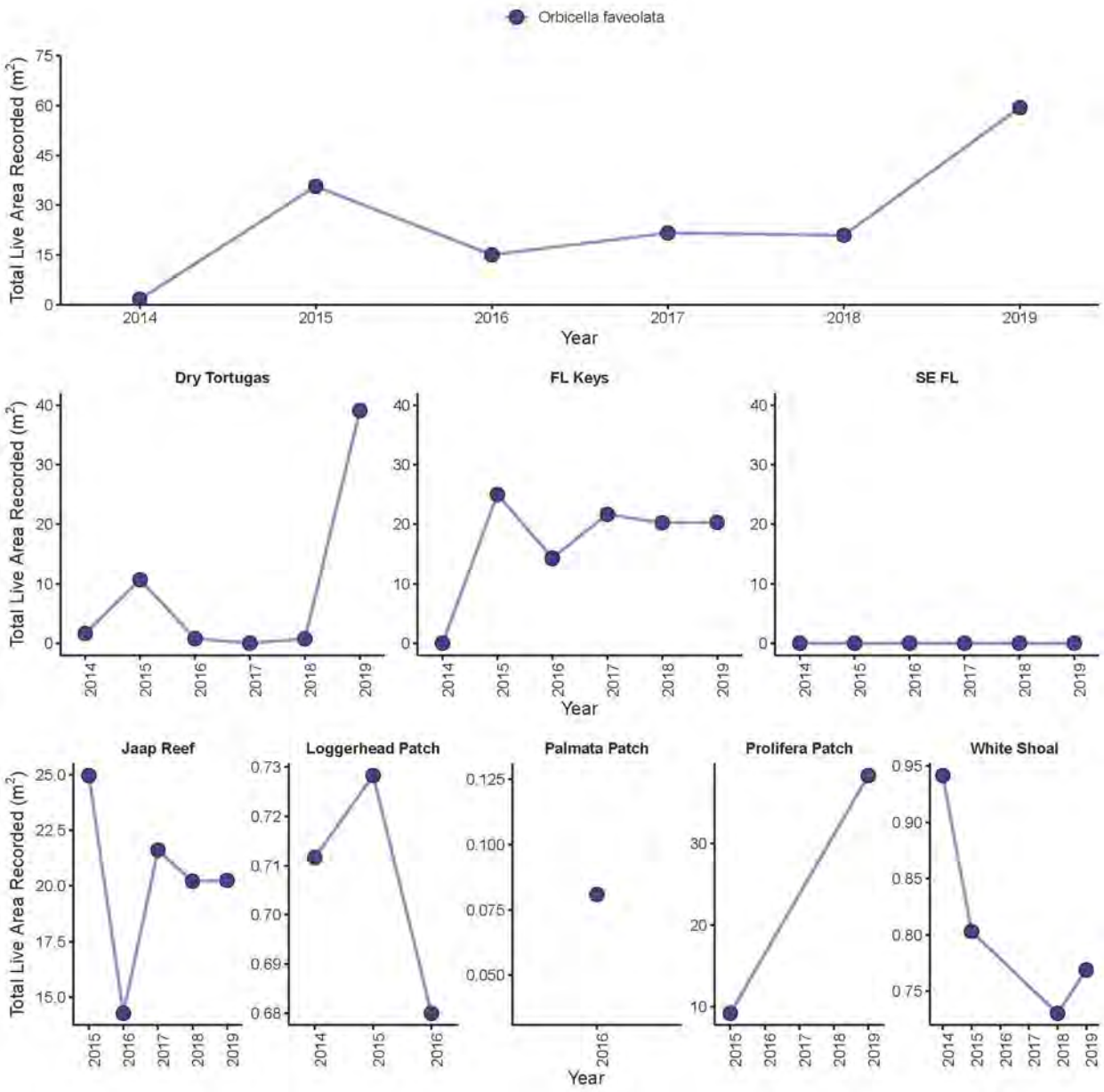

Figure 80. Total live area (m^2) of *Orbicella faveolata* from 2014 to 2019: Florida-wide and regional patterns at monotypic and special habitat sites. Total live area (m^2) of *O. faveolata* across all transects conducted at monotypic and special habitat Florida coral reef sites surveyed by CREMP and SECREMP (n = 8). (Middle panels) Total live area (m^2) of *O. faveolata* at monotpyic and special habitat sites for each region surveyed by CREMP and SECREMP (DT = 4 sites; FL Keys = 3 sites; SE FL = 1 site). No data was reported for *O. faveolata* at monotypic sites in the Dry Tortuguas in 2017 or in the Florida Keys in 2014. (Bottom panels) Total live area (m^2) of *O. faveolata* at individual monotypic and special habitat sites (n=8) where *O. faveolata* was recorded on at least one transect between 2014 and 2019. Data is only presented for years when *O. faveolata* was present. Note different y-axis values for each plot.

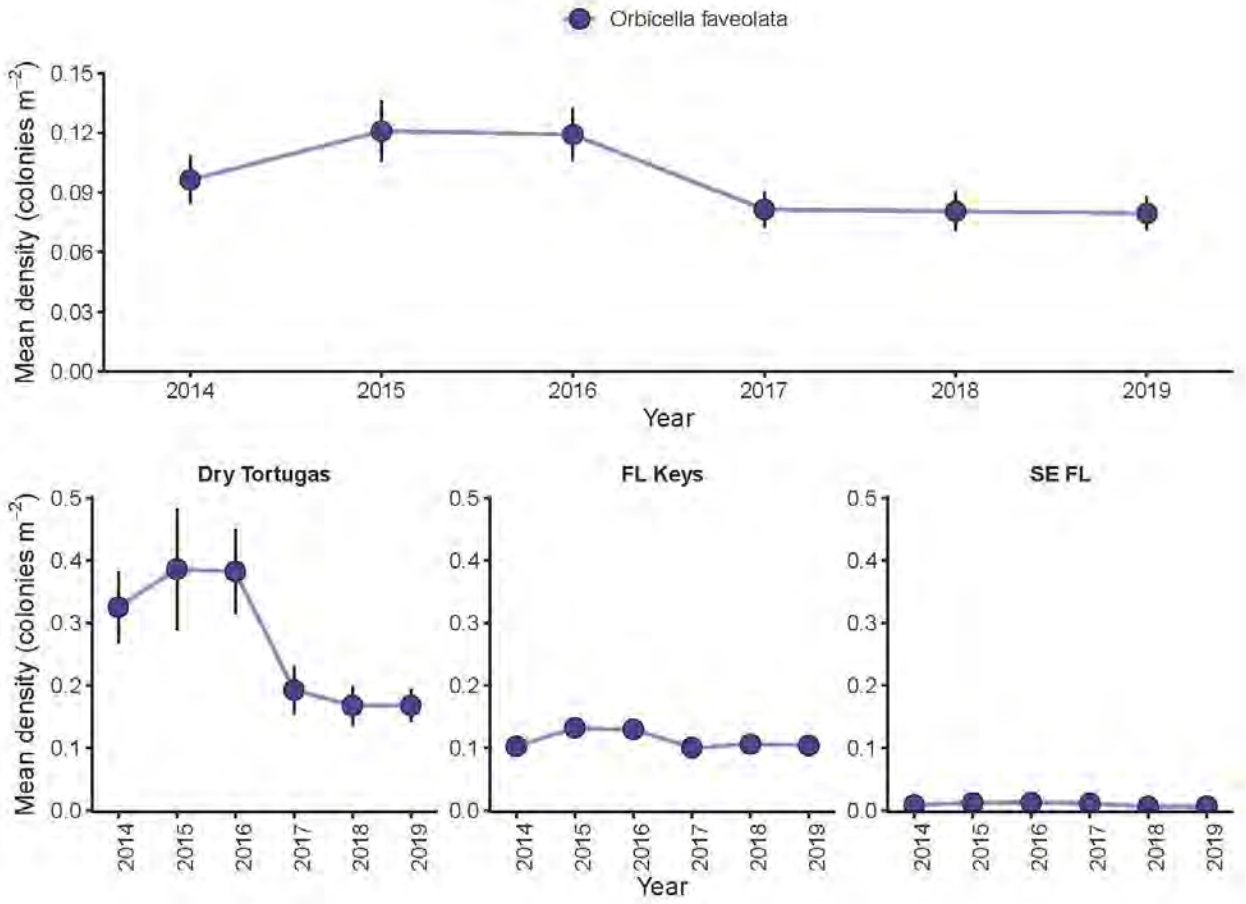

Figure 81. Mean density of *Orbicella faveolata* colonies from 2014 to 2019: Florida-wide and regional patterns. (Top panel) Mean density (colonies m^{-2}) of *O. faveolata* colonies averaged across all transects conducted at Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites). (Bottom panels) Mean density (colonies m^{-2}) of *O. faveolata* colonies for each region surveyed by CREMP and SECREMP (DT = 7 sites; FL Keys = 37 sites; SE FL = 21 sites). Data presented are means ±SE. Note different y-axis values for each plot.

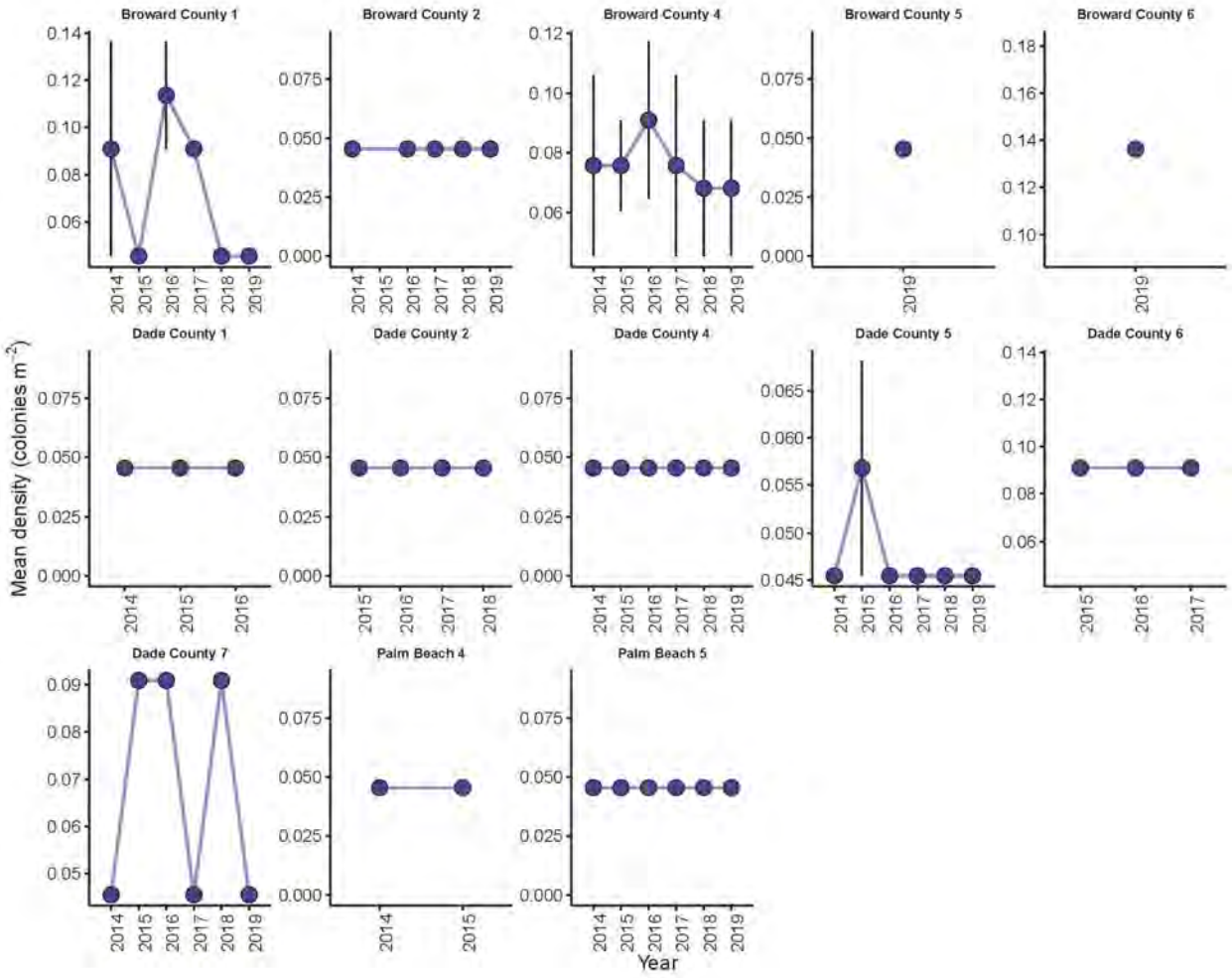

Figure 82. Mean density of *Orbicella faveolata* colonies from 2014 to 2019: Individual site patterns at sites in Southeast Florida. Mean density (colonies m^{-2}) of *O. faveolata*. colonies on transects at any Florida coral reef site in the Southeast Florida subregion (n = 21) surveyed by where *O. faveolata* was recorded on at least one transect between 2014 – 2019. Data presented are means ±SE. Note different y-axis values for each plot.

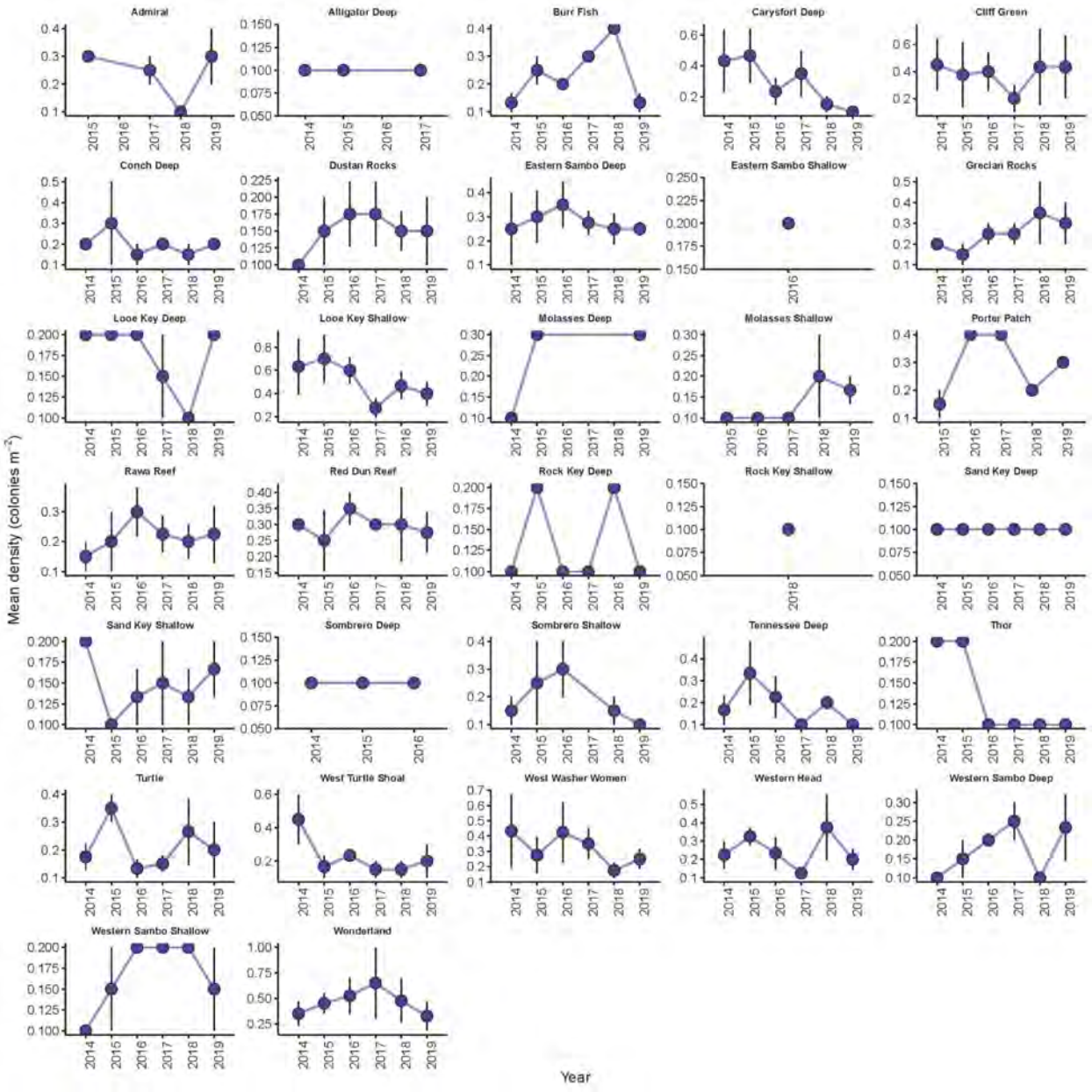

Figure 83. Mean density of *Orbicella faveolata* colonies from 2014 to 2019: Individual site patterns at sites in the Florida Keys. Mean density (colonies m^{-2}) of *O. faveolat*a colonies on transects at any Florida coral reef site in the Florida Keys subregion (n = 37) surveyed by where *O. faveolata* was recorded on at least one transect between 2014 – 2019. Data presented are means ±SE. Note different y-axis values for each plot.

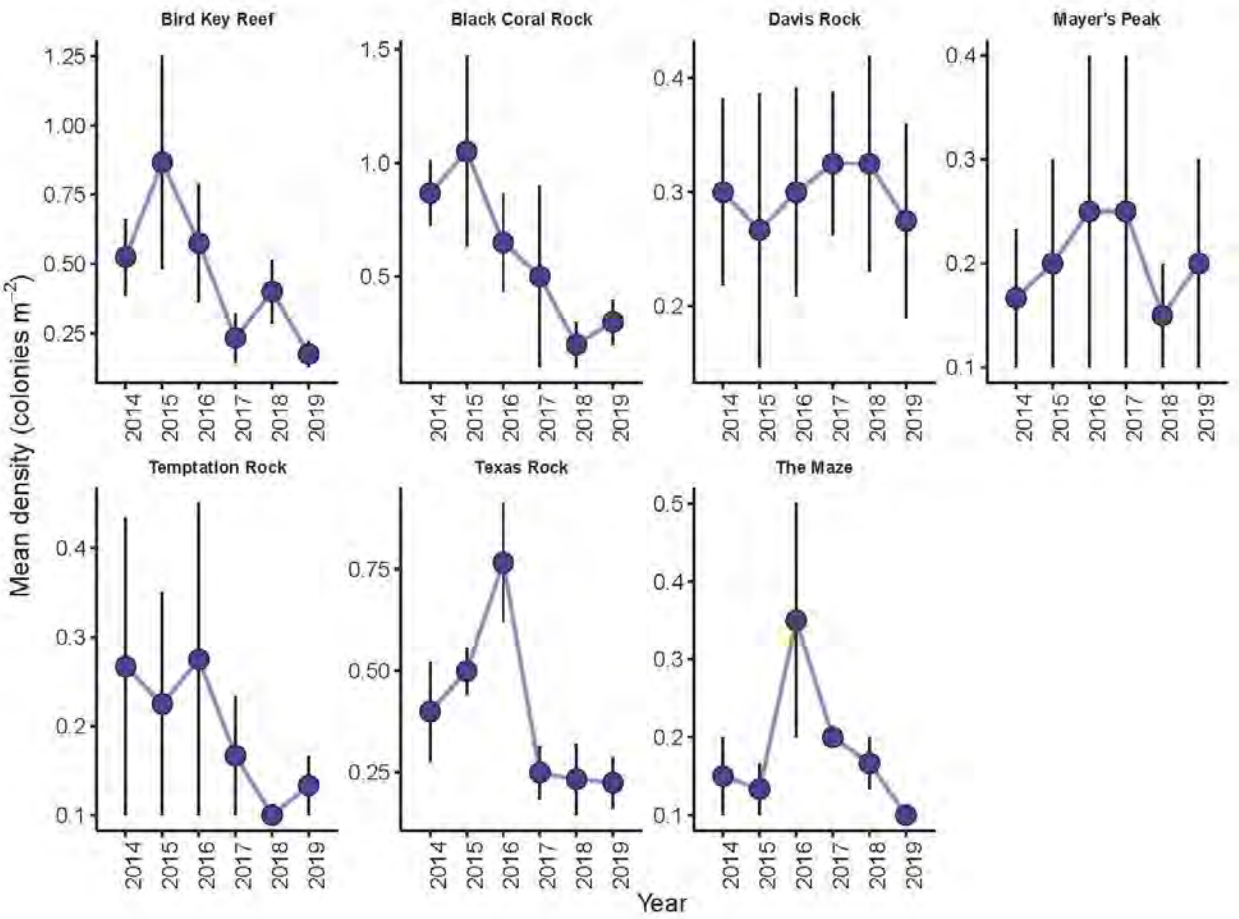

Figure 84. Mean density of *Orbicella faveolata* colonies from 2014 to 2019: Individual site patterns at sites in the Dry Tortugas. Mean density (colonies m^{-2}) of *O. faveolata*. colonies on transects at any Florida coral reef site in the Dry Tortugas subregion (n = 7) surveyed by where *O. faveolata* was recorded on at least one transect between 2014 – 2019. Data presented are means ±SE. Note different y-axis values for each plot.

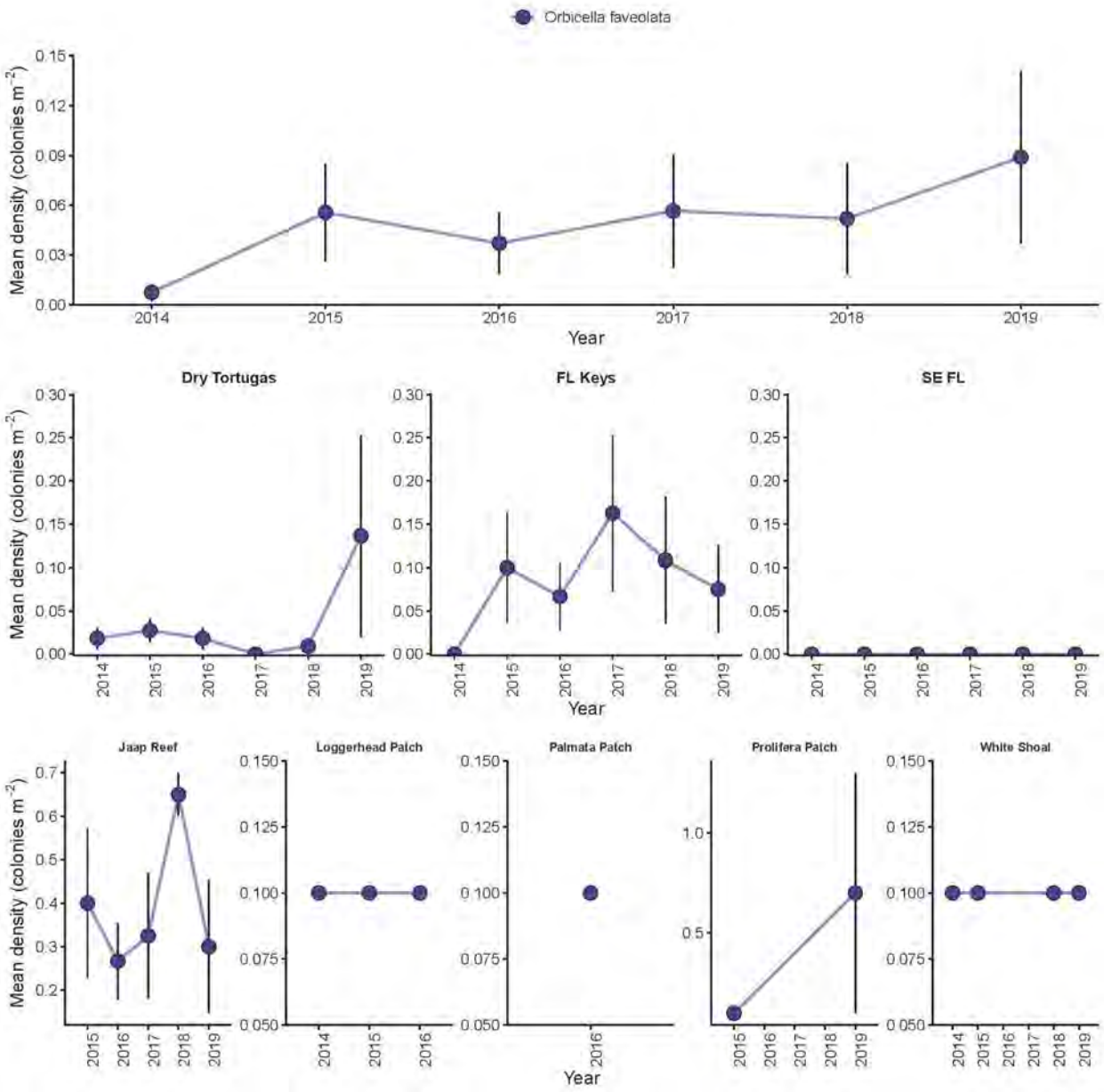

Figure 85. Mean density of *Orbicella faveolata* from 2014 to 2019: Florida-wide and regional patterns at monotypic and special habitat sites. Mean density (colonies m^{-2}) of *O. faveolata* across all transects conducted at monotypic and special habitat Florida coral reef sites surveyed by CREMP and SECREMP (n = 8). (Middle panels) Mean density (colonies m^{-2}) of *O. faveolata* at monotpyic and special habitat sites for each region surveyed by CREMP and SECREMP (DT = 4 sites; FL Keys = 3 sites; SE FL = 1 site). (Bottom panels) Mean density (colonies m^{-2}) of *O. faveolata* at individual monotypic and special habitat sites (n=8) where *O. faveolata* was recorded on at least one transect between 2014 and 2019. Data are only presented for years when *O. faveolata* was present. Data presented are means ±SE. Note different y-axis values for each plot.

National Coral Reef Monitoring program (NCRMP) and the Florida Reef Resilience Program (FRRP) Disturbance Response Monitoring (DRM)

The National Coral Reef Monitoring Program (NCRMP) provides a biennial ecological characterization at a broad spatial scale of general reef condition for reef fishes, corals and benthic habitat (i.e., fish species composition/density/size, benthic cover, and coral density/size/condition). Data collection occurs at stratified random sites where the sampling domain for each region (e.g., Florida, Puerto Rico, U.S. Virgin Islands, Flower Garden Banks National Marine Sanctuary [FGBNMS]) is partitioned by habitat type and depth, sub-regional location (e.g., along-shelf position) and management zone.

The FRRP DRM uses a stratified random sampling design and focuses on bleaching species in <60 ft of water. Two $10m^2$ belt transects (1m width x 10m length) were completed at each site for a total of $20m^2$ surveyed at each site. Because NCRMP and DRM sampling overlaps in the geographic regions they survey and both employ a stratified random sampling design, density, percent cover and coral colony measures (maximum diameter, height, and percent partial mortality) data for these two surveys were combined and presented together.

Table 22. Number of surveys conducted by NCRMP and DRM monitoring programs each year from 2014 to 2020 broken down by each region surveyed. SE FL = Southeast Florida, STTSTJ = St. Thomas and St. John, STX = St. Croix.*In 2018 NCRMP and DRM surveys were conducted together and were not provided as individual data sets.

Year	Region	Survey	No. Surveys		Year	Region	Survey	No. Surveys
2014	Dry Tortugas	DRM	29		2017	Dry Tortugas	DRM	31
2014	Dry Tortugas	NCRMP	105		2017	FL Keys	DRM	18
2014	FL Keys	DRM	86		2017	SE FL	DRM	23
2014	FL Keys	NCRMP	314		2017	STTSTJ	NCRMP	230
2014	SE FL	DRM	41		2017	STX	NCRMP	171
2014	SE FL	NCRMP	49		2018	Dry Tortugas	NCRMP/ DRM*	139
2014	Puerto Rico	NCRMP	103		2018	FL Keys	DRM	95
2015	Dry Tortugas	DRM	20		2018	FL Keys	NCRMP	86
2015	FL Keys	DRM	129		2018	SE FL	DRM	50
2015	SE FL	DRM	100		2018	SE FL	NCRMP	70
2015	STTSTJ	NCRMP	162		2019	Dry Tortugas	DRM	79
2015	STX	NCRMP	133		2019	FL Keys	DRM	123
2016	Dry Tortugas	DRM	29		2019	SE FL	DRM	81
2016	Dry Tortugas	NCRMP	97		2019	Puerto Rico	NCRMP	147
2016	FL Keys	DRM	107		2019	STTSTJ	NCRMP	221
2016	FL Keys	NCRMP	92		2019	STX	NCRMP	245
2016	SE FL	DRM	48		2020	Dry Tortugas	DRM	108
2016	SE FL	NCRMP	93		2020	FL Keys	DRM	165
2016	Puerto Rico	NCRMP	157		2020	SE FL	DRM	116

Figure 86. Mean percent cover of *Orbicella faveolata* for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

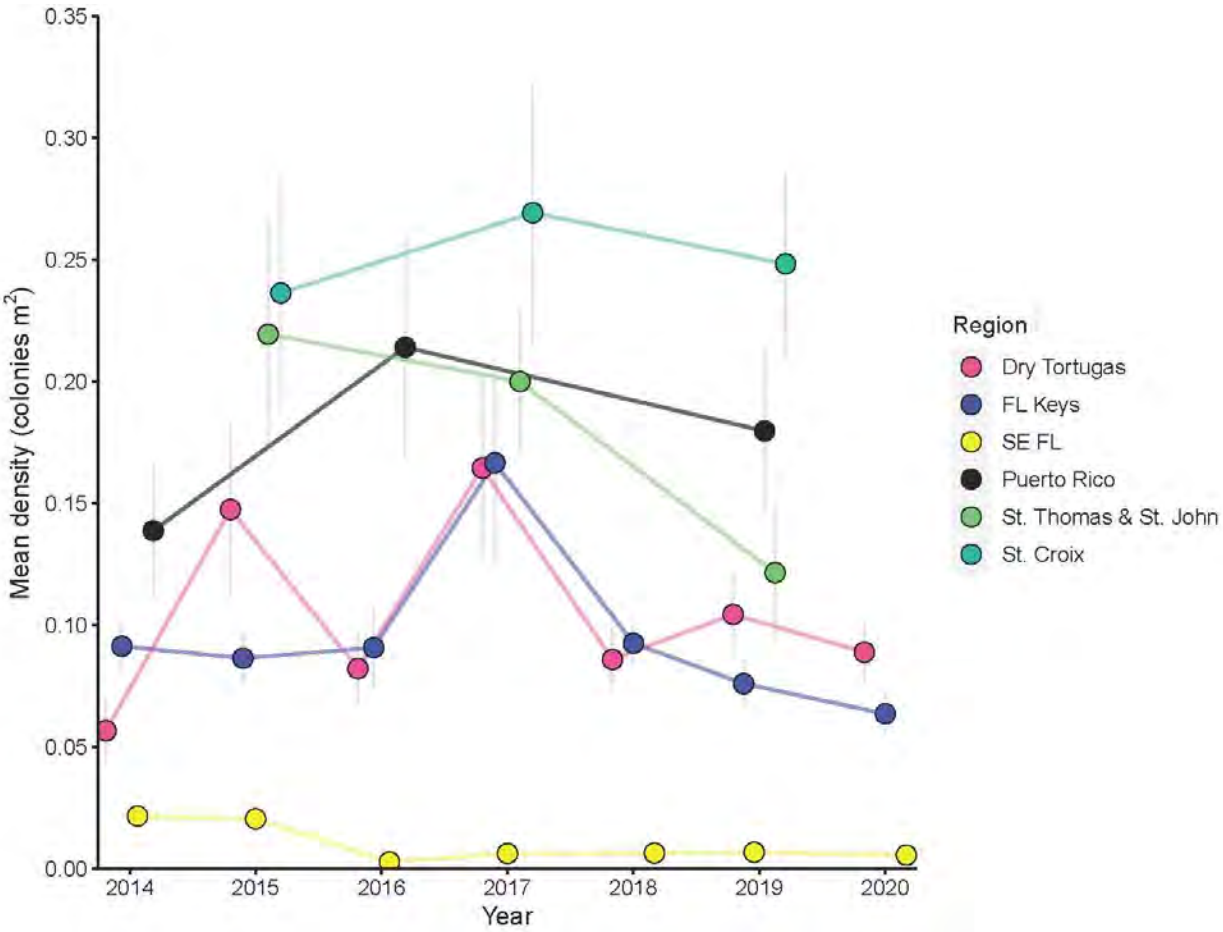

Figure 87. Mean density (colonies m^{-2}) of *Orbicella faveolata* colonies for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

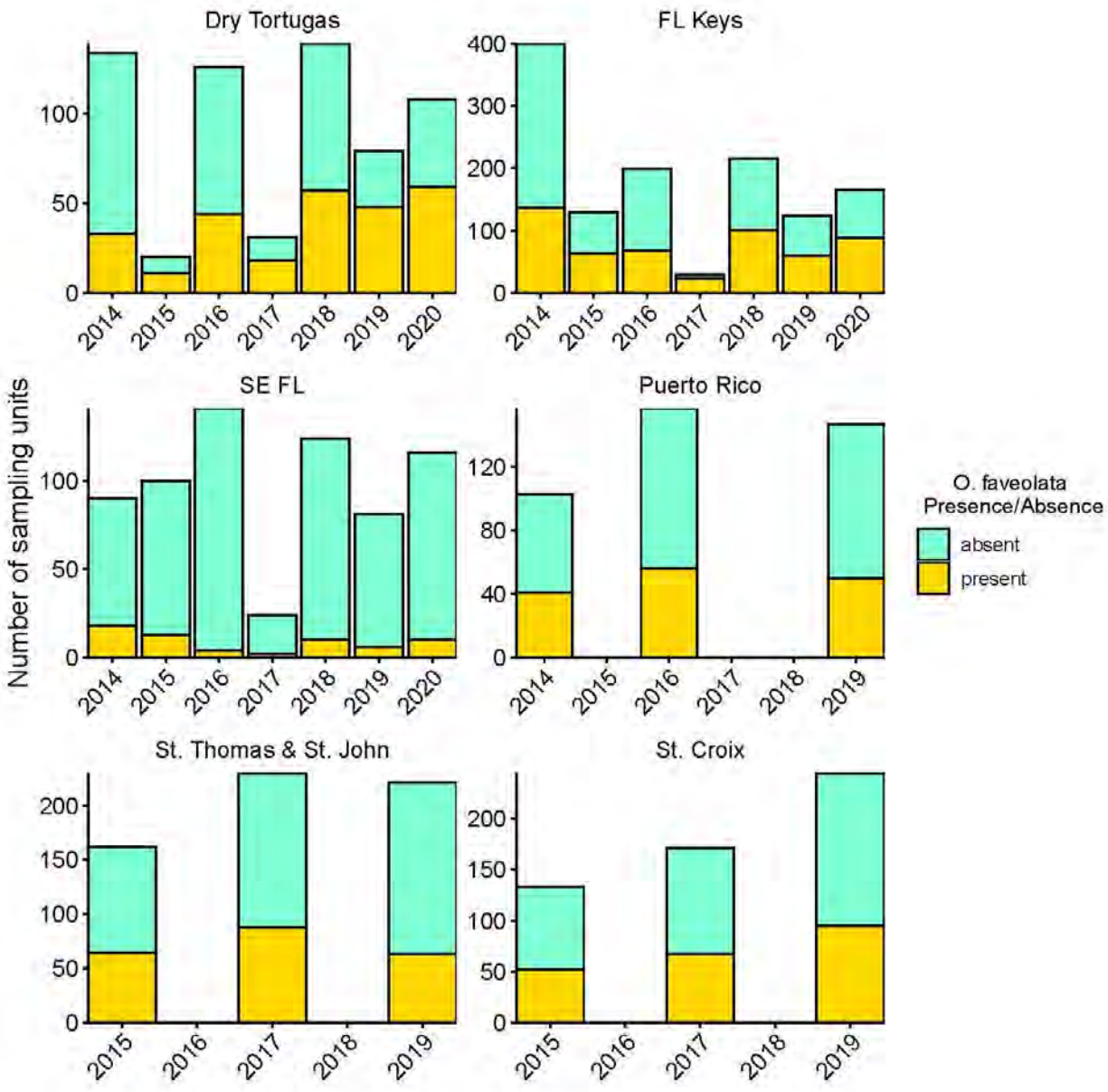

Figure 88. Number of sites where *Orbicella faveolata* was observed (gold) or absent (teal) for each year and region surveyed by NCRMP and DRM from 2014 to 2020.

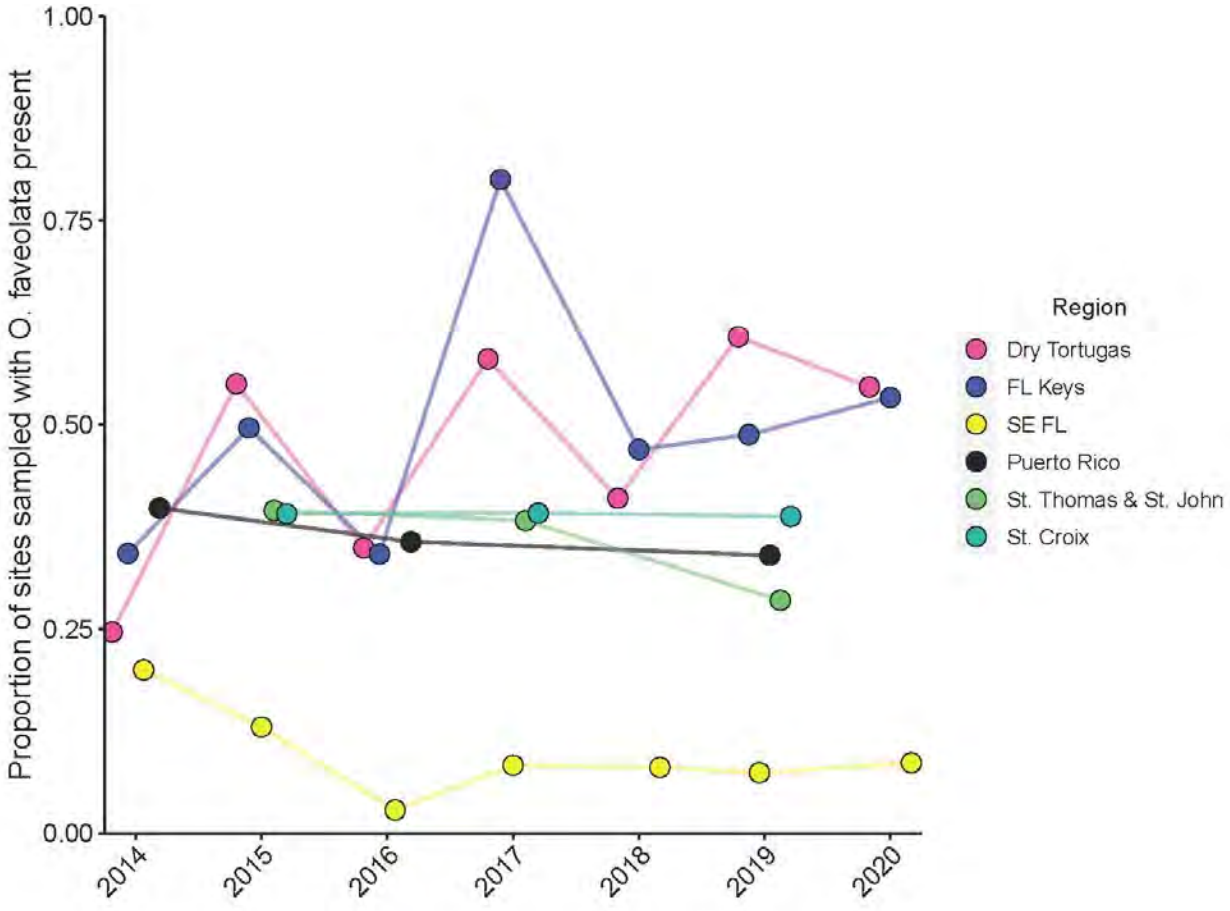

Figure 89. Proportion of all sites surveyed where *Orbicella faveolata* was present for each year and region surveyed by NCRMP and DRM from 2014 to 2020.

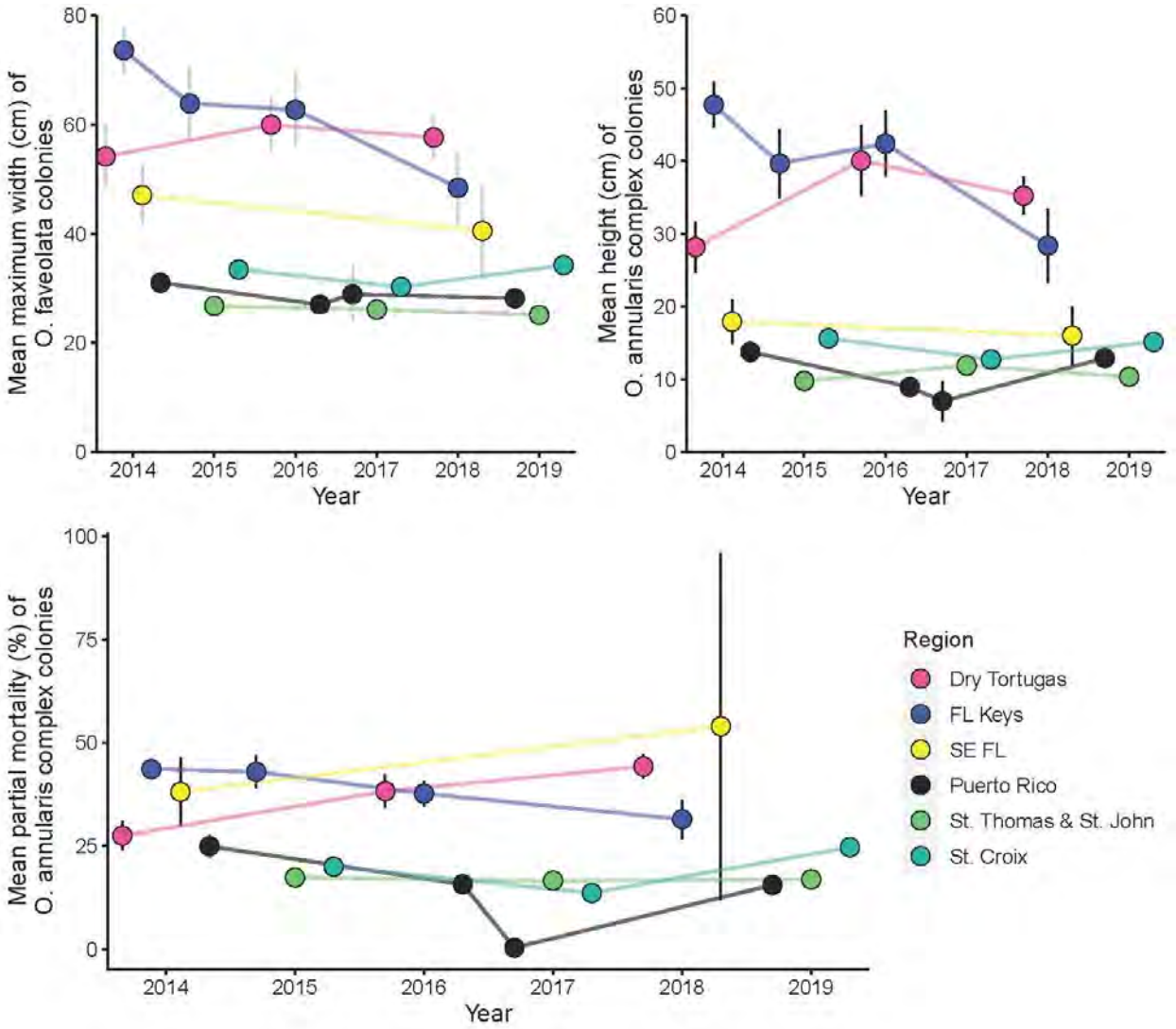

Figure 90. (Top Left) Mean maximum diameter (cm), (Top Right) mean height (cm), and (Bottom) mean partial colony mortality (%) of *Orbicella faveolata* colonies surveyed on each transect for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

Puerto Rico CREMP (PR CREMP)

Data used in the figures below was provided by The Puerto Rico Coral Reef Monitoring Program (Miguel G Figuerola Hernandez, University of Puerto Rico, to Mark Ladd. Nov 24, 2020) and is publicly available at https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.nodc:0204647.

Benthic data collection and description (Copied from NCEI website): Data files include raw data (by transect) for 86 stations where substrate cover by sessile-benthic categories and fish, and motile megabenthic invertebrate taxonomic composition and densities have been characterized from 1999-2020. At present, 42 permanent stations are surveyed biannually (21 per year). For the benthic characterization, a set of five 10-meter-long permanent transects are surveyed at each station. Sessile-benthic reef communities are characterized by the continuous intercept chain-link method, following the Caribbean Coastal Marine Productivity (CARICOMP) (1994) protocol. The PRCREMP data files also include a site classification spreadsheet with descriptors for each monitoring station, some of which can be used as spatial and temporal factors for statistical analyses. These descriptors include information about depth, habitat type, distance from shore, marine protected areas attributes, coordinates, and other metadata.

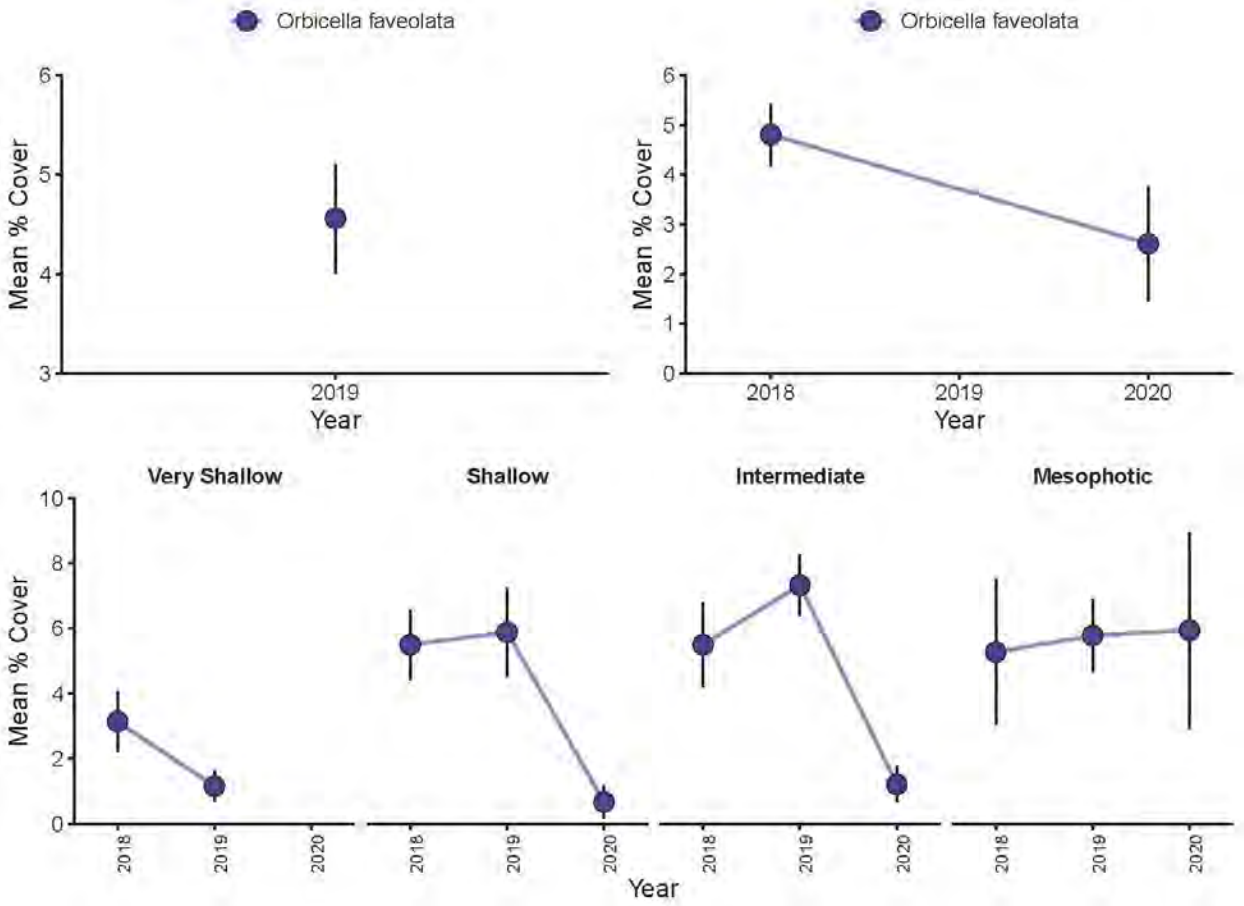

Figure 91. Mean percent cover of *Orbicella faveolata* from 2015 to 2020 at sites monitored by Puerto Rico CREMP. (Top left panel) Mean percent cover of *O. faveolata* averaged across all transects at sites surveyed by PR CREMP in 2015, 2017, and 2019. (Top right panel) Mean percent cover of *O. faveolata* averaged across all transects at sites surveyed by PR CREMP in 2016, 2018, and 2020. (21 sites surveyed in 2016 and 2018, only 3 sites included for 2020). (Bottom panels) Mean percent cover of *O. faveolata* at all sites surveyed by PR CREMP broken down by site depth (21 sites surveyed 2015 to 2019, only 3 sites included for 2020).

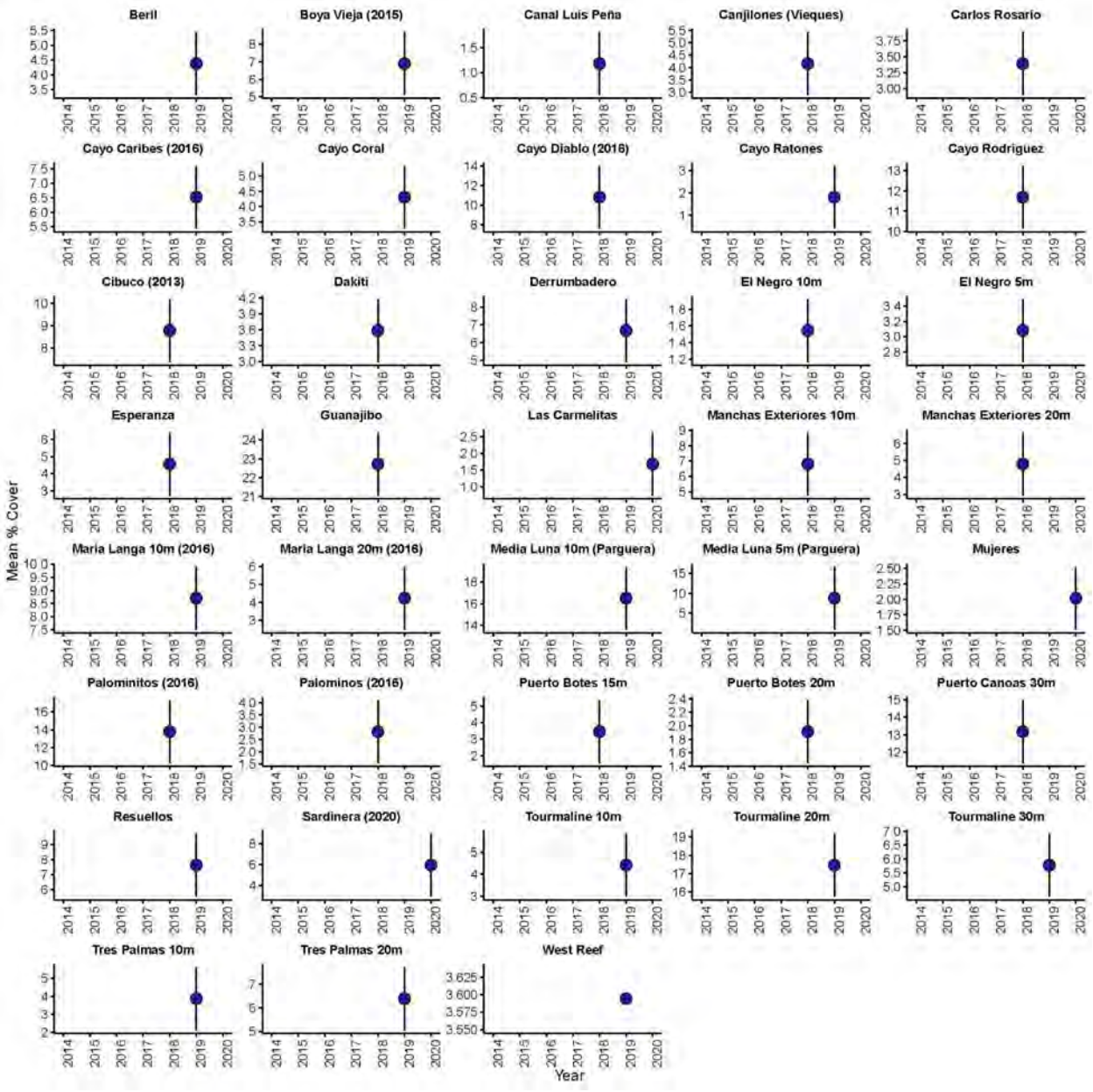

Figure 92. Mean percent cover of *Orbicella faveolata* at individual sites where *O. faveolata* was recorded on at least one transect between 2015 and 2019 in PR CREMP surveys. For bottom panels data are only presented for years when *O. faveolata* was present. Note different y-axis values for each plot. Data presented are means ±SE. 21 sites were surveyed from 2015 to 2019, only data from 3 sites was provided for 2020.

Puerto Rico FEMA surveys

Monitoring was conducted in coral reef habitat at six subregions of Puerto Rico in 2018. These surveys were conducted in March of 2018, following Hurricane Irma, which affected the area in the fall of 2017. Two types of surveys were conducted to collect two types of data: (1) presence-absence data and (2) density data. Both presence-absence and density data were collected via a combination of roving diver surveys and transect surveys. The total number of surveys conducted in 2018 within each subregion of Puerto Rico is provided in the table below. Density surveys were conducted at a subset of sites where presence-absence surveys were conducted. The area covered by roving diver surveys ranged from 157 m^2 to 1,702 m^2, whereas transect areas ranged from 50 m^2 to 1000 m^2.

Table 23. Number of surveys conducted in Puerto Rico in 2018 broken down by Subregion, roving surveys, and transects surveys.

Survey Type	Subregion	Roving surveys	Transect surveys	Total surveys
Presence - Absence Surveys	North	11	9	20
Presence - Absence Surveys	Northeast	52	65	117
Presence - Absence Surveys	Southeast	8	8	16
Presence - Absence Surveys	Southwest	14	12	26
Presence - Absence Surveys	West	16	13	29
Presence - Absence Surveys	Vieques	19	21	40
Presence - Absence Surveys	**Total**	**120**	**128**	**248**
Density Surveys	North	11	9	20
Density Surveys	Northeast	52	56	108
Density Surveys	Southeast	8	7	15
Density Surveys	Southwest	14	10	24
Density Surveys	West	15	12	27
Density Surveys	Vieques	19	18	37
Density Surveys	**Total**	**119**	**112**	**231**

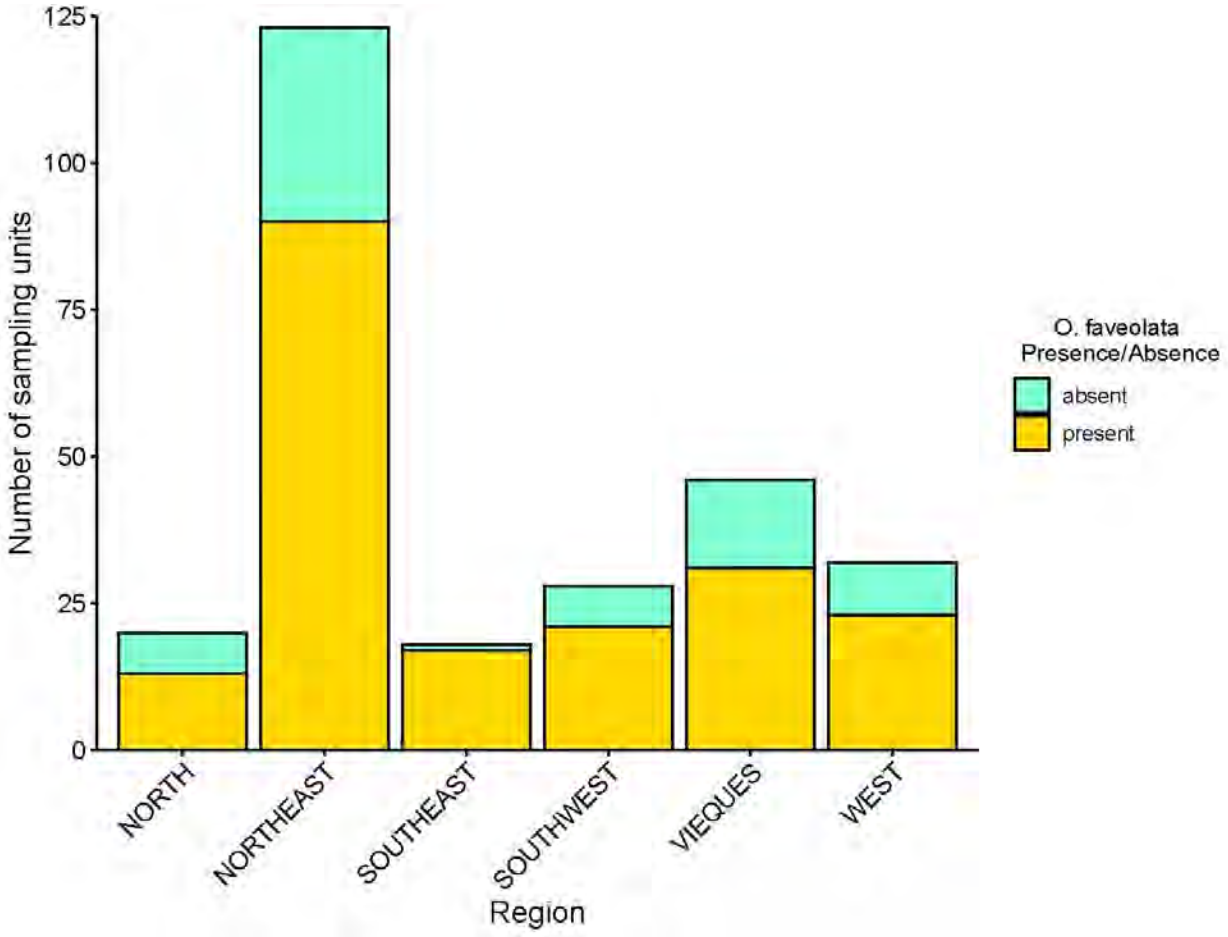

Figure 93. Number of surveys where *Orbicella faveolata* was present (gold) or absent (teal) in each subregion of Puerto Rico. Surveys were conducted in March of 2018 and were a mix of transect and roving diver surveys.

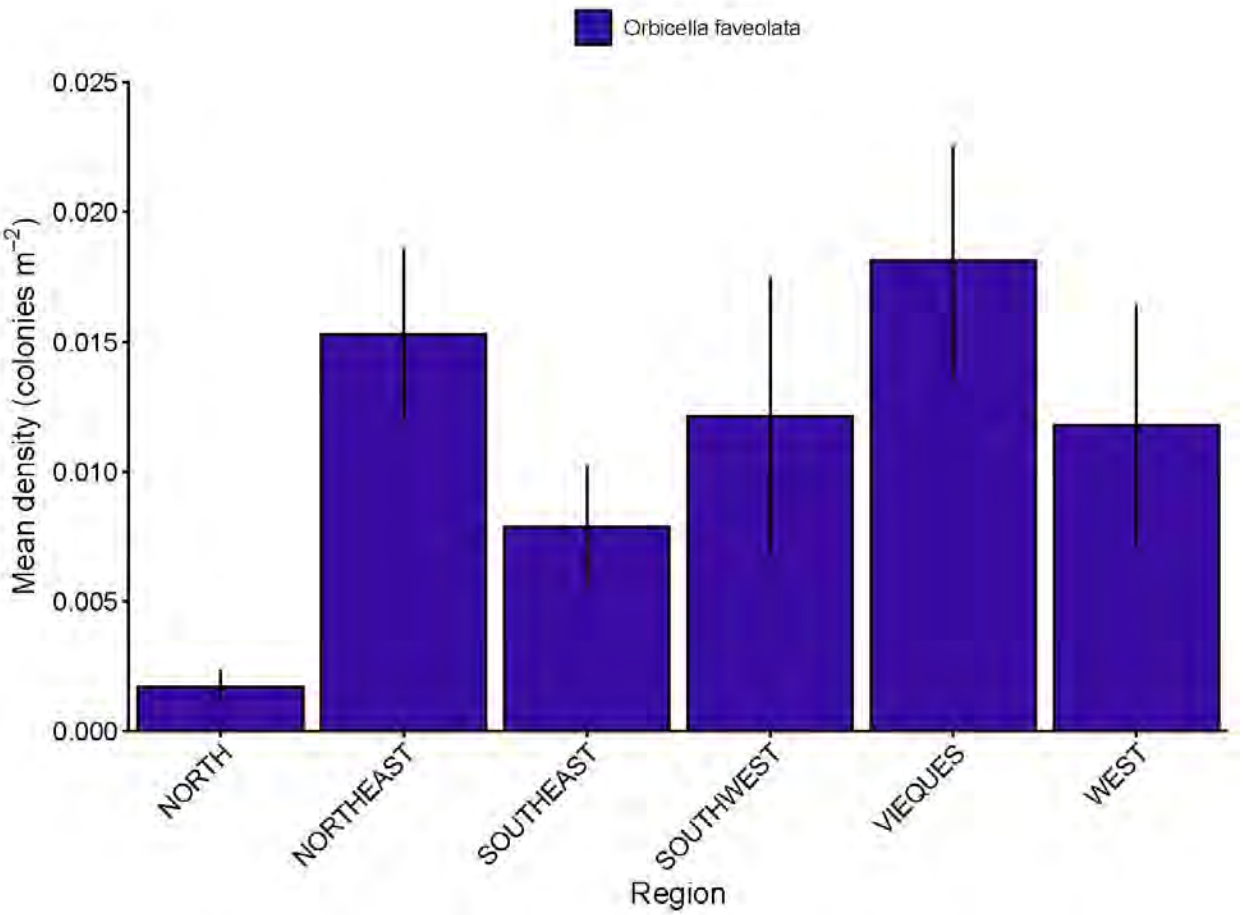

Figure 94. Density of O*rbicella faveolata* colonies (corals m^{-2}*)* in each subregion of Puerto Rico. Surveys were conducted in March of 2018 and were a mix of transect and roving diver surveys. Data presented are means ±SE.

USVI CREMP

Benthic cover data collection and description from website: At each site, benthic cover surveys are conducted annually along six 10 m long permanent transects marked with steel or brass rods. Video sampling consists of one diver traversing each transect videotaping the benthic cover using a high definition digital video recorder. After taping, images from each transect are captured and imported into RStudio where twenty randomly allocated points are superimposed on each image. Analysis consists of identifying the substrate located under each point. For each transect, the percent cover of coral, epilithic algae (EAC), macroalgae, sponges, gorgonians, and sand/sediment are calculated by dividing the number of random dots falling on that substrate type by the total number of dots for that transect.

The USVI CREMP program monitors 34 sites. However, not all sites were surveyed each year. Number of sites surveyed for each year included in this review were: 2015: n = 33; 2016: n = 32; 2017: n = 11; 2018: n = 34; 2019: n = 33; 2020: n = 19. In 2018 and 2019 some sites were surveyed twice in one year and thus there are 12 instead of 6 transects total for those sites.

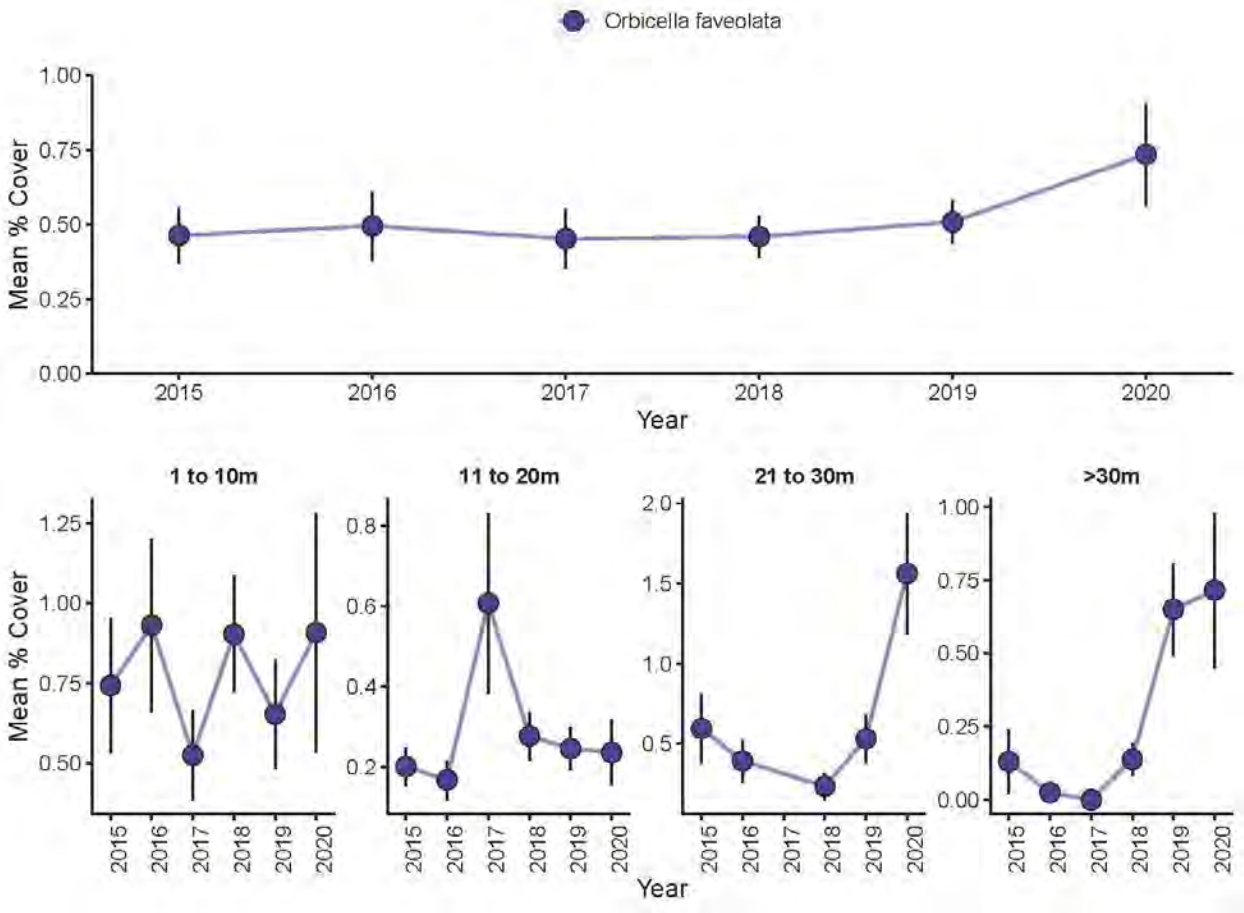

Figure 95. Mean percent cover of *Orbicella faveolata* from 2015 to 2020 at sites monitored by USVI CREMP. (Top panel) Mean percent cover of *O. faveolata* averaged across all transects at sites surveyed by USVI CREMP (range: 11 to 34 sites per year). (Bottom panels) Mean percent cover of *O. faveolata* at all sites surveyed by USVI CREMP broken down by site depth. Data presented are means ±SE.

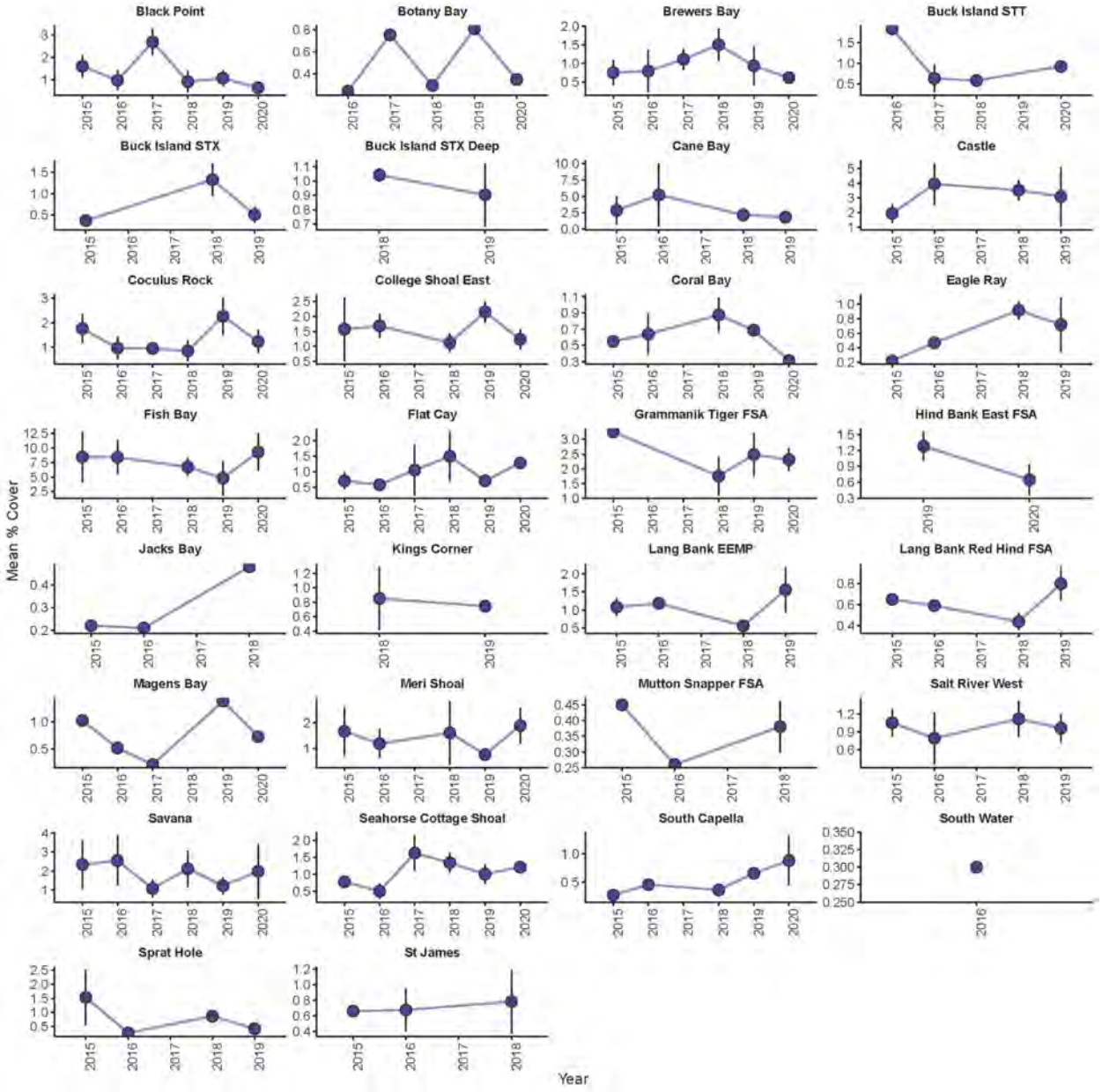

Figure 96. Mean percent cover of *Orbicella faveolata* from 2015 to 2020 at sites monitored by USVI CREMP. Mean percent cover of *O. faveolata* at individual sites where *O. faveolata* was recorded on at least one transect between 2015 and 2019. For bottom panels data are only presented for years when *O. faveolata* was present. Note different y-axis values for each plot. Data presented are means ±SE.

Orbicella franksi

Table 24. Information on the data sources used to create the figures within this document for the *Orbicella franksi* 5 Year Status Review.

DATA SOURCE	LOCATION(S)	YEARS INCLUDED	DATA TYPE(S)
Coral Reef Evaluation and Monitoring Project (CREMP)	Florida Keys, Dry Tortugas	2014 - 2020	Density, Live Tissue Area
Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP)	Southeast Florida	2014 - 2019	Density, Live Tissue Area
Puerto Rico Coral Reef Monitoring Program (PR CRMP)	Puerto Rico	2014 – 2020	Percent cover
Puerto Rico FEMA monitoring	Puerto Rico	2018	Presence absence, density
US Virgin Island Coral Reef Monitoring Program (USVI CRMP)	U.S. Virgin Islands	2014-2020	Percent cover
Florida Reef Resilience Program's Disturbance Response Monitoring (FRRP DRM)	Southeast Florida, Florida Keys, Dry Tortugas	2014 -2019	Abundance, density, size, mortality
National Coral Reef Monitoring Program (NCRMP) (includes DRM data)	Southeast Florida, Florida Keys, Dry Tortugas, U.S. Virgin Islands, Puerto Rico	2014-2020	Percent cover, density

OTHER DATA FROM THE ESA CORAL DATABASE FILE

*Excluding the above data, the ESA Coral Database file did not include additional entries for *Orbicella franksi* between 2014 and 2020.

Coral Reef Evaluation and Monitoring Project (CREMP) and the Southeast Coral Reef Evaluation and Monitoring Project (SECREMP)

The data used to generate **Figure 97** through **Figure 100** were provided by Florida's Coral Reef Evaluation and Monitoring Project (CREMP) and SECREMP (pers. comm., Mike Colella, Florida Fish and Wildlife Conservation Commission (FWC), to Alison Moulding, Aug. 27, 2020). CREMP in the Florida Keys is funded through the EPA South Florida Water Quality Protection Program and CREMP in the Dry Tortugas is funded through the National Park Service. Both Florida Keys and Dry Tortugas surveys were completed by the Coral Program at the FWC Fish and Wildlife Research Institute (FWRI). SECREMP data is credited to Florida Department of Environmental Protection (FDEP) Coral Reef Conservation Program and Dr. David Gilliam's lab at the National Coral Reef Institute (NCRI) and Nova Southeastern University (NSU).

CREMP and SECREMP surveys were conducted annually in permanent transects across sites (n=4 transects per site) in three regions of Florida: Dry Tortugas (DT), Florida Keys (FL Keys), and Southeast Florida (SE FL) north of the Florida Keys (see Table below for number of sites within each region). This sampling scheme includes eight sites that are located at monospecific coral stands or special habitat areas for the coral species in this status review. Thus, data from these eight sites (DT n = 4 sites, FL Keys n = 3 sites; SE FL n = 1 site) were excluded from the general CREMP data analyses. The figures below display Florida-wide, regional and site-specific trends in mean percent coral cover, total or mean live coral area, and total colony counts by species between 2014 and 2019 from CREMP and SECREMP survey data. For these figures means were calculated by using transect as a replicate (n = 260 per year, except for 2017, where n = 258 transects).

Table 25. Number of sites surveyed annually by CREMP and SECREMP programs.

Region	Number of Sites	Number of monospecific or special habitat area sites
Southeast Florida (SE FL)	21	1
Florida Keys	37	3
Dry Tortugas	7	4

CREMP and SECREMP monitoring data summary

Note: Percent cover values provided in the CREMP and SECREMP dataset are categorized as "*Orbicella annularis* complex", rather than individual Orbicella species. Live Tissue Area and Density data are broken down by specific *Orbicella* species

LIVE TISSUE AREA: The total amount of live tissue area of *Orbicella franksi* (estimated area; m^2) across all 260 transects surveyed was relatively stable from 2014 to 2019. Total live tissue area was highest in 2014 when an estimated total of 193.08 m^2 was recorded, and lowest value in 2016 when 136.74 m^2 of live tissue was recorded (**Figure 97**). Total live tissue area for *O. franksi* showed contrasting patterns for different regions within Florida. In the Dry Tortugas region, the lowest recorded total live tissue area for *O. franksi* was in 2015, when 72.02 m^2 was recorded and highest in 2019 (146.97 m^2). In contrast, live tissue area in the Florida Keys region declined from a high of 97.13 m^2 in 2014 to a low of 21.01 m^2 in 2019. In the Southeast Florida region, *O. franksi* was only observed in surveys conducted in 2014 and 2019.

DENSITY: The mean density of *Orbicella franksi* colonies across all 260 transects surveyed was lowest in 2015 at 0.036 ± 0.009 colonies m^{-2} (mean ±SE; **Figure 99**), and highest in 2018 with an average density of at 0.068 ± 0.018 colonies m^{-2}. In the Dry Tortugas, the density of *O. franksi* approximately doubled from the period of 2014 to 2016 to the period of 2017 to 2019 (**Figure 99**). The lowest mean density of *O. franksi* colonies recorded in the Dry Tortugas region was in 2015 (0.236 ± 0.065 colonies^{-2}) and the highest mean density was recorded in 2018 (0.496 ± 0.143 colonies^{-2}). The mean density of *O. franksi* colonies observed on transects in the Florida Keys was variable across years and ranged from a high of 0.033 ± 0.007 colonies^{-2} in 2014 to a low of 0.0149 ± 0.0004 colonies^{-2} in 2019. *Orbicella franksi* colonies were rare in the Southeast Florida region and were only recorded on surveys in 2014 and 2019.

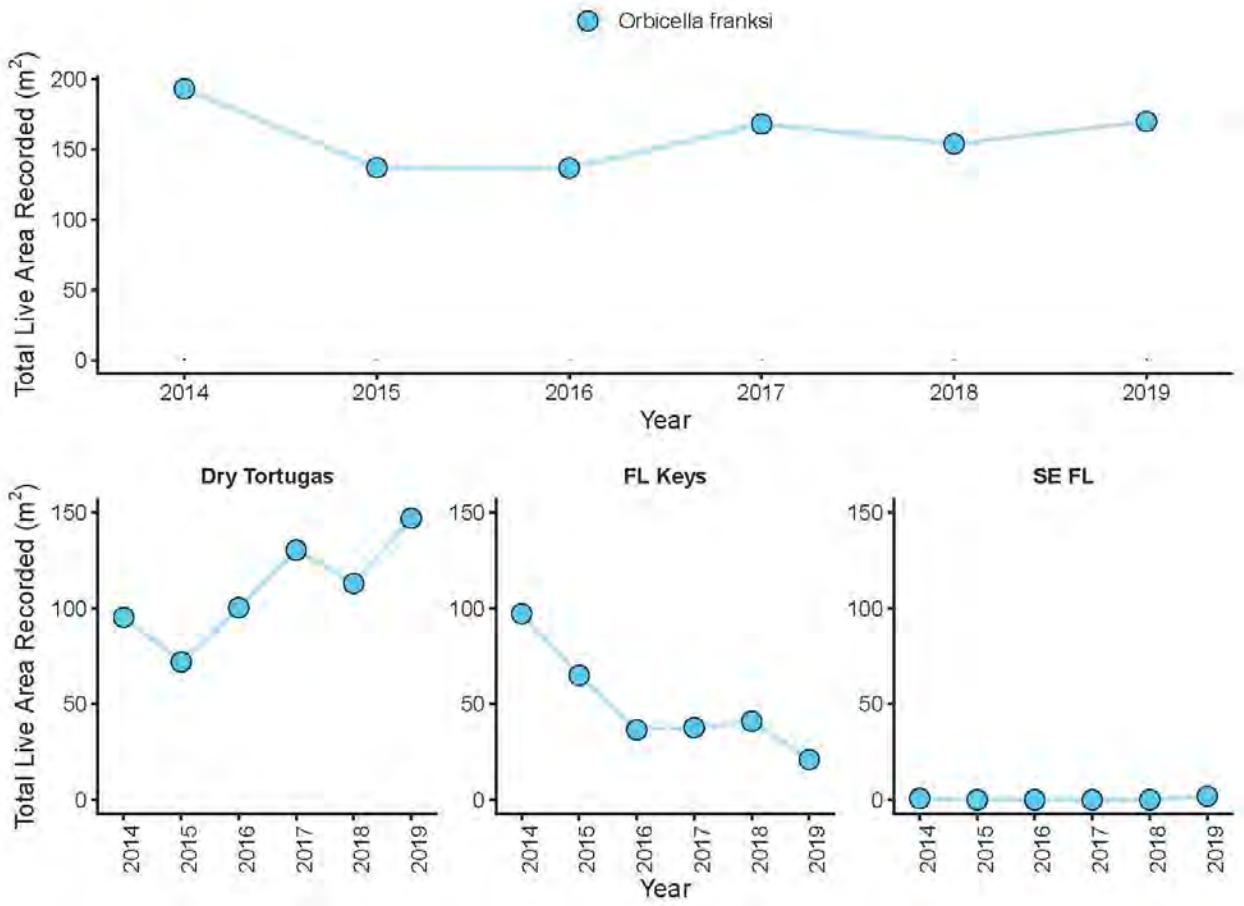

Figure 97. Total live area (m^2) of *Orbicella franksi* from 2014 to 2019: Florida-wide and regional patterns. (Top panel) Total live area (m^2) of *O. franksi* summed across all transects conducted at Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites). (Bottom panels Total live area (m^2) of *O. franksi* for each region surveyed by CREMP (DT = 7 sites; FL Keys = 37 sites; SE FL = 21 sites). Note different y-axis values for each plot.

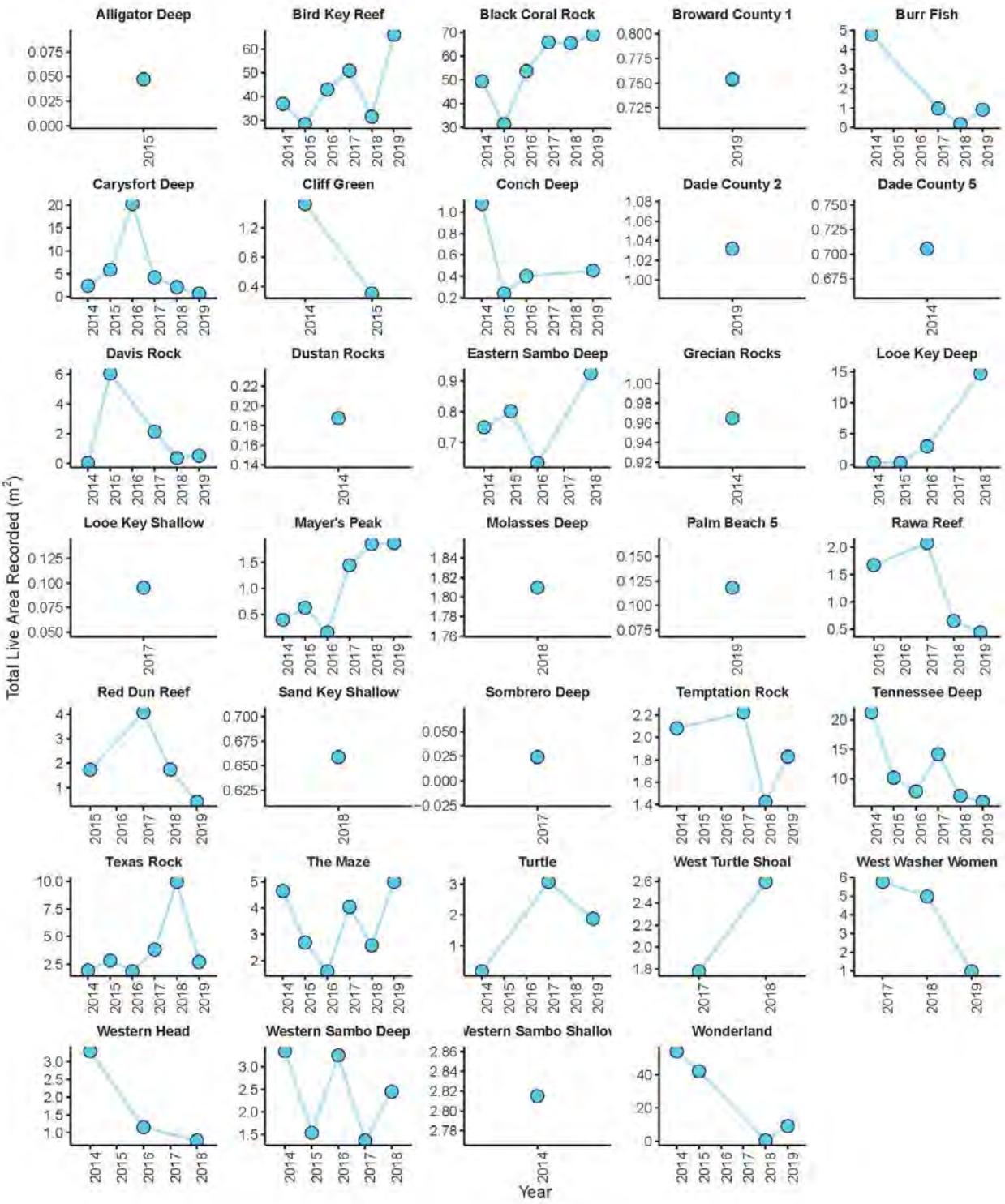

Figure 98. Total live area (m^2) of *Orbicella franksi* from 2014 to 2019: Individual site patterns. Total live area (m^2) on transects conducted at any Florida coral reef sites surveyed by SECREMP where *O. franksi* was recorded on at least one transect between 2014 – 2019. Note different y-axis values for each plot.

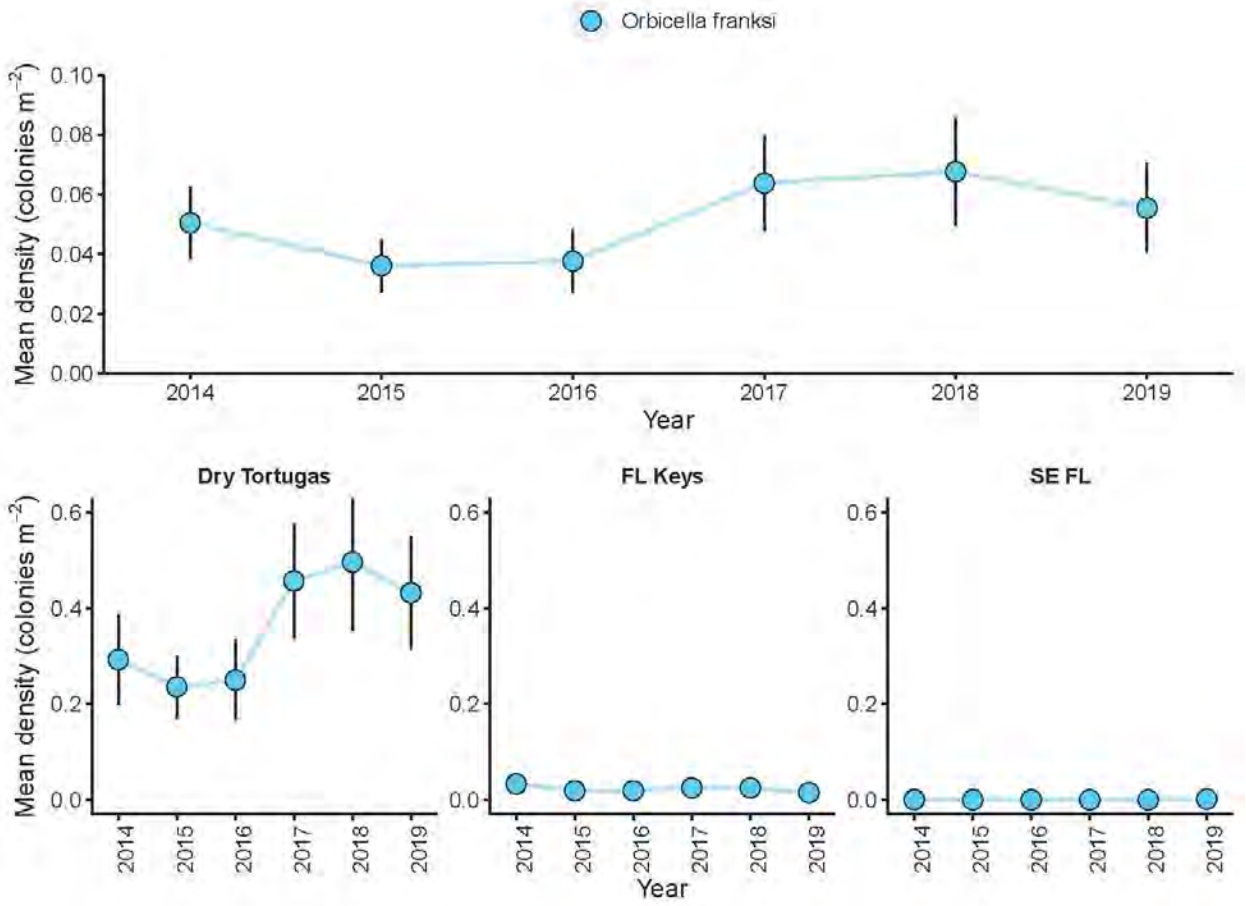

Figure 99. Mean density of *Orbicella franksi* colonies from 2014 to 2019: Florida-wide and regional patterns. (Top panel) Mean density (colonies m^{-2}) of *O. franksi* colonies averaged across all transects conducted at Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites). (Bottom panels) Mean density (colonies m^{-2}) of *O. franksi* colonies for each region surveyed by CREMP and SECREMP (DT = 7 sites; FL Keys = 37 sites; SE FL = 21 sites). Data presented are means ±SE. Note different y-axis values for each plot.

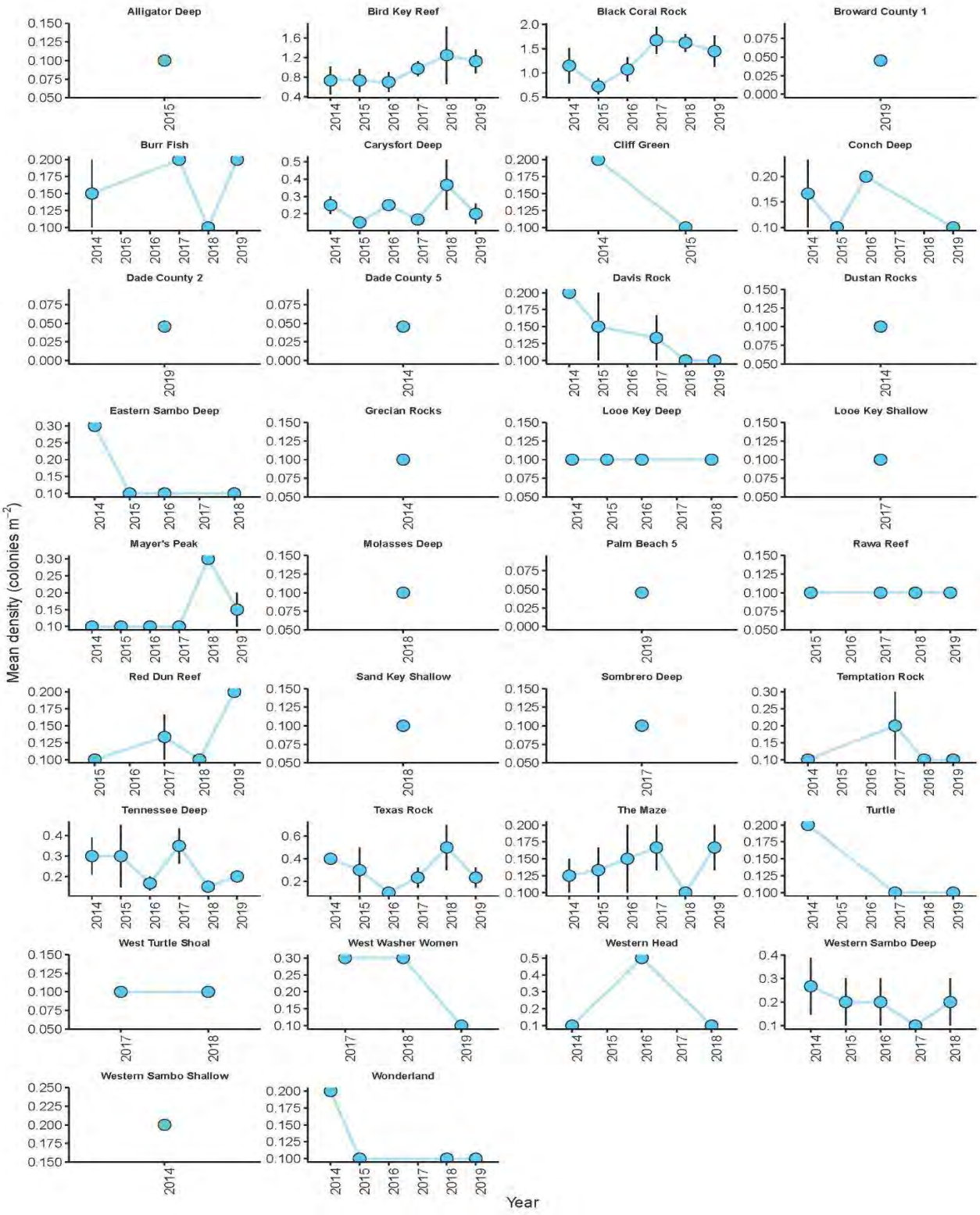

Figure 100. Mean density of *Orbicella franksi* colonies from 2014 to 2019: Individual site patterns. Mean density (colonies m^{-2}) of *O. franksi* colonies on transects at any Florida coral reef site surveyed where *O. franksi* was recorded on at least one transect between 2014 – 2019. Data presented are means ±SE. Note different y-axis values for each plot.

National Coral Reef Monitoring program (NCRMP) and the Florida Reef Resilience Program (FRRP) Disturbance Response Monitoring (DRM)

The National Coral Reef Monitoring Program (NCRMP) provides a biennial ecological characterization at a broad spatial scale of general reef condition for reef fishes, corals and benthic habitat (i.e., fish species composition/density/size, benthic cover, and coral density/size/condition). Data collection occurs at stratified random sites where the sampling domain for each region (e.g., Florida, Puerto Rico, U.S. Virgin Islands, Flower Garden Banks National Marine Sanctuary [FGBNMS]) is partitioned by habitat type and depth, sub-regional location (e.g., along-shelf position) and management zone.

The FRRP DRM uses a stratified random sampling design and focuses on bleaching species in <60 ft of water. Two $10m^2$ belt transects (1m width x 10m length) were completed at each site for a total of $20m^2$ surveyed at each site. Because NCRMP and DRM sampling overlaps in the geographic regions they survey and both employ a stratified random sampling design, density, percent cover and coral colony measures (maximum diameter, height, and percent partial mortality) data for these two surveys were combined and presented together.

Table 26. Number of surveys conducted by NCRMP and DRM monitoring programs each year from 2014 to 2020 broken down by each region surveyed. SE FL = Southeast Florida, STTSTJ = St. Thomas and St. John, STX = St. Croix.*In 2018 NCRMP and DRM surveys were conducted together and were not provided as individual data sets.

Year	Region	Survey	No. Surveys		Year	Region	Survey	No. Surveys
2014	Dry Tortugas	DRM	29		2017	Dry Tortugas	DRM	31
2014	Dry Tortugas	NCRMP	105		2017	FL Keys	DRM	18
2014	FL Keys	DRM	86		2017	SE FL	DRM	23
2014	FL Keys	NCRMP	314		2017	STTSTJ	NCRMP	230
2014	SE FL	DRM	41		2017	STX	NCRMP	171
2014	SE FL	NCRMP	49		2018	Dry Tortugas	NCRMP /DRM*	139
2014	Puerto Rico	NCRMP	103		2018	FL Keys	DRM	95
2015	Dry Tortugas	DRM	20		2018	FL Keys	NCRMP	86
2015	FL Keys	DRM	129		2018	SE FL	DRM	50
2015	SE FL	DRM	100		2018	SE FL	NCRMP	70
2015	STTSTJ	NCRMP	162		2019	Dry Tortugas	DRM	79
2015	STX	NCRMP	133		2019	FL Keys	DRM	123
2016	Dry Tortugas	DRM	29		2019	SE FL	DRM	81
2016	Dry Tortugas	NCRMP	97		2019	Puerto Rico	NCRMP	147
2016	FL Keys	DRM	107		2019	STTSTJ	NCRMP	221
2016	FL Keys	NCRMP	92		2019	STX	NCRMP	245
2016	SE FL	DRM	48		2020	Dry Tortugas	DRM	108
2016	SE FL	NCRMP	93		2020	FL Keys	DRM	165
2016	Puerto Rico	NCRMP	157		2020	SE FL	DRM	116

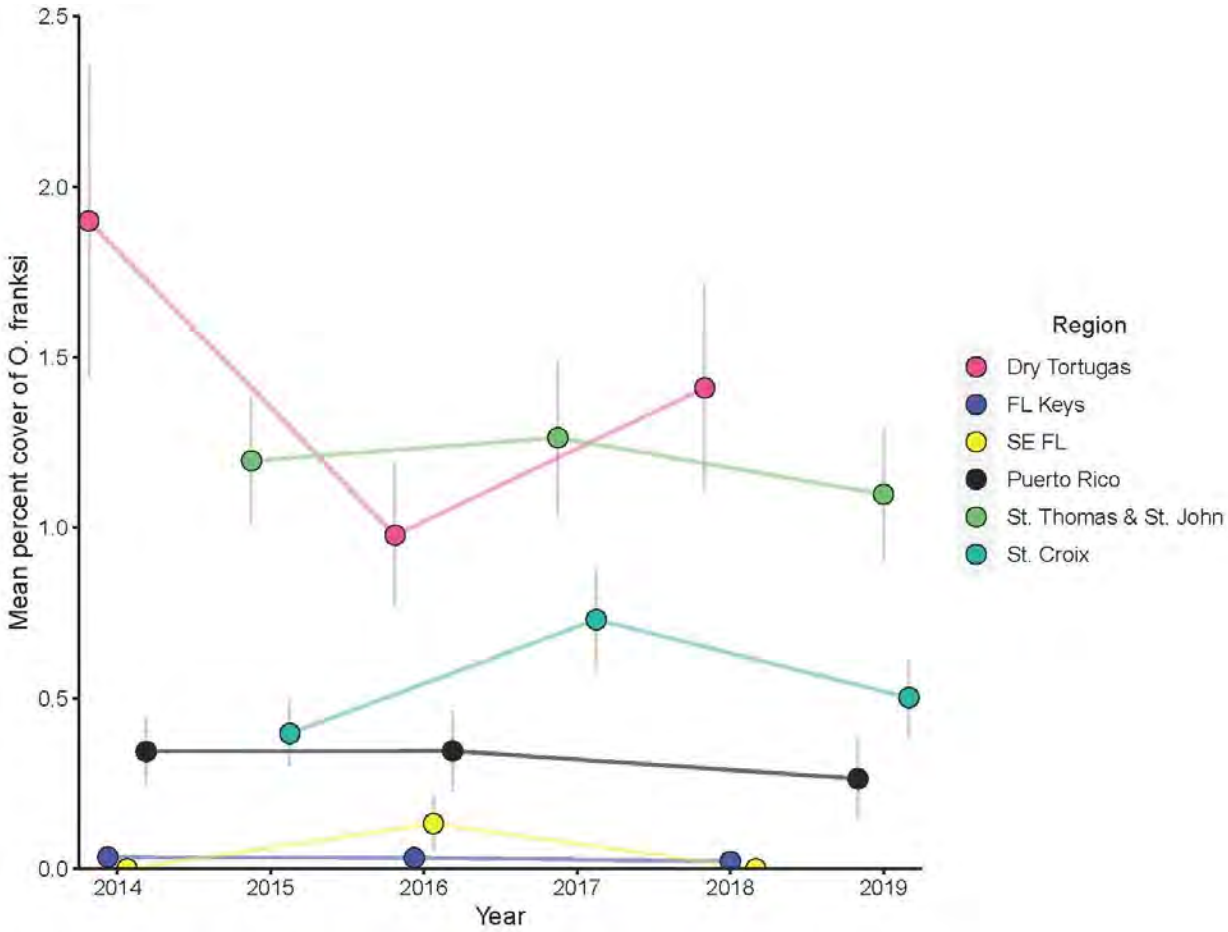

Figure 101. Mean percent cover of *Orbicella franksi* for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

Figure 102. Mean density (colonies m^{-2}) of *O. franksi* colonies for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

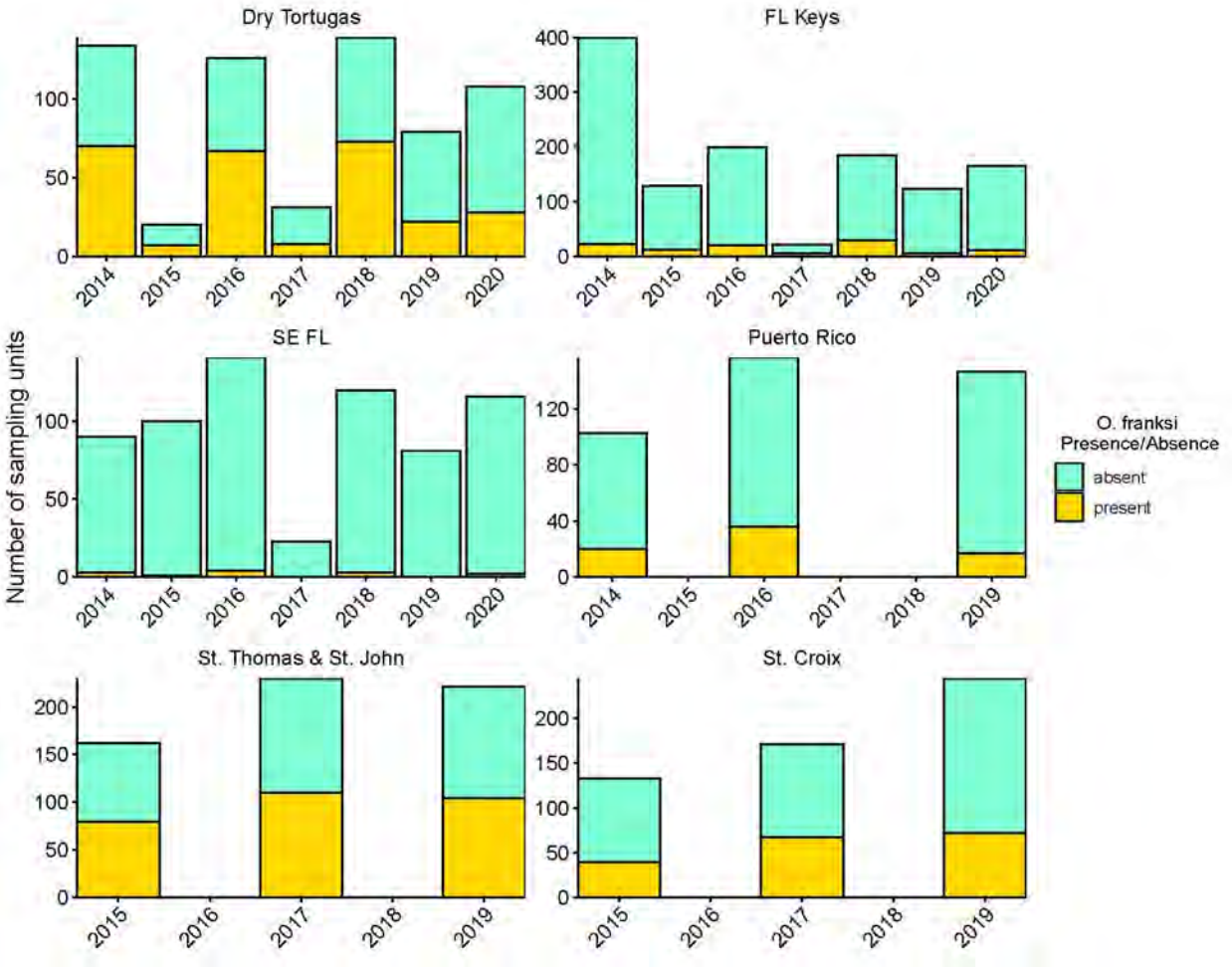

Figure 103. Number of sites where *Orbicella franksi* was observed (gold) or absent (teal) for each year and region surveyed by NCRMP and DRM from 2014 to 2020.

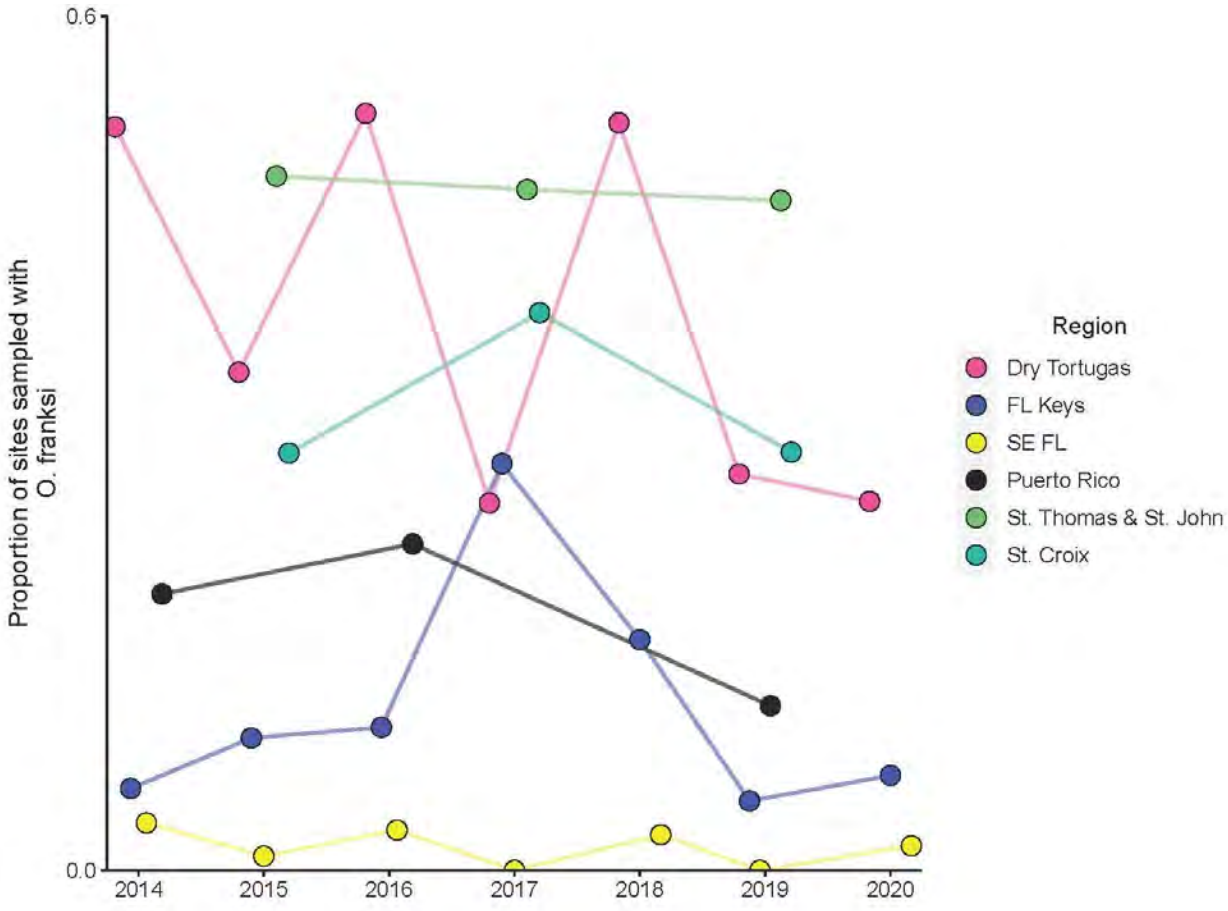

Figure 104. Proportion of all sites surveyed where *Orbicella franksi* was present for each year and region surveyed by NCRMP and DRM from 2014 to 2020.

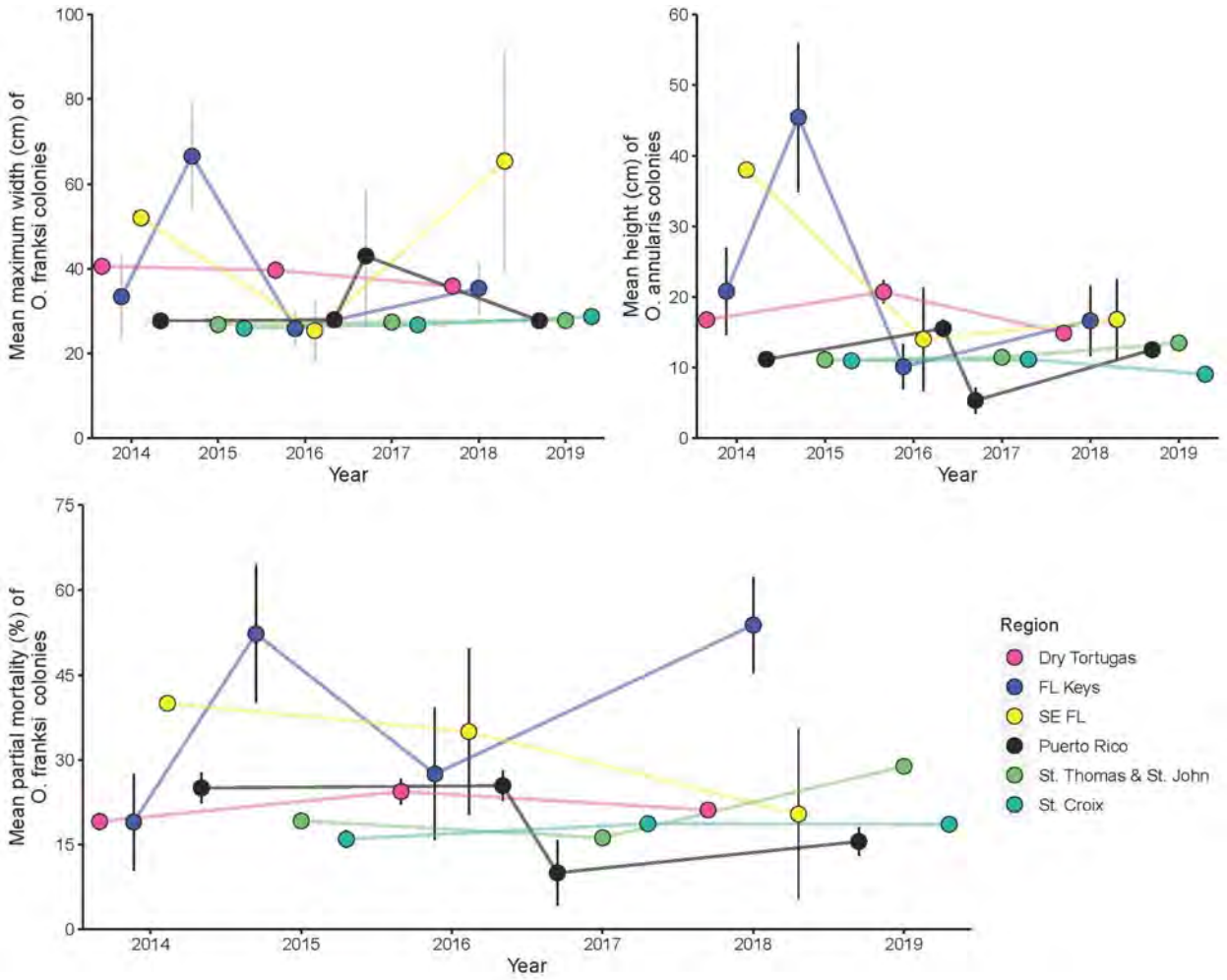

Figure 105. (Top Left) Mean maximum diameter (cm), (Top Right) mean height (cm), and (Bottom) mean partial colony mortality (%) of *Orbicella franksi* colonies surveyed on each transect for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

Puerto Rico CREMP (PR CREMP)

Data used in the figures below was provided by The Puerto Rico Coral Reef Monitoring Program (Miguel G Figuerola Hernandez, University of Puerto Rico, to Mark Ladd. Nov 24, 2020) and is publicly available at https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.nodc:0204647.

Benthic data collection and description (Copied from NCEI website): Data files include raw data (by transect) for 86 stations where substrate cover by sessile-benthic categories and fish, and motile megabenthic invertebrate taxonomic composition and densities have been characterized from 1999-2020. At present, 42 permanent stations are surveyed biannually (21 per year). For the benthic characterization, a set of five 10-meter-long permanent transects are surveyed at each station. Sessile-benthic reef communities are characterized by the continuous intercept chain-link method, following the Caribbean Coastal Marine Productivity (CARICOMP) (1994) protocol. The PRCREMP data files also include a site classification spreadsheet with descriptors for each monitoring station, some of which can be used as spatial and temporal factors for statistical analyses. These descriptors include information about depth, habitat type, distance from shore, marine protected areas attributes, coordinates, and other metadata.

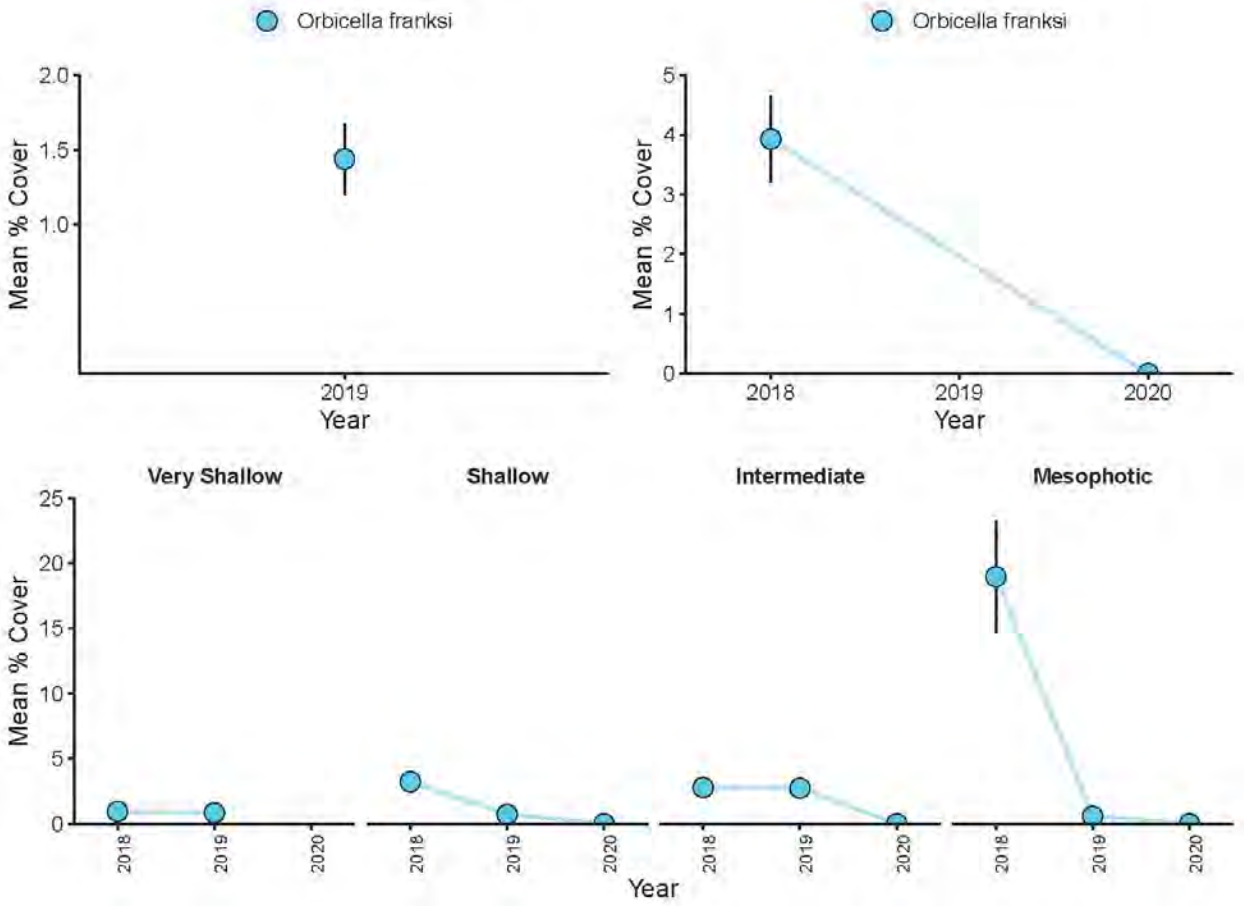

Figure 106. Mean percent cover of *Orbicella franksi* from 2015 to 2020 at sites monitored by Puerto Rico CREMP. (Top left panel) Mean percent cover of *O. franksi* averaged across all transects at sites surveyed by PR CREMP in 2015, 2017, and 2019. (Top right panel) Mean percent cover of *O. franksi* averaged across all transects at sites surveyed by PR CREMP in 2016, 2018, and 2020. (21 sites surveyed in 2016 and 2018, only 3 sites included for 2020). (Bottom panels) Mean percent cover of *O. franksi* at all sites surveyed by PR CREMP broken down by site depth (21 sites surveyed 2015 to 2019, only 3 sites included for 2020).

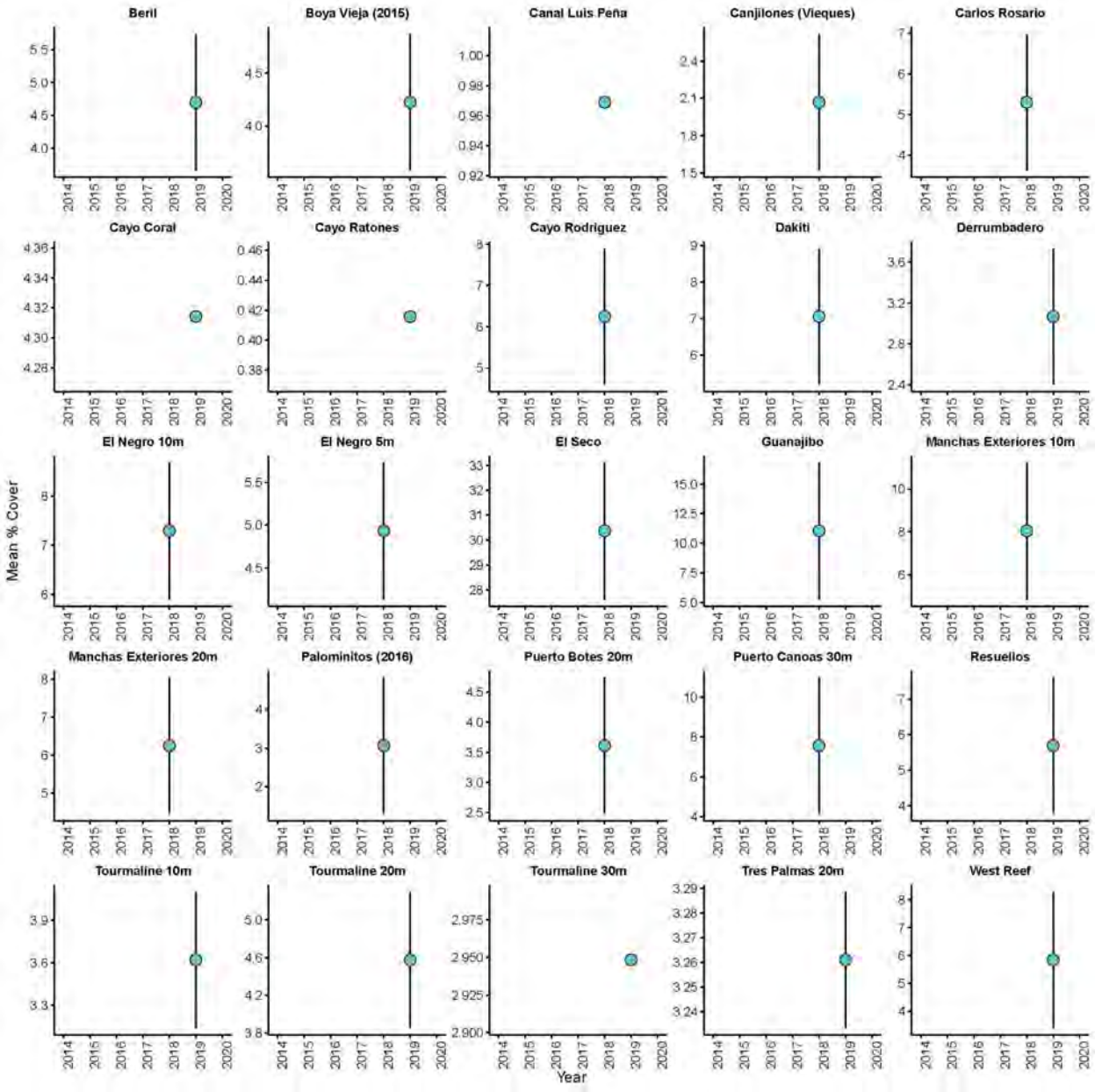

Figure 107. Mean percent cover of *Orbicella franksi* at individual sites where *O. franksi* was recorded on at least one transect between 2015 and 2019 in PR CREMP surveys. For bottom panels data is only presented for years when *O. franksi* was present. Note different y-axis values for each plot. Data presented are means ±SE. 21 sites were surveyed from 2015 to 2019, only data from 3 sites was provided for 2020.

Puerto Rico FEMA surveys

Monitoring was conducted in coral reef habitat at six subregions of Puerto Rico in 2018. These surveys were conducted in March of 2018, following Hurricane Irma, which affected the area in the fall of 2017. Two types of surveys were conducted to collect two types of data: (1) presence-absence data and (2) density data. Both presence-absence and density data were collected via a combination of roving diver surveys and transect surveys. The total number of surveys conducted in 2018 within each subregion of Puerto Rico is provided in the table below. Density surveys were conducted at a subset of sites where presence-absence surveys were conducted. The area covered by roving diver surveys ranged from 157 m^2 to 1,702 m^2, whereas transect areas ranged from 50 m^2 to 1000 m^2.

Table 27. Number of surveys conducted in Puerto Rico in 2018 broken down by Subregion, roving surveys, and transects surveys.

Survey Type	Subregion	Roving surveys	Transect surveys	Total surveys
Presence - Absence Surveys	North	11	9	20
Presence - Absence Surveys	Northeast	52	65	117
Presence - Absence Surveys	Southeast	8	8	16
Presence - Absence Surveys	Southwest	14	12	26
Presence - Absence Surveys	West	16	13	29
Presence - Absence Surveys	Vieques	19	21	40
Presence - Absence Surveys	**Total**	**120**	**128**	**248**
Density Surveys	North	11	9	20
Density Surveys	Northeast	52	56	108
Density Surveys	Southeast	8	7	15
Density Surveys	Southwest	14	10	24
Density Surveys	West	15	12	27
Density Surveys	Vieques	19	18	37
Density Surveys	**Total**	**119**	**112**	**231**

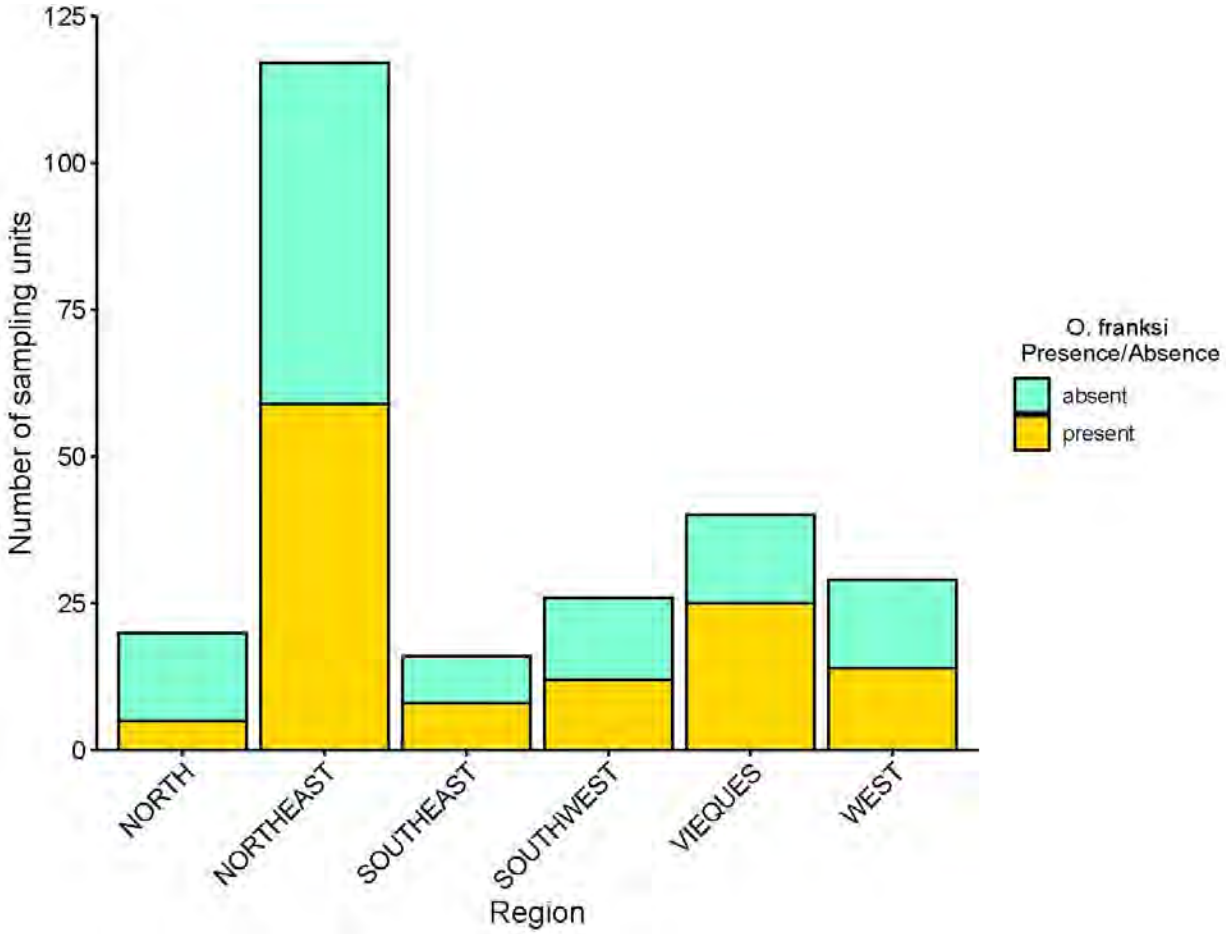

Figure 108. Number of surveys where *Orbicella franksi* was present (gold) or absent (teal) in each subregion of Puerto Rico. Surveys were conducted in March of 2018 and were a mix of transect and roving diver surveys.

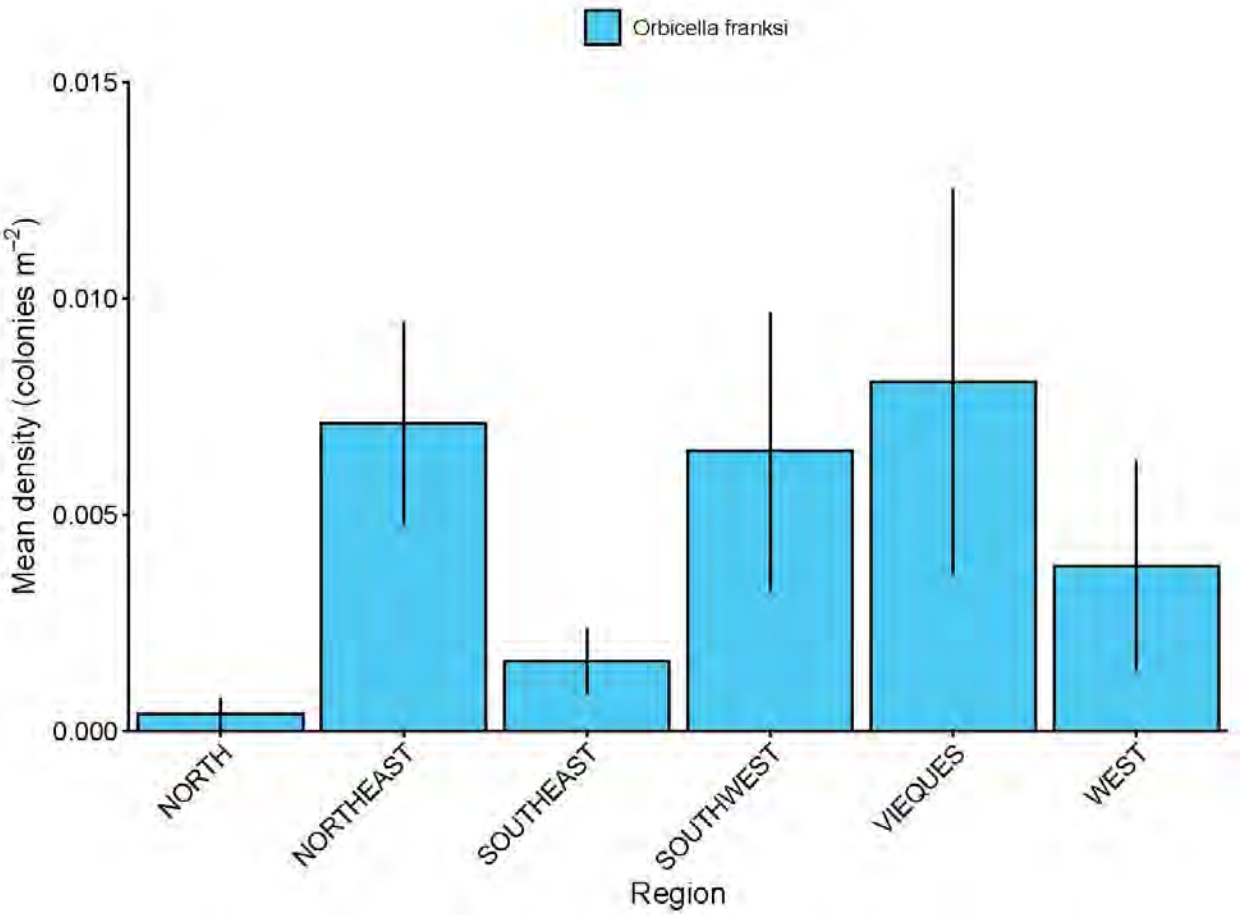

Figure 109. Density of O*rbicella franksi* colonies (corals m^{-2}*)* in each subregion of Puerto Rico. Surveys were conducted in March of 2018 and were a mix of transect and roving diver surveys.

USVI CREMP

Benthic cover data collection and description from website: At each site, benthic cover surveys are conducted annually along six 10 m long permanent transects marked with steel or brass rods. Video sampling consists of one diver traversing each transect videotaping the benthic cover using a high definition digital video recorder. After taping, images from each transect are captured and imported into RStudio where twenty randomly allocated points are superimposed on each image. Analysis consists of identifying the substrate located under each point. For each transect, the percent cover of coral, epilithic algae (EAC), macroalgae, sponges, gorgonians, and sand/sediment are calculated by dividing the number of random dots falling on that substrate type by the total number of dots for that transect.

The USVI CREMP program monitors 34 sites. However, not all sites were surveyed each year. Number of sites surveyed for each year included in this review were: 2015: n = 33; 2016: n = 32; 2017: n = 11; 2018: n = 34; 2019: n = 33; 2020: n = 19. In 2018 and 2019 some sites were surveyed twice in one year and thus there are 12 instead of 6 transects total for those sites.

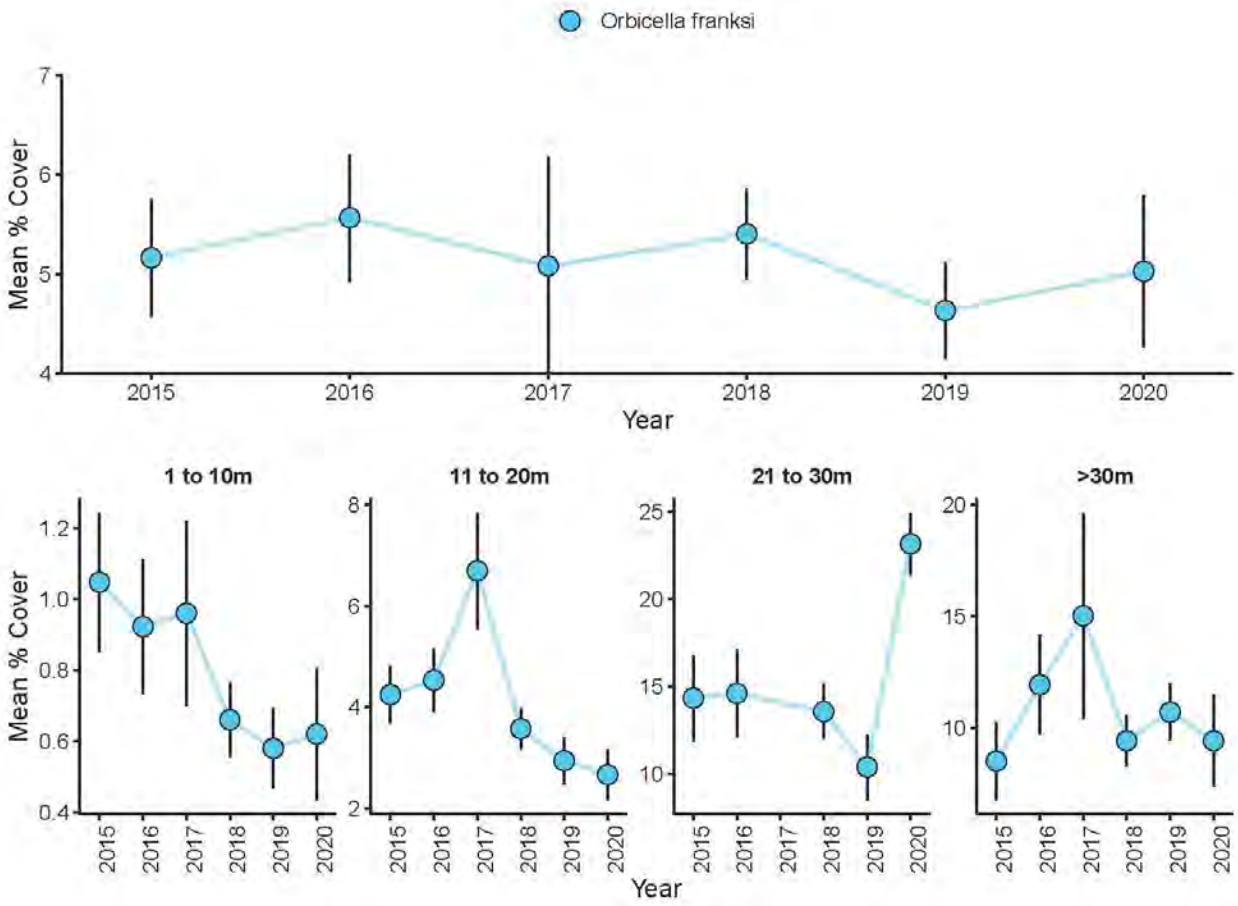

Figure 110. Mean percent cover of *Orbicella franksi* from 2015 to 2020 at sites monitored by USVI CREMP. (Top panel) Mean percent cover of *O. franksi* averaged across all transects at sites surveyed by USVI CREMP (range: 11 to 34 sites per year). (Bottom panels) Mean percent cover of *O. franksi* at all sites surveyed by USVI CREMP broken down by site depth.

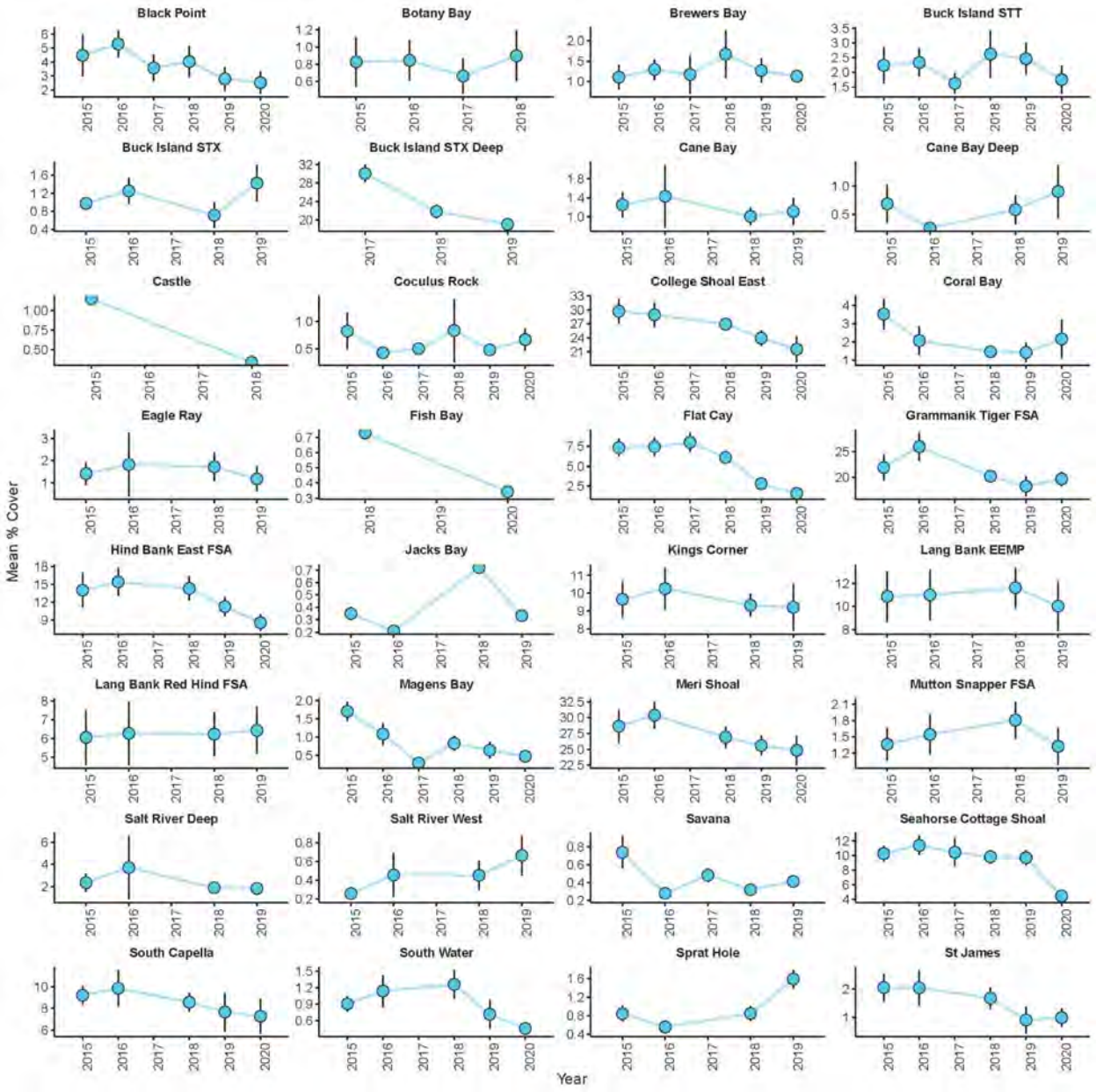

Figure 111. Mean percent cover of *Orbicella franksi* at sites monitored by USVI CREMP at individual sites where *O. franksi* was recorded on at least one transect between 2015 and 2019. Data are only presented for years when *O. franksi* was present. Note different y-axis values for each plot. Data presented are means ±SE.

Dendrogyra cylindrus

Table 28. Information on the data sources used to create the figures within this document for the *Dendrogyra cylindrus* 5 Year Status Review.

DATA SOURCE	LOCATION(S)	YEARS INCLUDED	DATA TYPE(S)
Coral Reef Evaluation and Monitoring Project (CREMP)	Florida Keys, Dry Tortugas	2014 - 2020	Density, Live Tissue Area
Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP)	Southeast Florida	2014 - 2019	Density, Live Tissue Area
Puerto Rico Coral Reef Monitoring Program (PR CRMP)	Puerto Rico	2014 – 2020	Percent cover
Puerto Rico FEMA monitoring	Puerto Rico	2018	Presence absence, density
US Virgin Island Coral Reef Monitoring Program (USVI CRMP)	U.S. Virgin Islands	2014-2020	Percent cover
Florida Reef Resilience Program's Disturbance Response Monitoring (FRRP DRM)	Southeast Florida, Florida Keys, Dry Tortugas	2014 -2019	Abundance, density, size, mortality
National Coral Reef Monitoring Program (NCRMP) (includes DRM data)	Southeast Florida, Florida Keys, Dry Tortugas, U.S. Virgin Islands, Puerto Rico	2014-2020	Percent cover, density

OTHER DATA FROM THE ESA CORAL DATABASE FILE

*Excluding the above data, the ESA Coral Database file included 166 additional entries for *Dendrogyra cylindrus* between 2014 and 2020. They were:

1. Presence/Absence data from FWC surveys conducted in 2014 (n=123), 2015 (n=10), and 2018 (n = 33).

Coral Reef Evaluation and Monitoring Project (CREMP) and the Southeast Coral Reef Evaluation and Monitoring Project (SECREMP)

The data used to generate **Figure 112** through **Figure 114** (below) were provided by Florida's Coral Reef Evaluation and Monitoring Project (CREMP) and SECREMP (pers. comm., Mike Colella, Florida Fish and Wildlife Conservation Commission (FWC), to Alison Moulding, Aug. 27, 2020). CREMP in the Florida Keys is funded through the EPA South Florida Water Quality Protection Program and CREMP in the Dry Tortugas is funded through the National Park Service. Both Florida Keys and Dry Tortugas surveys were completed by the Coral Program at the FWC Fish and Wildlife Research Institute (FWRI). SECREMP data is credited to Florida Department of Environmental Protection (FDEP) Coral Reef Conservation Program and Dr. David Gilliam's lab at the National Coral Reef Institute (NCRI) and Nova Southeastern University (NSU).

CREMP and SECREMP surveys were conducted annually in permanent transects across sites (n=4 transects per site) in three regions of Florida: Dry Tortugas (DT), Florida Keys (FL Keys), and Southeast Florida (SE FL) north of the Florida Keys (see Table below for number of sites within each region). This sampling scheme includes eight sites that are located at monospecific coral stands or special habitat areas for the coral species in this status review. Thus, data from these eight sites (DT n = 4 sites, FL Keys n = 3 sites; SE FL n = 1 site) were excluded from the general CREMP data analyses. The figures below display Florida-wide, regional and site-specific trends in mean percent coral cover, total or mean live coral area, and total colony counts by species between 2014 and 2019 from CREMP and SECREMP survey data. For these figures means were calculated by using transect as a replicate (n = 260 per year, except for 2017, where n = 258 transects).

Table 29. Number of sites surveyed annually by CREMP and SECREMP programs.

Region	Number of Sites	Number of monospecific or special habitat area sites
Southeast Florida (SE FL)	21	1
Florida Keys	37	3
Dry Tortugas	7	4

CREMP and SECREMP monitoring data summary

PERCENT COVER: The mean percent cover of *Dendrogyra cylindrus* across all 260 transects surveyed was highest in 2014 at 0.013% ±0.013 and lowest in 2017 and 2018 when no colonies were recorded on transects (**Figure 112**). *Dendrogyra cylindrus* was not observed on any surveys conducted between 2014 and 2019 in the Dry Tortugas region or the Southeast Florida Region, and was only detected in the Florida Keys on surveys conducted in 2014 and 2016 (mean cover 0.022% ±0.022 in 2014 and 0.0007% ±0.0007 in 2016,). There was no *D. cylindrus* observed at monotypic sites from 2014 to 2019.

LIVE TISSUE AREA: *Dendrogyra cylindrus* was only observed on surveys conducted in 2014 and 2016 in the Florida Keys. The live tissue area of *D. cylindrus* (estimated area; m2) across all 260 transects surveyed was 0.98 m^2 in 2014 and 0.36m^2 in 2016, and both of these observations were from a single site (Conch Shallow; **Figure 113**). There was no *D. cylindrus* observed on surveys conducted in the Dry Tortugas or Southeast Florida any year between 2014 and 2019, and no *D. cylindrus* was observed at monotypic sites surveyed from 2014 to 2019.

DENSITY: *Dendrogyra cylindrus* was only observed on surveys conducted in 2014 and 2016 in the Florida Keys. The mean density of *D. cylindrus* across all 260 transects surveyed in 2014 and 2016 was 0.0004 ± 0.0004 colonies m^{-2} (mean ±SE; **Figure 114**) in both 2014 and 2016. There was no *D. cylindrus* observed on surveys conducted in the Dry Tortugas or Southeast Florida any year between 2014 and 2019, and no *D. cylindrus* was observed at monotypic sites surveyed from 2014 to 2019.

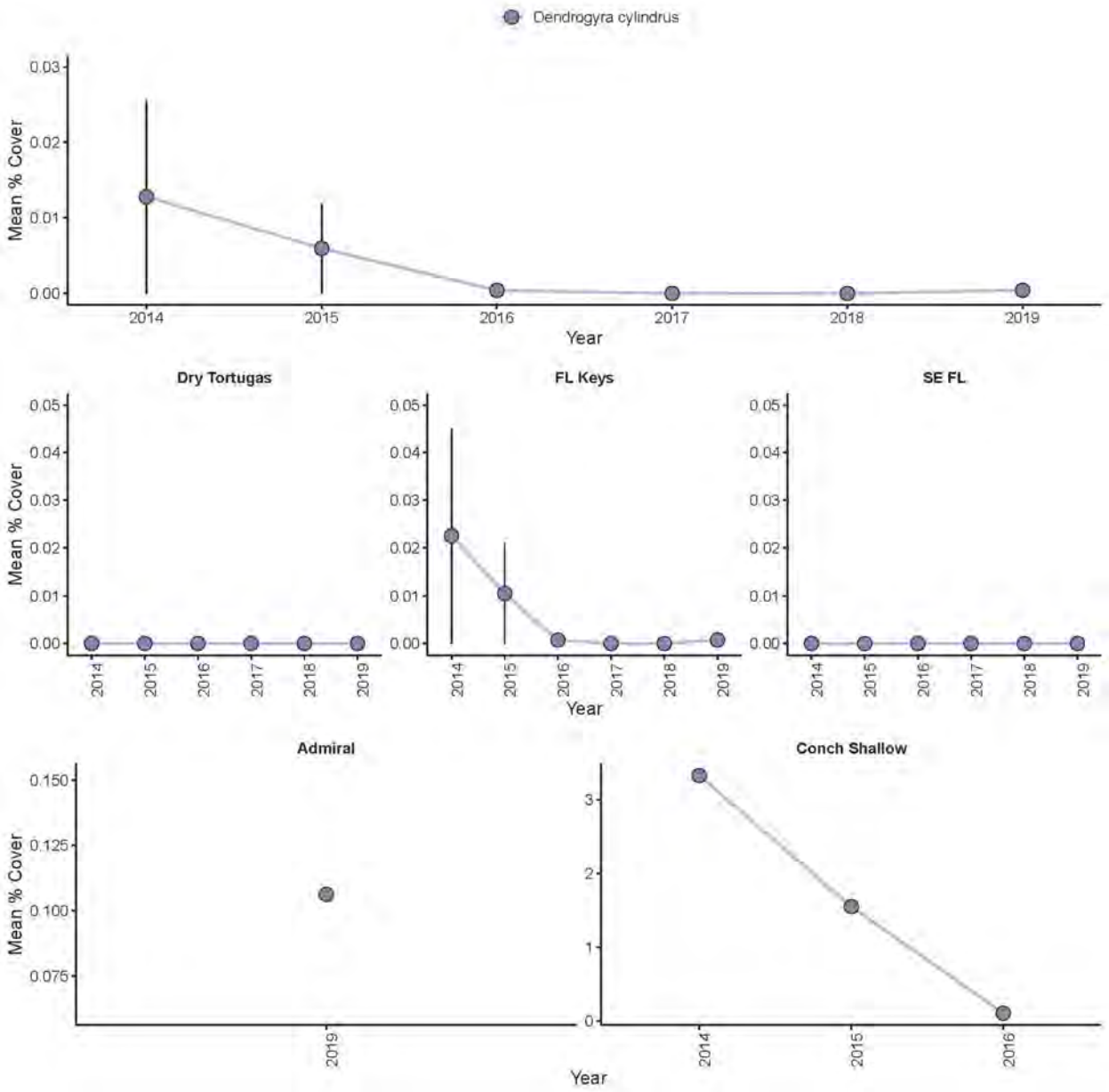

Figure 112. Mean percent cover of *Dendrogyra cylindrus* from 2014 to 2019: Florida-wide, regional, and individual site patterns. (Top panel) Mean percent cover of *D. cylindrus* averaged across all transects conducted at Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites). (Middle panels) Mean percent cover of *D. cylindrus* for each region surveyed by CREMP (DT = 7 sites; FL Keys = 37 sites; SE FL = 21 sites). (Bottom panels) Mean percent cover of *A. palmata* on transects conducted at any Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites) where *D. cylindrus* was recorded on at least one transect between 2014 – 2019. Data presented are means ±SE. Note different y-axis values for each plot.

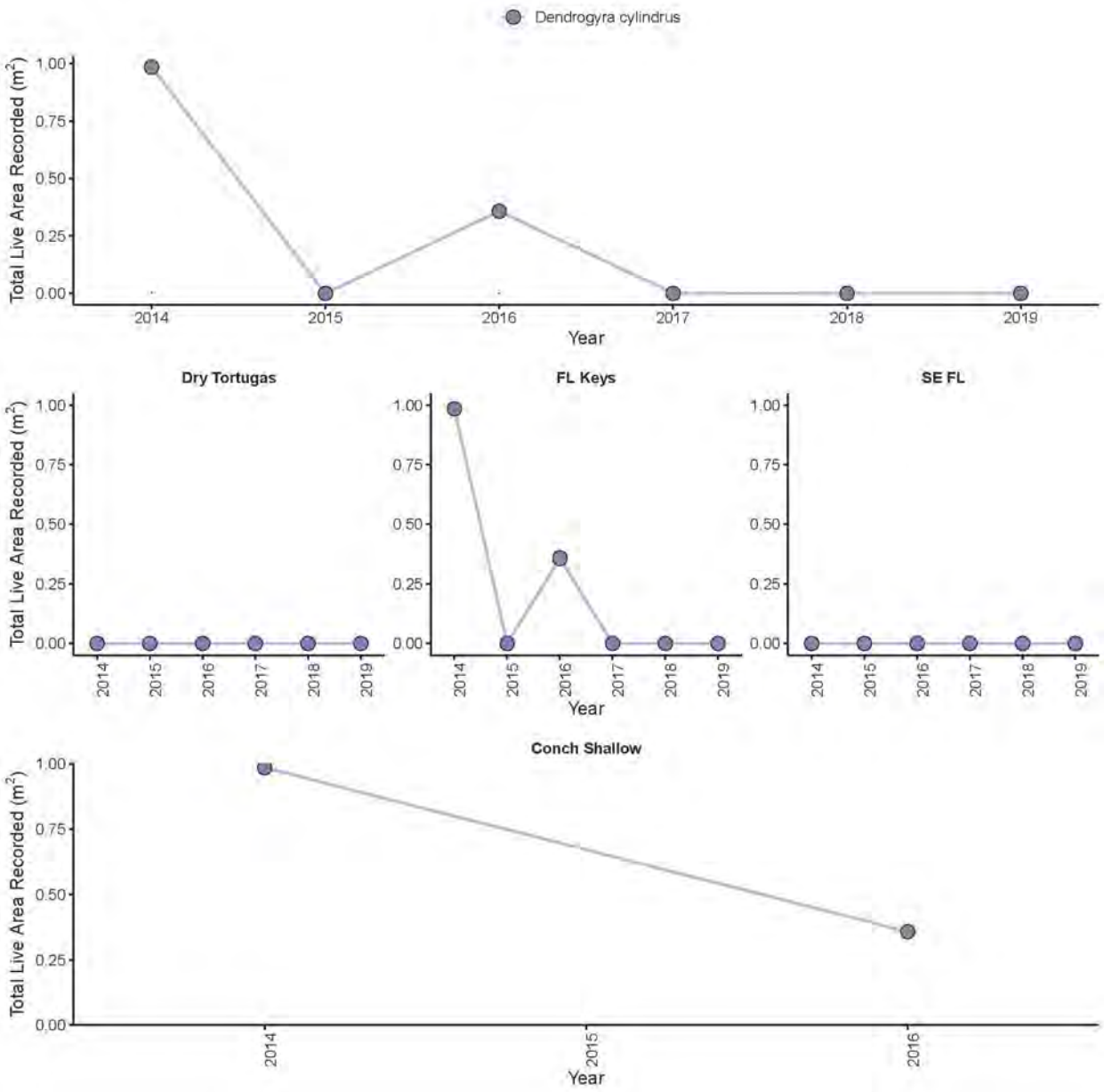

Figure 113. **Total live area (m^2) of *Dendrogyra cylindrus* from 2014 to 2019: Florida-wide and regional patterns.** (Top panel) Total live area (m^2) of *D. cylindrus* summed across all transects conducted at Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites). (Middle panel) Total live area (m^2) of *D. cylindrus* for each region surveyed by CREMP (DT = 7 sites; FL Keys = 37 sites; SE FL = 21 sites). (Bottom two panels) Total live area of *D. cylindrus* on transects conducted at any Florida coral reef sites surveyed by CREMP and SECREMP where *D. cylindrus* was recorded on at least one transect between 2014 – 2019. Note different y-axis values for each plot.

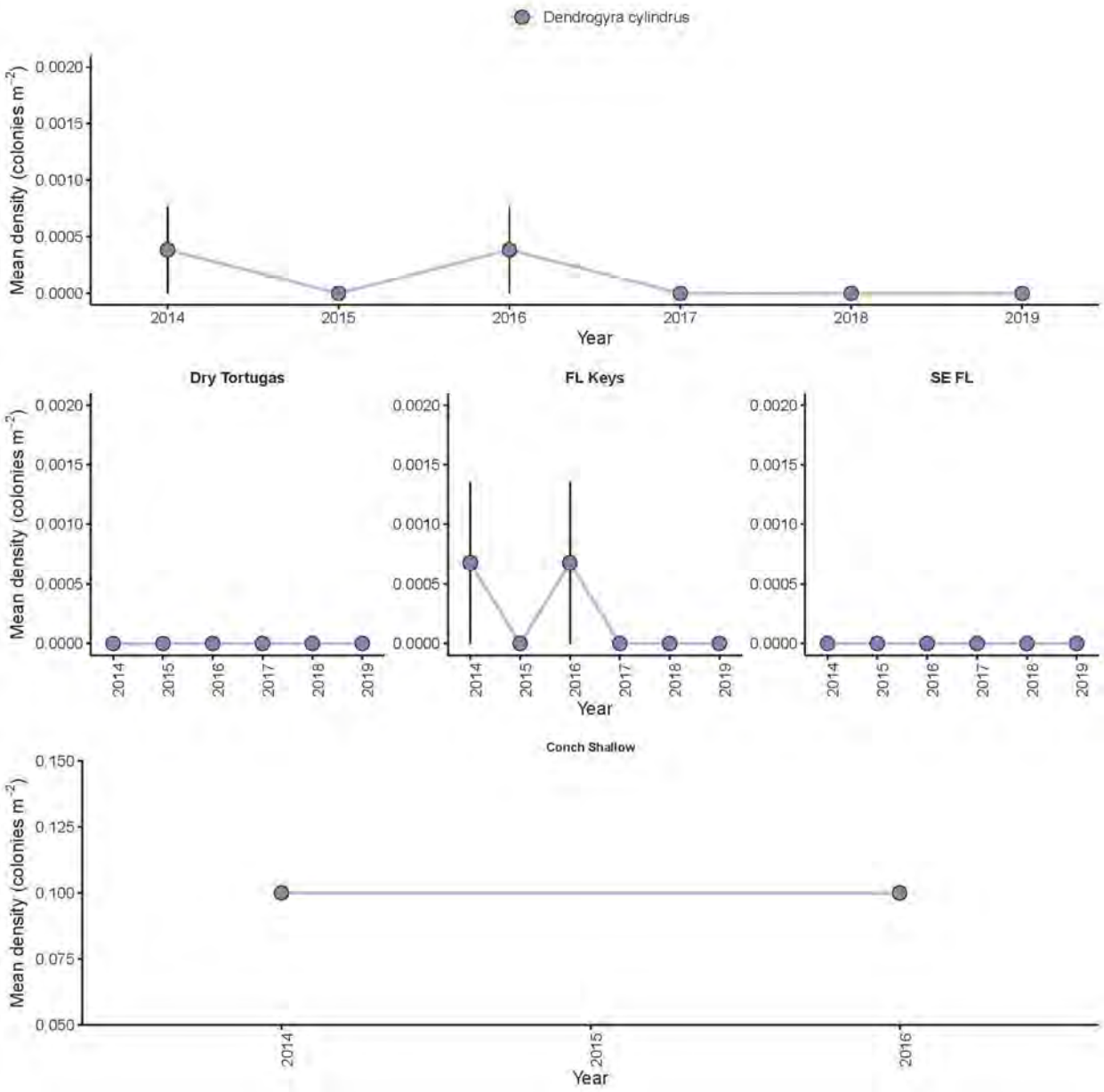

Figure 114. Mean density of *Dendrogyra cylindrus* colonies from 2014 to 2019: Florida-wide and regional patterns. (Top panel) Mean density (colonies m^{-2}) of *D. cylindrus* colonies averaged across all transects conducted at Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites). (Middle panel) Mean density (colonies m^{-2}) of *D. cylindrus* colonies for each region surveyed by CREMP and SECREMP (DT = 7 sites; FL Keys = 37 sites; SE FL = 21 sites). (Bottom two panels) Mean density (colonies m^{-2}) of *D. cylindrus*. colonies on transects at any Florida coral reef site in the Southeast Florida subregion (n = 21) surveyed by where *D. cylindrus* was recorded on at least one transect between 2014 – 2019. Data presented are means ±SE. Note different y-axis values for each plot.

National Coral Reef Monitoring program (NCRMP) and the Florida Reef Resilience Program (FRRP) Disturbance Response Monitoring (DRM)

The National Coral Reef Monitoring Program (NCRMP) provides a biennial ecological characterization at a broad spatial scale of general reef condition for reef fishes, corals and benthic habitat (i.e., fish species composition/density/size, benthic cover, and coral density/size/condition). Data collection occurs at stratified random sites where the sampling domain for each region (e.g., Florida, Puerto Rico, U.S. Virgin Islands, Flower Garden Banks National Marine Sanctuary [FGBNMS]) is partitioned by habitat type and depth, sub-regional location (e.g., along-shelf position) and management zone.

The FRRP DRM uses a stratified random sampling design and focuses on bleaching species in <60 ft of water. Two $10m^2$ belt transects (1m width x 10m length) were completed at each site for a total of $20m^2$ surveyed at each site. Because NCRMP and DRM sampling overlaps in the geographic regions they survey and both employ a stratified random sampling design, density, percent cover and coral colony measures (maximum diameter, height, and percent partial mortality) data for these two surveys were combined and presented together.

Table 30. Number of surveys conducted by NCRMP and DRM monitoring programs each year from 2014 to 2020 broken down by each region surveyed. SE FL = Southeast Florida, STTSTJ = St. Thomas and St. John, STX = St. Croix.*In 2018 NCRMP and DRM surveys were conducted together and were not provided as individual data sets.

Year	Region	Survey	No. Surveys	Year	Region	Survey	No. Surveys
2014	Dry Tortugas	DRM	29	2017	Dry Tortugas	DRM	31
2014	Dry Tortugas	NCRMP	105	2017	FL Keys	DRM	18
2014	FL Keys	DRM	86	2017	SE FL	DRM	23
2014	FL Keys	NCRMP	314	2017	STTSTJ	NCRMP	230
2014	SE FL	DRM	41	2017	STX	NCRMP	171
2014	SE FL	NCRMP	49	2018	Dry Tortugas	NCRMP/ DRM*	139
2014	Puerto Rico	NCRMP	103	2018	FL Keys	DRM	95
2015	Dry Tortugas	DRM	20	2018	FL Keys	NCRMP	86
2015	FL Keys	DRM	129	2018	SE FL	DRM	50
2015	SE FL	DRM	100	2018	SE FL	NCRMP	70
2015	STTSTJ	NCRMP	162	2019	Dry Tortugas	DRM	79
2015	STX	NCRMP	133	2019	FL Keys	DRM	123
2016	Dry Tortugas	DRM	29	2019	SE FL	DRM	81
2016	Dry Tortugas	NCRMP	97	2019	Puerto Rico	NCRMP	147
2016	FL Keys	DRM	107	2019	STTSTJ	NCRMP	221
2016	FL Keys	NCRMP	92	2019	STX	NCRMP	245
2016	SE FL	DRM	48	2020	Dry Tortugas	DRM	108
2016	SE FL	NCRMP	93	2020	FL Keys	DRM	165
2016	Puerto Rico	NCRMP	157	2020	SE FL	DRM	116

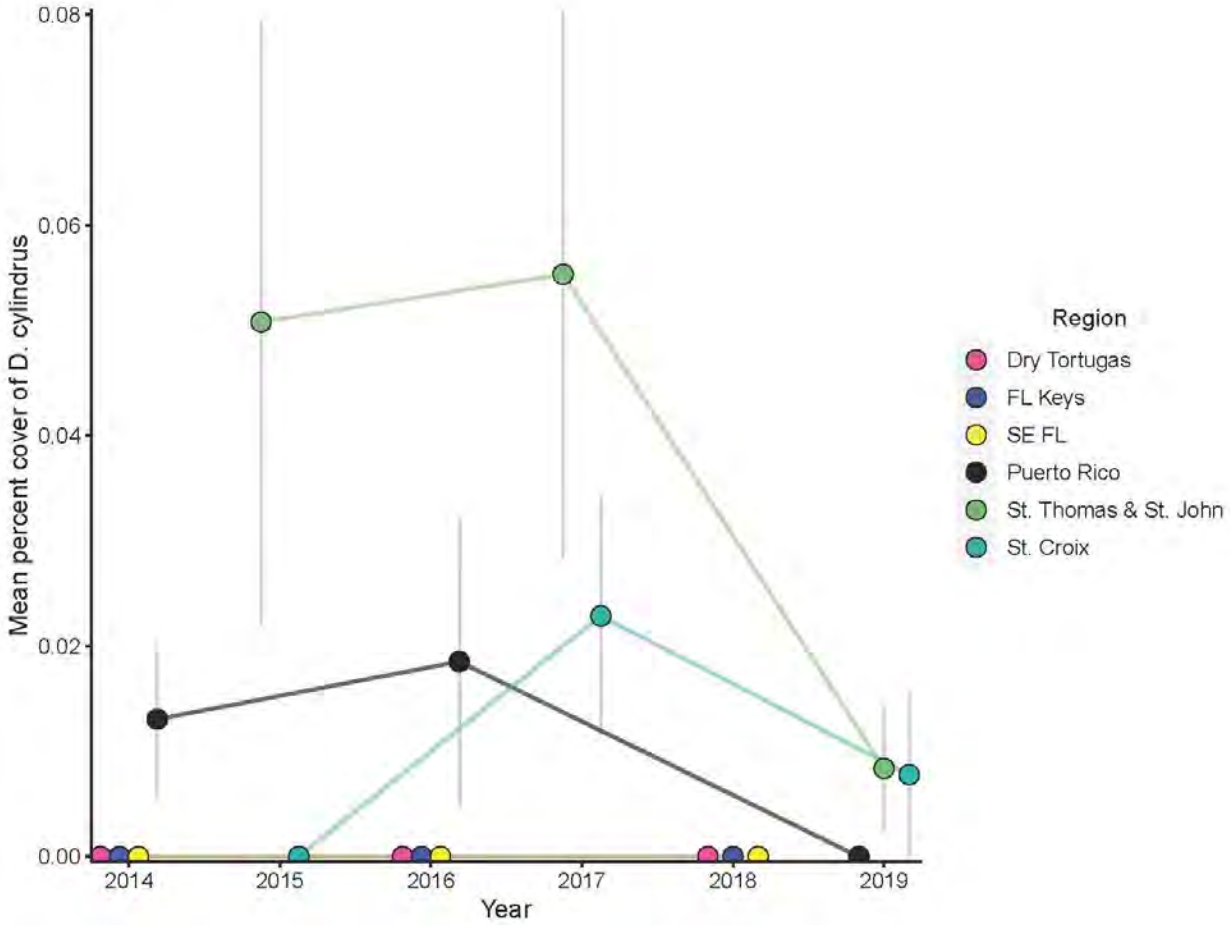

Figure 115. Mean percent cover of *Dendrogyra cylindrus* for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

Figure 116. Mean density (colonies m^{-2}) of *Dendrogyra cylindrus* colonies for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

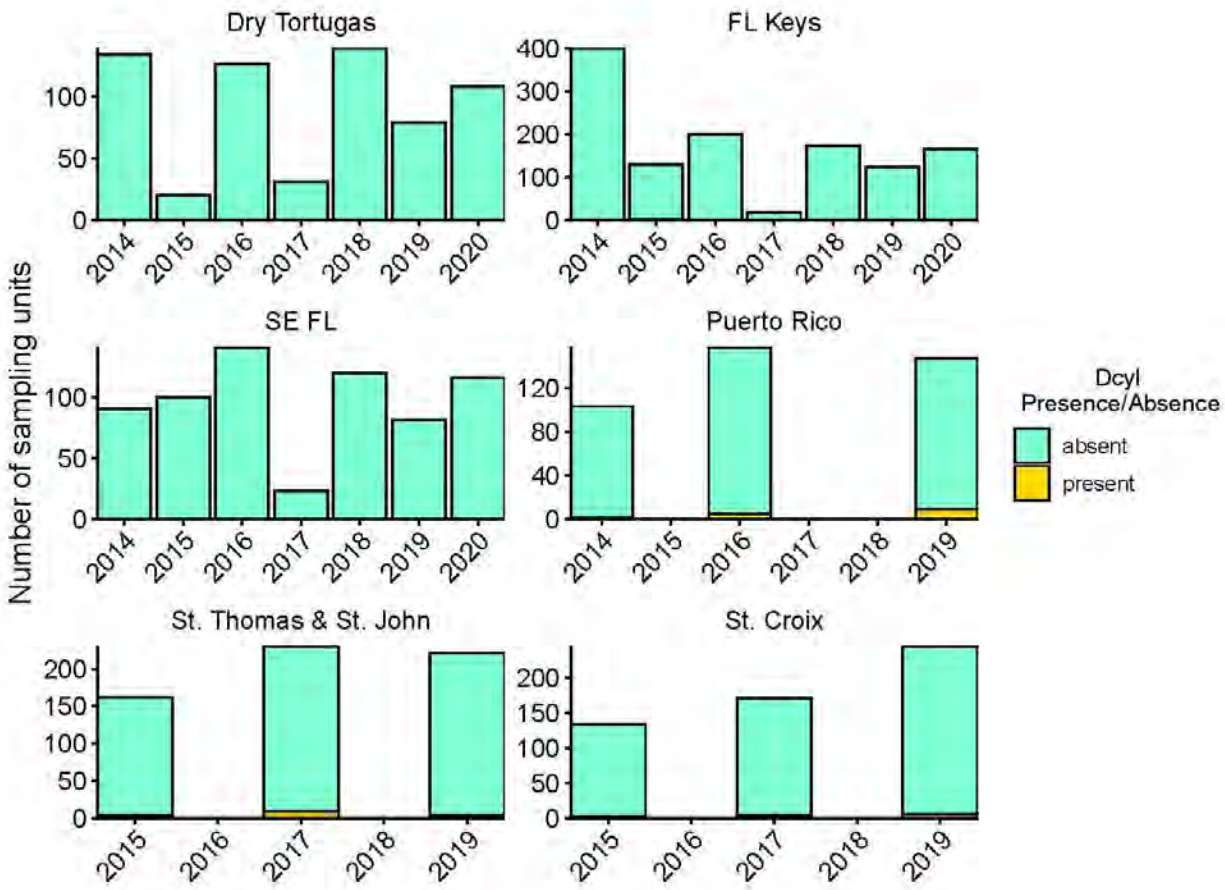

Figure 117. Number of sites where *Dendrogyra cylindrus* was observed (gold) or absent (teal) for each year and region surveyed by NCRMP and DRM from 2014 to 2020.

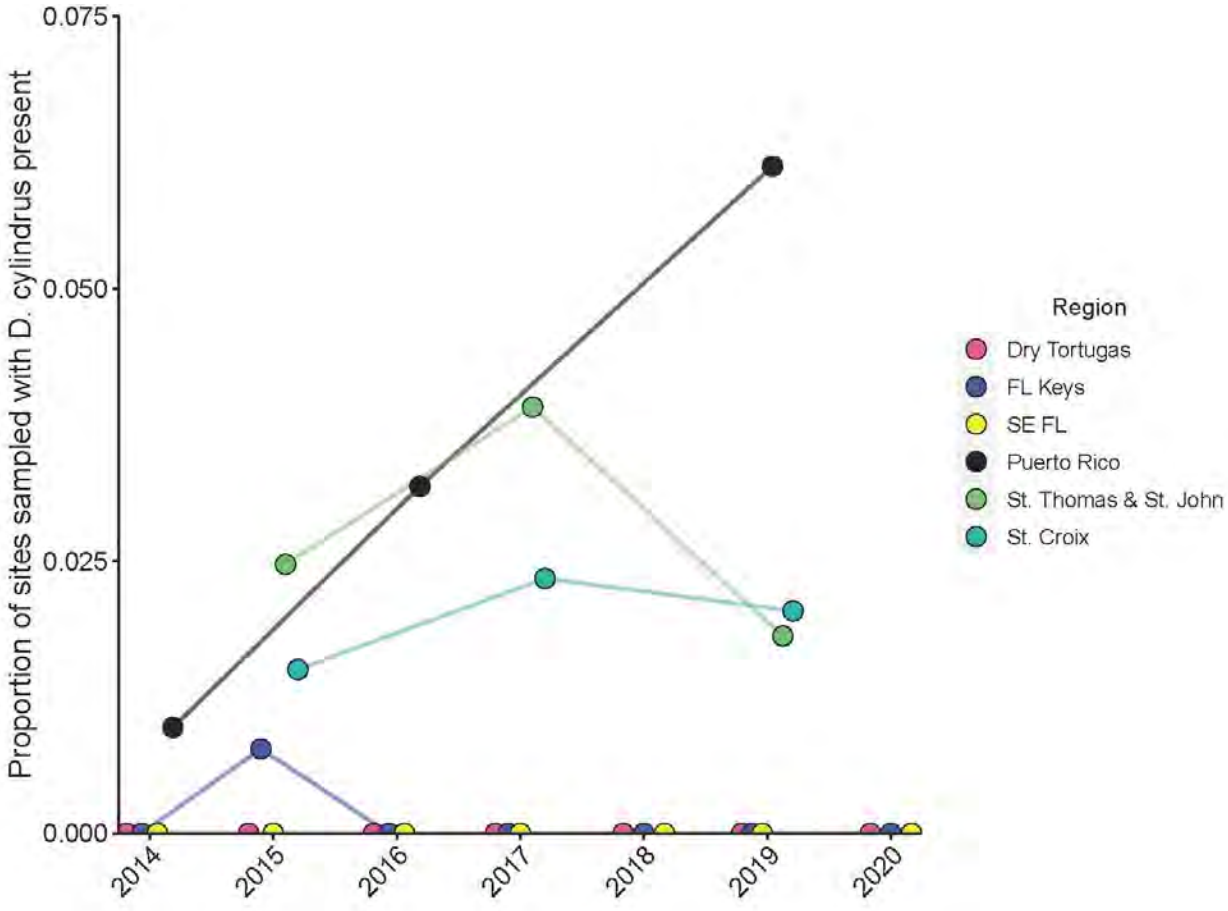

Figure 118. Proportion of all sites surveyed where *Dendrogyra cylindrus* was present for each year and region surveyed by NCRMP and DRM from 2014 to 2020.

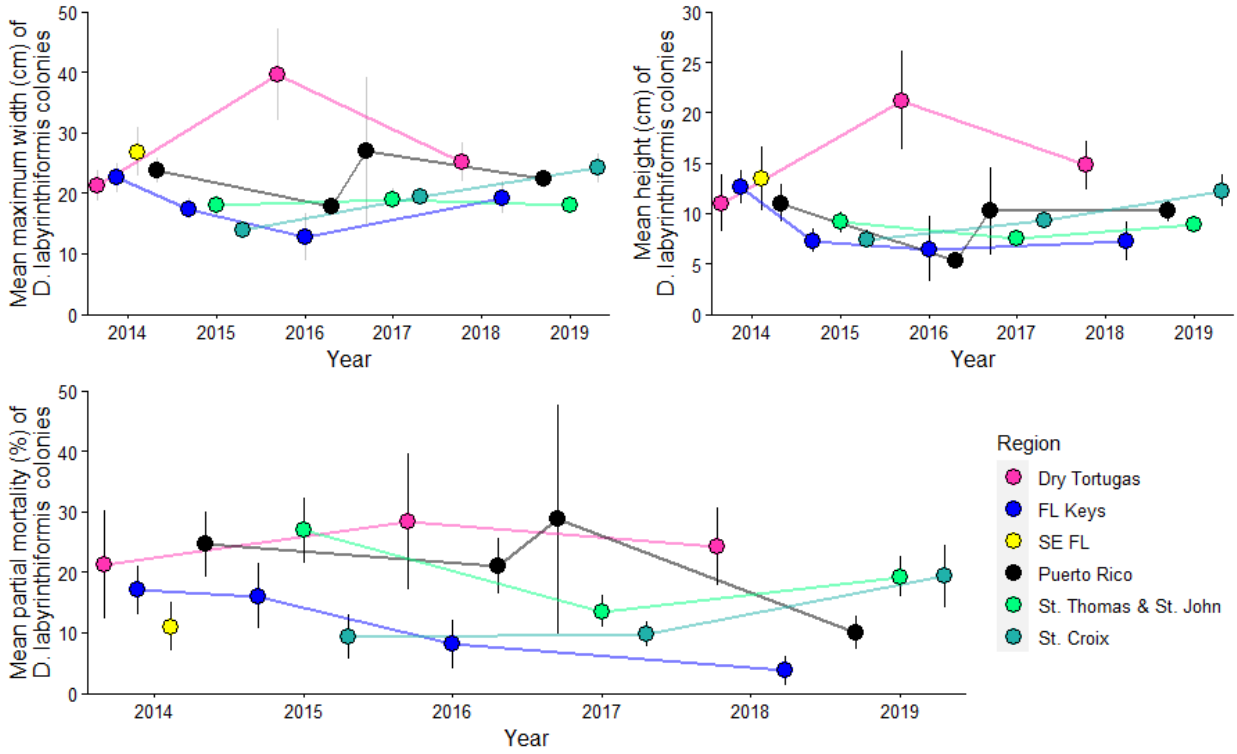

Figure 119. (Top Left) Mean maximum diameter (cm), (Top Right) mean height (cm), and (Bottom) mean partial colony mortality (%) of *D. cylindrus* colonies surveyed on each transect for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

Puerto Rico CREMP (PR CREMP)

Data used in the figures below was provided by The Puerto Rico Coral Reef Monitoring Program (Miguel G Figuerola Hernandez, University of Puerto Rico, to Mark Ladd. Nov 24, 2020) and is publicly available at https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.nodc:0204647.

Benthic data collection and description (Copied from NCEI website): Data files include raw data (by transect) for 86 stations where substrate cover by sessile-benthic categories and fish, and motile megabenthic invertebrate taxonomic composition and densities have been characterized from 1999-2020. At present, 42 permanent stations are surveyed biannually (21 per year). For the benthic characterization, a set of five 10-meter-long permanent transects are surveyed at each station. Sessile-benthic reef communities are characterized by the continuous intercept chain-link method, following the Caribbean Coastal Marine Productivity (CARICOMP) (1994) protocol. The PRCREMP data files also include a site classification spreadsheet with descriptors for each monitoring station, some of which can be used as spatial and temporal factors for statistical analyses. These descriptors include information about depth, habitat type, distance from shore, marine protected areas attributes, coordinates, and other metadata.

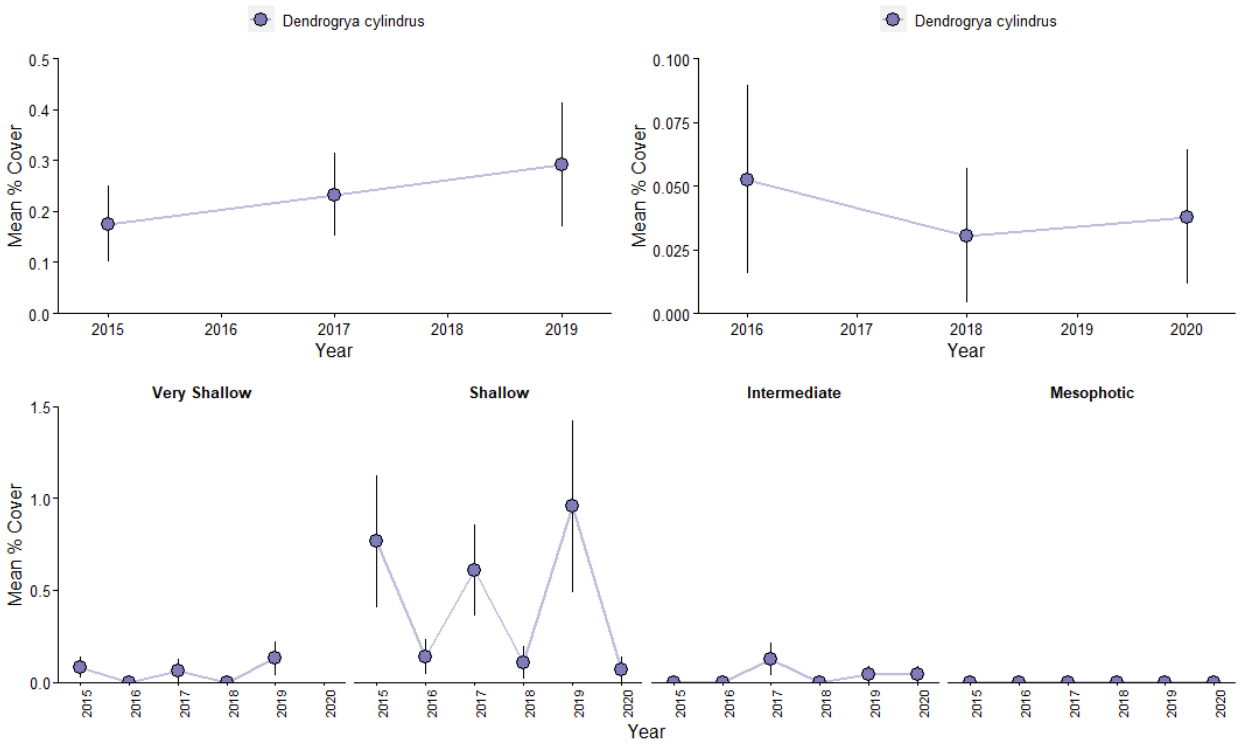

Figure 120. Mean percent cover of *Dendrogyra cylindrus* from 2015 to 2020 at sites monitored by Puerto Rico CREMP. (Top left panel) Mean percent cover of *D. cylindrus* averaged across all transects at sites surveyed by PR CREMP in 2015, 2017, and 2019. (Top right panel) Mean percent cover of *D. cylindrus* averaged across all transects at sites surveyed by PR CREMP in 2016, 2018, and 2020. (21 sites surveyed in 2016 and 2018, only 3 sites included for 2020). (Bottom panels) Mean percent cover of *D. cylindrus* at all sites surveyed by PR CREMP broken down by site depth (21 sites surveyed 2015 to 2019, only 3 sites included for 2020).

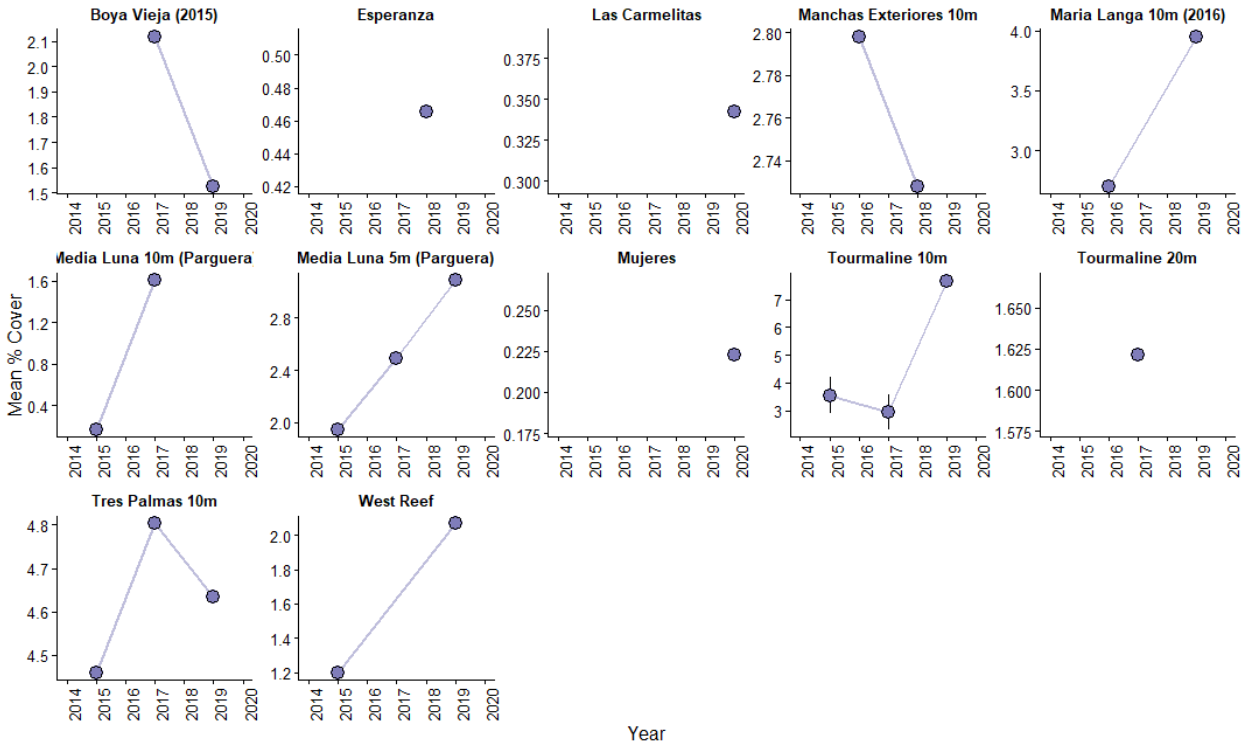

Figure 121. Mean percent cover of *Dendrogyra cylindrus* at individual sites where *D. cylindrus* was recorded on at least one transect between 2015 and 2019 in PR CREMP surveys. For bottom panels data is only presented for years when *D. cylindrus* was present. Note different y-axis values for each plot. Data presented are means ±SE. 21 sites were surveyed from 2015 to 2019, only data from 3 sites was provided for 2020.

Puerto Rico FEMA surveys

Monitoring was conducted in coral reef habitat at six subregions of Puerto Rico in 2018. These surveys were conducted in March of 2018, following Hurricane Irma, which affected the area in the fall of 2017. Two types of surveys were conducted to collect two types of data: (1) presence-absence data and (2) density data. Both presence-absence and density data were collected via a combination of roving diver surveys and transect surveys. The total number of surveys conducted in 2018 within each subregion of Puerto Rico is provided in the table below. Density surveys were conducted at a subset of sites where presence-absence surveys were conducted. The area covered by roving diver surveys ranged from 157 m^2 to 1,702 m^2, whereas transect areas ranged from 50 m^2 to 1000 m^2.

Table 31. Number of surveys conducted in Puerto Rico in 2018 broken down by Subregion, roving surveys, and transects surveys.

Survey Type	Subregion	Roving surveys	Transect surveys	Total surveys
Presence - Absence Surveys	North	11	9	20
Presence - Absence Surveys	Northeast	52	65	117
Presence - Absence Surveys	Southeast	8	8	16
Presence - Absence Surveys	Southwest	14	12	26
Presence - Absence Surveys	West	16	13	29
Presence - Absence Surveys	Vieques	19	21	40
Presence - Absence Surveys	**Total**	**120**	**128**	**248**
Density Surveys	North	11	9	20
Density Surveys	Northeast	52	56	108
Density Surveys	Southeast	8	7	15
Density Surveys	Southwest	14	10	24
Density Surveys	West	15	12	27
Density Surveys	Vieques	19	18	37
Density Surveys	**Total**	**119**	**112**	**231**

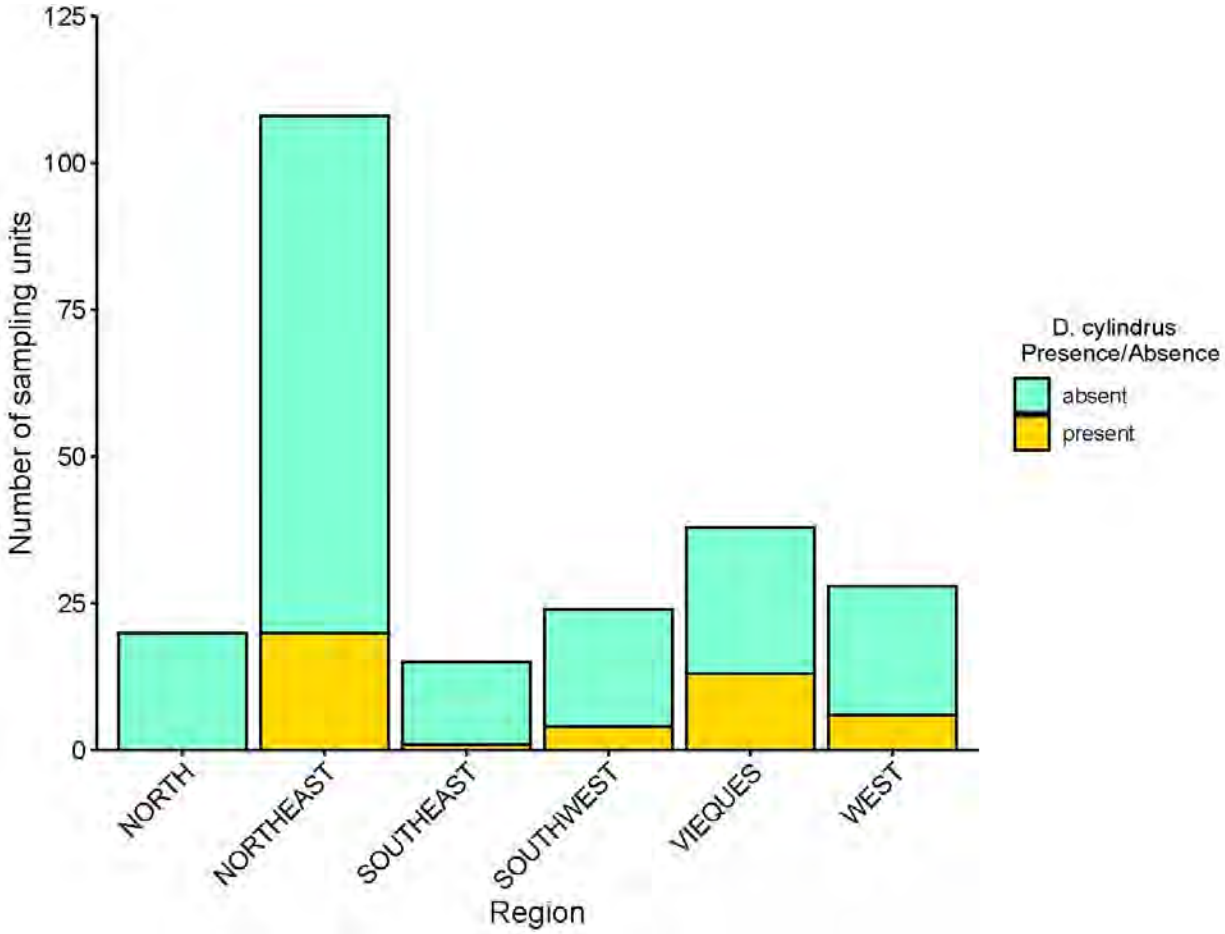

Figure 122. Number of surveys where *Dendrogyra cylindrus* was present (gold) or absent (teal) in each subregion of Puerto Rico. Surveys were conducted in March of 2018 and were a mix of transect and roving diver surveys.

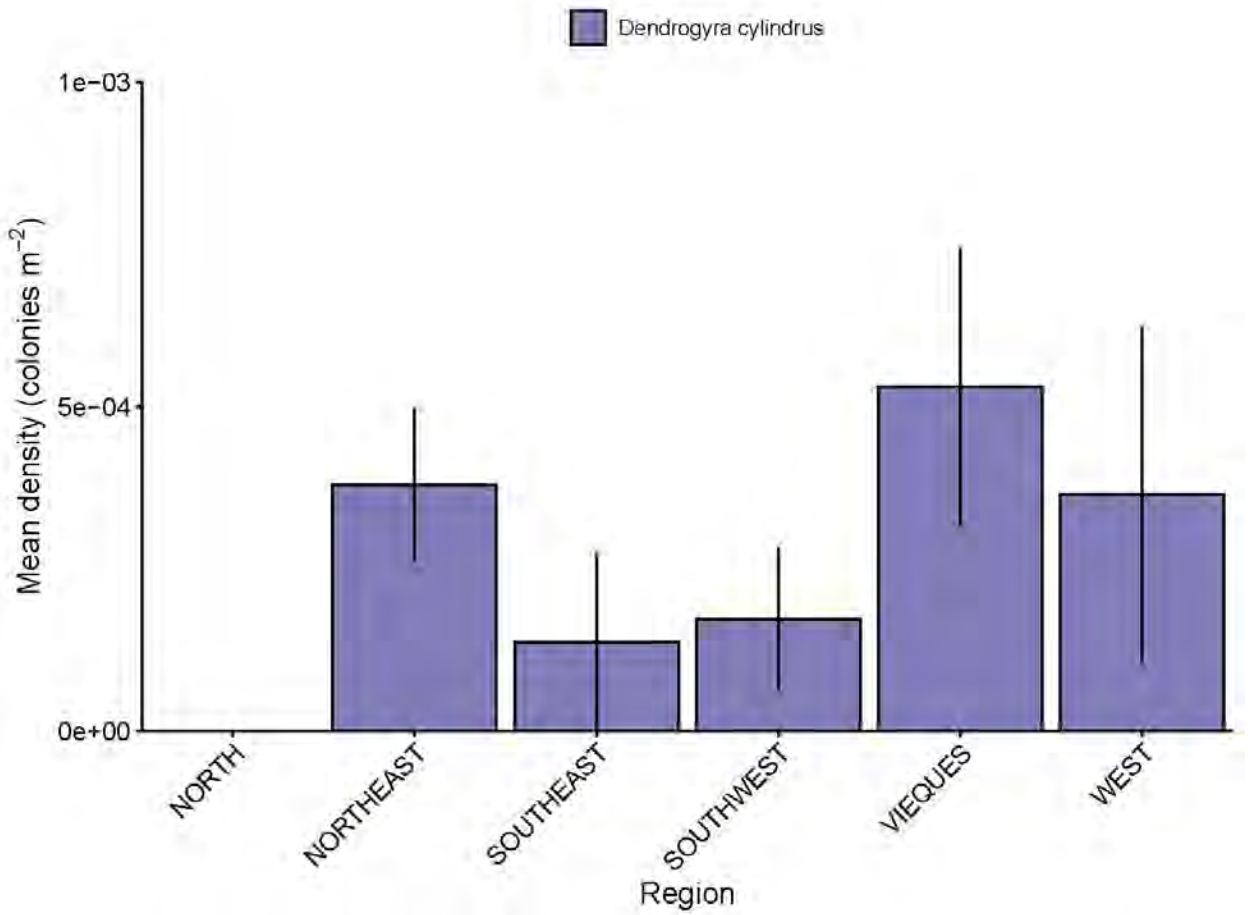

Figure 123. Density of *Dendrogyra cylindrus* colonies (corals m^{-2}*)* in each subregion of Puerto Rico. Surveys were conducted in March of 2018 and were a mix of transect and roving diver surveys. Data presented are means ±SE.

USVI CREMP

Benthic cover data collection and description from website: At each site, benthic cover surveys are conducted annually along six 10 m long permanent transects marked with steel or brass rods. Video sampling consists of one diver traversing each transect videotaping the benthic cover using a high definition digital video recorder. After taping, images from each transect are captured and imported into RStudio where twenty randomly allocated points are superimposed on each image. Analysis consists of identifying the substrate located under each point. For each transect, the percent cover of coral, epilithic algae (EAC), macroalgae, sponges, gorgonians, and sand/sediment are calculated by dividing the number of random dots falling on that substrate type by the total number of dots for that transect.

The USVI CREMP program monitors 34 sites. However, not all sites were surveyed each year. Number of sites surveyed for each year included in this review were: 2015: n = 33; 2016: n = 32; 2017: n = 11; 2018: n = 34; 2019: n = 33; 2020: n = 19. In 2018 and 2019 some sites were surveyed twice in one year and thus there are 12 instead of 6 transects total for those sites.

** There was no *Dendrogyra cylindrus* reported on USVI CREMP monitoring surveys between 2015 and 2020.**

Mycetophyllia ferox

Table 32. Information on the data sources used to create the figures within this document for the *Mycetophyllia ferox* 5 Year Status Review.

DATA SOURCE	LOCATION(S)	YEARS INCLUDED	DATA TYPE(S)
Coral Reef Evaluation and Monitoring Project (CREMP)	Florida Keys, Dry Tortugas	2014 - 2020	Density, Live Tissue Area
Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP)	Southeast Florida	2014 - 2019	Density, Live Tissue Area
Puerto Rico Coral Reef Monitoring Program (PR CRMP)	Puerto Rico	2014 – 2020	Percent cover
Puerto Rico FEMA monitoring	Puerto Rico	2018	Presence absence, density
US Virgin Island Coral Reef Monitoring Program (USVI CRMP)	U.S. Virgin Islands	2014-2020	Percent cover
Florida Reef Resilience Program's Disturbance Response Monitoring (FRRP DRM)	Southeast Florida, Florida Keys, Dry Tortugas	2014 -2019	Abundance, density, size, mortality
National Coral Reef Monitoring Program (NCRMP) (includes DRM data)	Southeast Florida, Florida Keys, Dry Tortugas, U.S. Virgin Islands, Puerto Rico	2014-2020	Percent cover, density

OTHER DATA FROM THE ESA CORAL DATABASE FILE

*Excluding the above data, the ESA Coral Database file included 33 entries for *Mycetophyllia ferox* between 2014 and 2020. They were:

1. FWC presence-absence data recorded in 2018 (n = 33)

Coral Reef Evaluation and Monitoring Project (CREMP) and the Southeast Coral Reef Evaluation and Monitoring Project (SECREMP)

The data used to generate **Figure 125** through **Figure 127** were provided by Florida's Coral Reef Evaluation and Monitoring Project (CREMP) and SECREMP (pers. comm., Mike Colella, Florida Fish and Wildlife Conservation Commission (FWC), to Alison Moulding, Aug. 27, 2020). CREMP in the Florida Keys is funded through the EPA South Florida Water Quality Protection Program and CREMP in the Dry Tortugas is funded through the National Park Service. Both Florida Keys and Dry Tortugas surveys were completed by the Coral Program at the FWC Fish and Wildlife Research Institute (FWRI). SECREMP data is credited to Florida Department of Environmental Protection (FDEP) Coral Reef Conservation Program and Dr. David Gilliam's lab at the National Coral Reef Institute (NCRI) and Nova Southeastern University (NSU).

CREMP and SECREMP surveys were conducted annually in permanent transects across sites (n=4 transects per site) in three regions of Florida: Dry Tortugas (DT), Florida Keys (FL Keys), and Southeast Florida (SE FL) north of the Florida Keys (see Table below for number of sites within each region). This sampling scheme includes eight sites that are located at monospecific coral stands or special habitat areas for the coral species in this status review. Thus, data from these eight sites (DT n = 4 sites, FL Keys n = 3 sites; SE FL n = 1 site) were excluded from the general CREMP data analyses. The figures below display Florida-wide, regional and site-specific trends in mean percent coral cover, total or mean live coral area, and total colony counts by species between 2014 and 2019 from CREMP and SECREMP survey data. For these figures means were calculated by using transect as a replicate (n = 260 per year, except for 2017, where n = 258 transects).

Table 33. Number of sites surveyed annually by CREMP and SECREMP programs.

Region	Number of Sites	Number of monospecific or special habitat area sites
Southeast Florida (SE FL)	21	1
Florida Keys	37	3
Dry Tortugas	7	4

CREMP and SECREMP monitoring data summary

PERCENT COVER: The mean percent cover of *Mycetophyllia ferox* across all 260 transects surveyed was highest in 2014 at 0.013% ±0.006 and lowest in 2018 (0.001% ±0.0008; **Figure 125**). *Mycetophyllia ferox* was only observed on surveys in the Dry Tortugas region in 2014, 2015, and 2016 (max: 0.024% ±0.01 in 2015, min 0.001% ±0.0007 in 2016). *Mycetophyllia ferox* was observed in all survey years (2014 to 2019) in the Florida Keys region and ranged from a high of 0.02% ±0.007 in 2015 to a low of 0.002% ±0.0007 in 2018. *Mycetophyllia ferox* was not observed on any surveys conducted from 2014 to 2019 in the Southeast Florida region. There was no *M. ferox* observed at monotypic sites from 2014 to 2019.

LIVE TISSUE AREA: The total amount of live tissue area of *Mycetophyllia ferox* (estimated area; m2) across all 260 transects surveyed was highest in 2015 when an estimated total of 3.70 m^2 was recorded, and was lowest in 2018 when 0.33 m^2 of live tissue was recorded (**Figure 126**). *Mycetophyllia ferox* was only observed on surveys in the Dry Tortugas region in 2014, 2015, and 2016 (max: 0.66 m^2 in 2015, min 0.04 m^2 in 2016). *Mycetophyllia ferox* was observed in all survey years (2014 to 2019) in the Florida Keys region and ranged from a high of 2.04 m^2 in 2015 to a low of 0.33 m^2 in 2018. *Mycetophyllia ferox* was not observed on any surveys conducted from 2014 to 2019 in the Southeast Florida region. There was no *M. ferox* observed at monotypic sites from 2014 to 2019.

DENSITY: The mean density of *Mycetophyllia ferox* colonies was consistently low across all 260 transects surveyed, but was highest in 2014 and 2015 at 0.0015 ± 0.0015 colonies m^{-2} (mean ±SE; **Figure 127**), and lowest in 2019 with an average density of at 0.001 ± 0.0006 colonies m^{-2}. In the Dry Tortugas, *Mycetophyllia ferox* was only observed on surveys in the Dry Tortugas region in 2014, 2015, and 2016, and mean colony density ranged from a high of 0.007 ± 0.005 colonies^{-2} in 2014 to a low of 0.004 ± 0.004 colonies^{-2} in 2015 and 2016. The mean density of *M. ferox* colonies observed on transects in the Florida Keys ranged two-fold from a mean of 0.0027 ± 0.001 colonies m^{-2} in 2016, 2018, and 2019 to a high of 0.006 ± 0.003 colonies m^{-2} in 2015. *Mycetophyllia ferox* was not observed on any surveys conducted from 2014 to 2019 in the Southeast Florida region. There was no *M. ferox* observed at monotypic sites from 2014 to 2019.

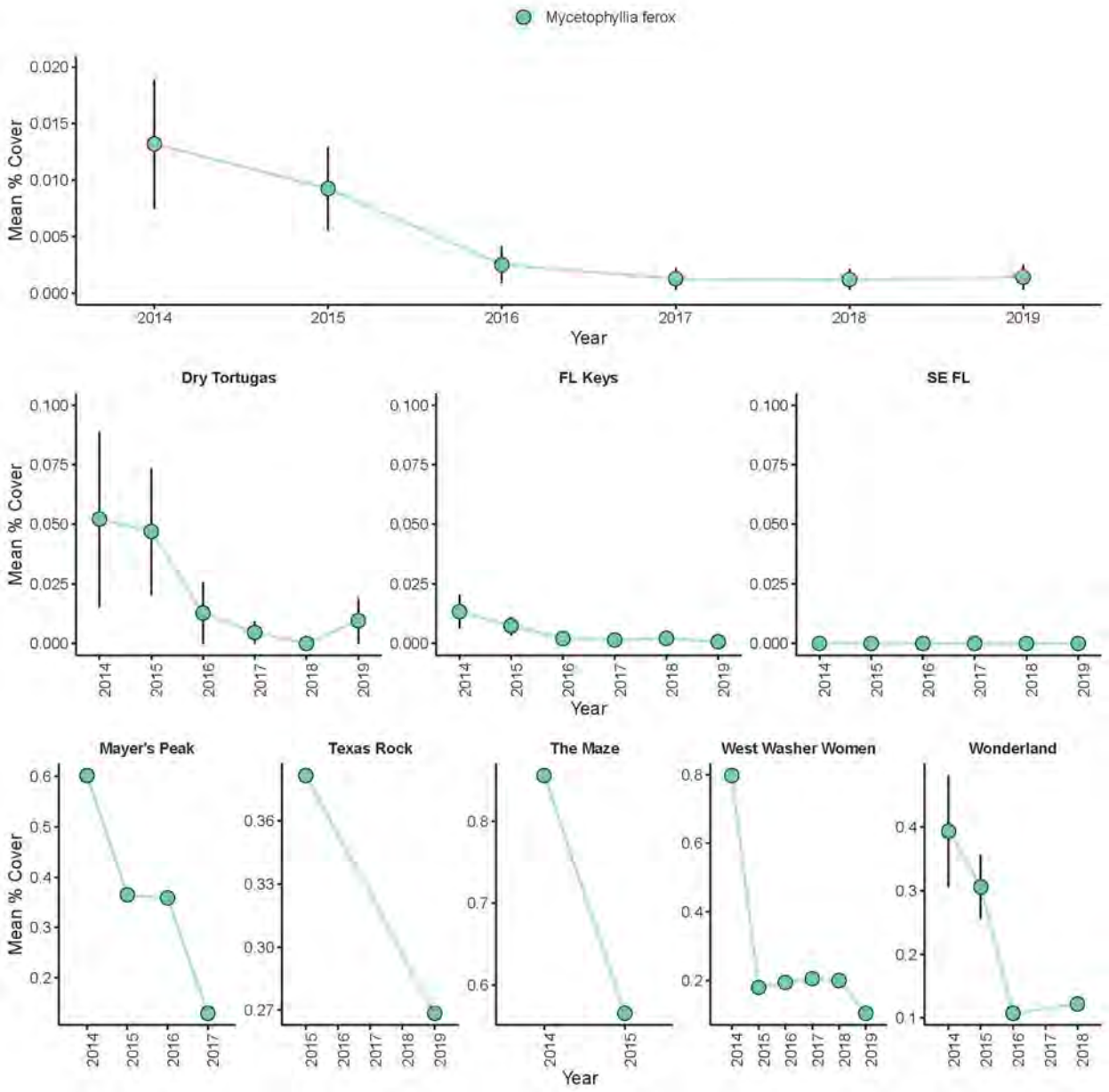

Figure 125. Mean percent cover of *Mycetophyllia ferox* from 2014 to 2019: Florida-wide, regional, and individual site patterns. (Top panel) Mean percent cover of *M. ferox* averaged across all transects conducted at Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites). (Middle panels) Mean percent cover of *M. ferox* for each region surveyed by CREMP (DT = 7 sites; FL Keys = 37 sites; SE FL = 21 sites). (Bottom panels) Mean percent cover of *A. palmata* on transects conducted at any Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites) where *M. ferox* was recorded on at least one transect between 2014 – 2019. Data presented are means ±SE. Note different y-axis values for each plot.

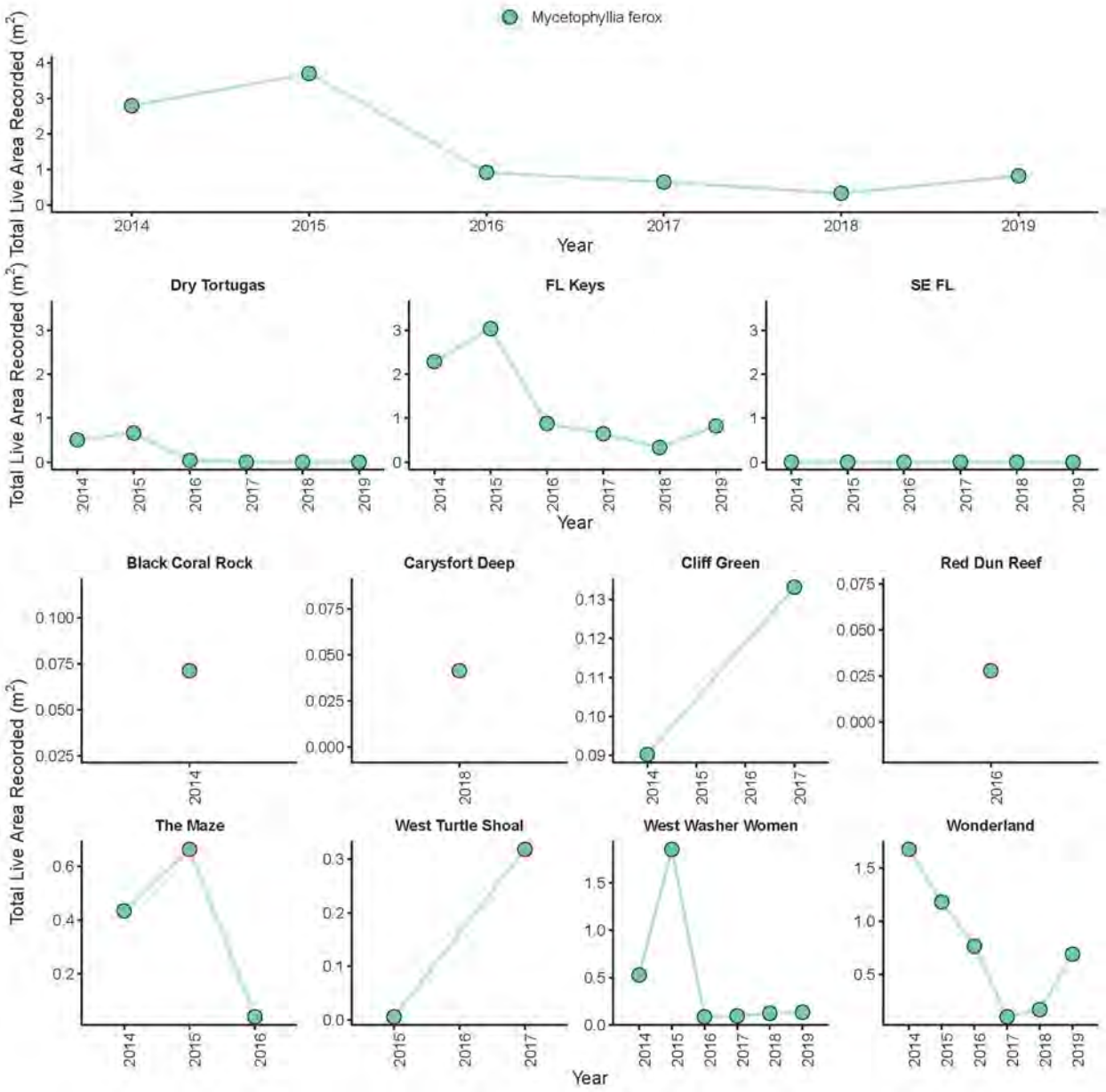

Figure 126. **Total live area (m^2) of *Mycetophyllia ferox* from 2014 to 2019: Florida-wide and regional patterns.** (Top panel) Total live area (m^2) of *M. ferox* summed across all transects conducted at Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites). (Middle panel) Total live area (m^2) of *M. ferox* for each region surveyed by CREMP (DT = 7 sites; FL Keys = 37 sites; SE FL = 21 sites). (Bottom two panels) Total live area of *M. ferox* on transects conducted at any Florida coral reef sites surveyed by CREMP and SECREMP where *M. ferox* was recorded on at least one transect between 2014 – 2019. Note different y-axis values for each plot.

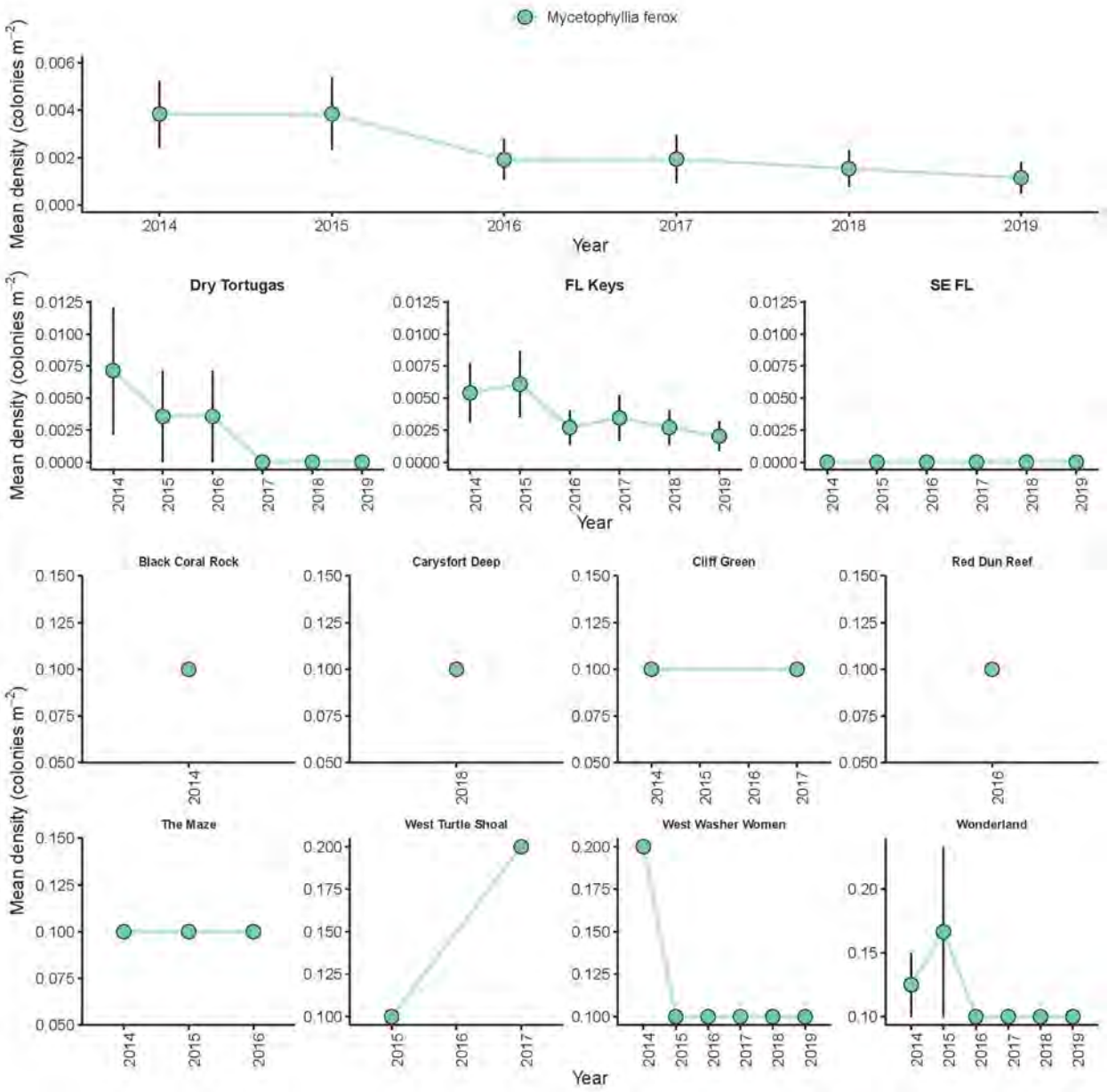

Figure 127. Mean density of *Mycetophyllia ferox* colonies from 2014 to 2019: Florida-wide and regional patterns. (Top panel) Mean density (colonies m^{-2}) of *M. ferox* colonies averaged across all transects conducted at Florida coral reef sites surveyed by CREMP and SECREMP (n = 65; excludes monotypic and special habitat sites). (Middle panel) Mean density (colonies m^{-2}) of *M. ferox* colonies for each region surveyed by CREMP and SECREMP (DT = 7 sites; FL Keys = 37 sites; SE FL = 21 sites). (Bottom two panels) Mean density (colonies m^{-2}) of *M. ferox*. colonies on transects at any Florida coral reef site in the Southeast Florida subregion (n = 21) surveyed by where *M. ferox* was recorded on at least one transect between 2014 – 2019. Data presented are means ±SE. Note different y-axis values for each plot.

National Coral Reef Monitoring program (NCRMP) and the Florida Reef Resilience Program (FRRP) Disturbance Response Monitoring (DRM)

The National Coral Reef Monitoring Program (NCRMP) provides a biennial ecological characterization at a broad spatial scale of general reef condition for reef fishes, corals and benthic habitat (i.e., fish species composition/density/size, benthic cover, and coral density/size/condition). Data collection occurs at stratified random sites where the sampling domain for each region (e.g., Florida, Puerto Rico, U.S. Virgin Islands, Flower Garden Banks National Marine Sanctuary [FGBNMS]) is partitioned by habitat type and depth, sub-regional location (e.g., along-shelf position) and management zone.

The FRRP DRM uses a stratified random sampling design and focuses on bleaching species in <60 ft of water. Two $10m^2$ belt transects (1m width x 10m length) were completed at each site for a total of $20m^2$ surveyed at each site. Because NCRMP and DRM sampling overlaps in the geographic regions they survey and both employ a stratified random sampling design, density, percent cover and coral colony measures (maximum diameter, height, and percent partial mortality) data for these two surveys were combined and presented together.

Table 34. Number of surveys conducted by NCRMP and DRM monitoring programs each year from 2014 to 2020 broken down by each region surveyed. SE FL = Southeast Florida, STTSTJ = St. Thomas and St. John, STX = St. Croix.*In 2018 NCRMP and DRM surveys were conducted together and were not provided as individual data sets.

Year	Region	Survey	No. Surveys	Year	Region	Survey	No. Surveys
2014	Dry Tortugas	DRM	29	2017	Dry Tortugas	DRM	31
2014	Dry Tortugas	NCRMP	105	2017	FL Keys	DRM	18
2014	FL Keys	DRM	86	2017	SE FL	DRM	23
2014	FL Keys	NCRMP	314	2017	STTSTJ	NCRMP	230
2014	SE FL	DRM	41	2017	STX	NCRMP	171
2014	SE FL	NCRMP	49	2018	Dry Tortugas	NCRMP/ DRM*	139
2014	Puerto Rico	NCRMP	103	2018	FL Keys	DRM	95
2015	Dry Tortugas	DRM	20	2018	FL Keys	NCRMP	86
2015	FL Keys	DRM	129	2018	SE FL	DRM	50
2015	SE FL	DRM	100	2018	SE FL	NCRMP	70
2015	STTSTJ	NCRMP	162	2019	Dry Tortugas	DRM	79
2015	STX	NCRMP	133	2019	FL Keys	DRM	123
2016	Dry Tortugas	DRM	29	2019	SE FL	DRM	81
2016	Dry Tortugas	NCRMP	97	2019	Puerto Rico	NCRMP	147
2016	FL Keys	DRM	107	2019	STTSTJ	NCRMP	221
2016	FL Keys	NCRMP	92	2019	STX	NCRMP	245
2016	SE FL	DRM	48	2020	Dry Tortugas	DRM	108
2016	SE FL	NCRMP	93	2020	FL Keys	DRM	165
2016	Puerto Rico	NCRMP	157	2020	SE FL	DRM	116

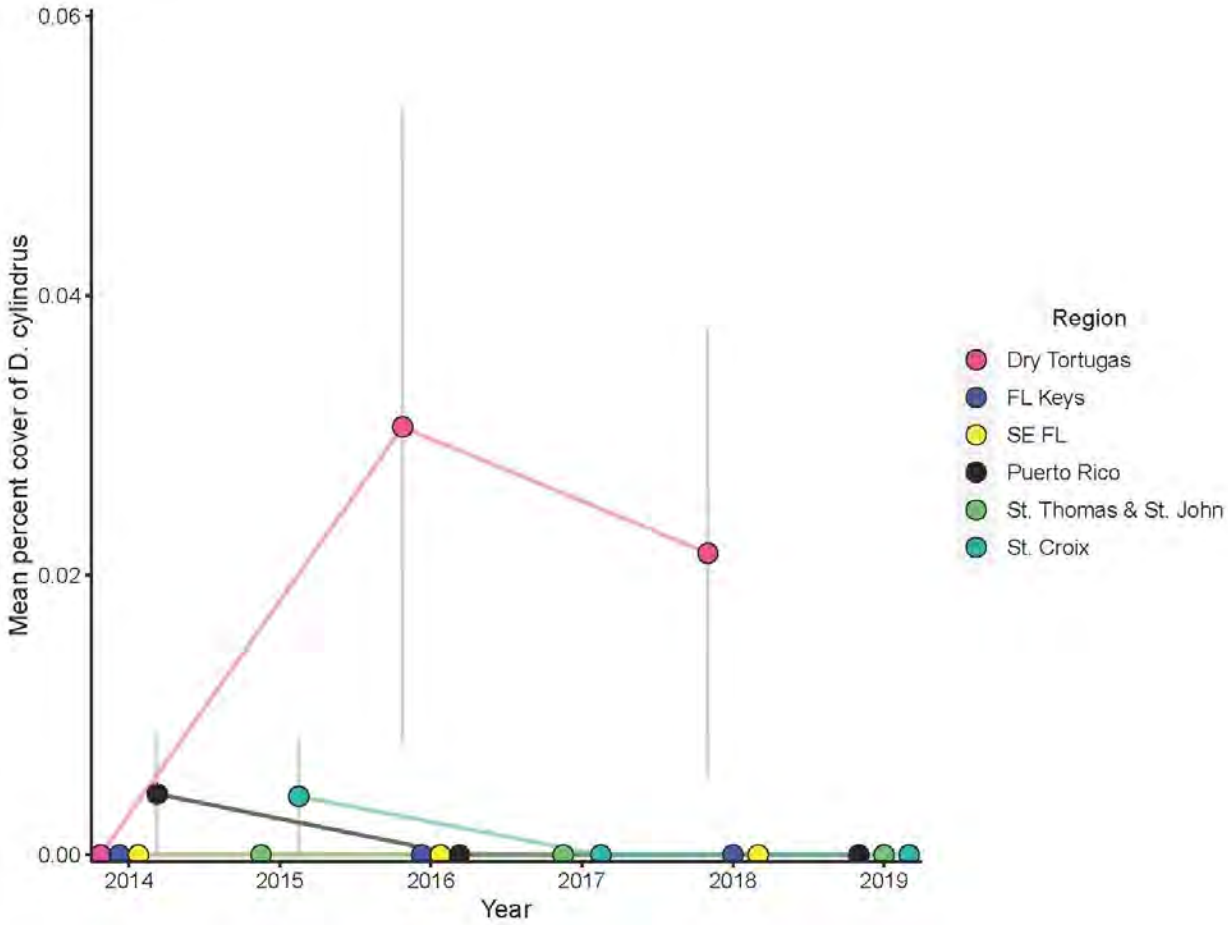

Figure 128. Mean percent cover of *Mycetophyllia ferox* for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

Figure 129. Mean density (colonies m^{-2}) of *Mycetophyllia ferox* colonies for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

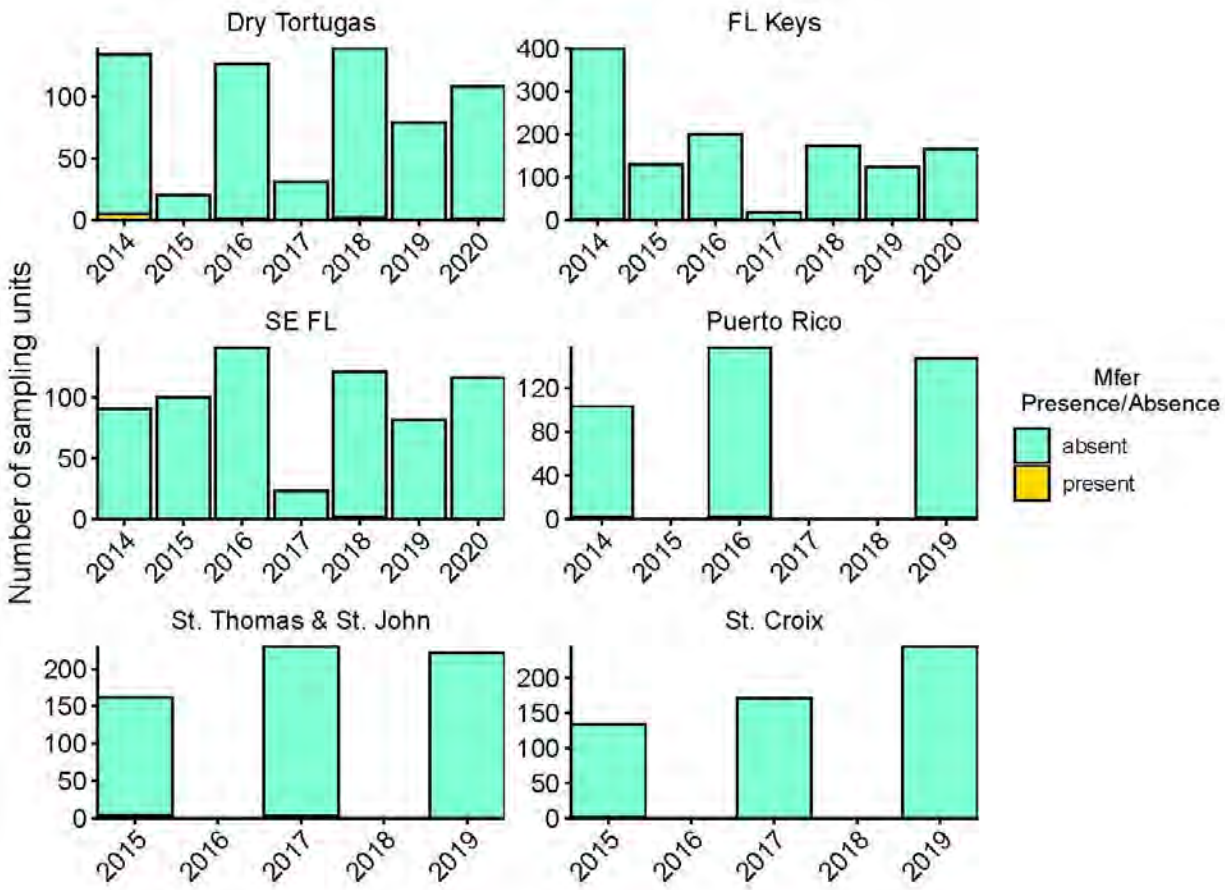

Figure 130. Number of sites where *Mycetophyllia ferox* was observed (gold) or absent (teal) for each year and region surveyed by NCRMP and DRM from 2014 to 2020.

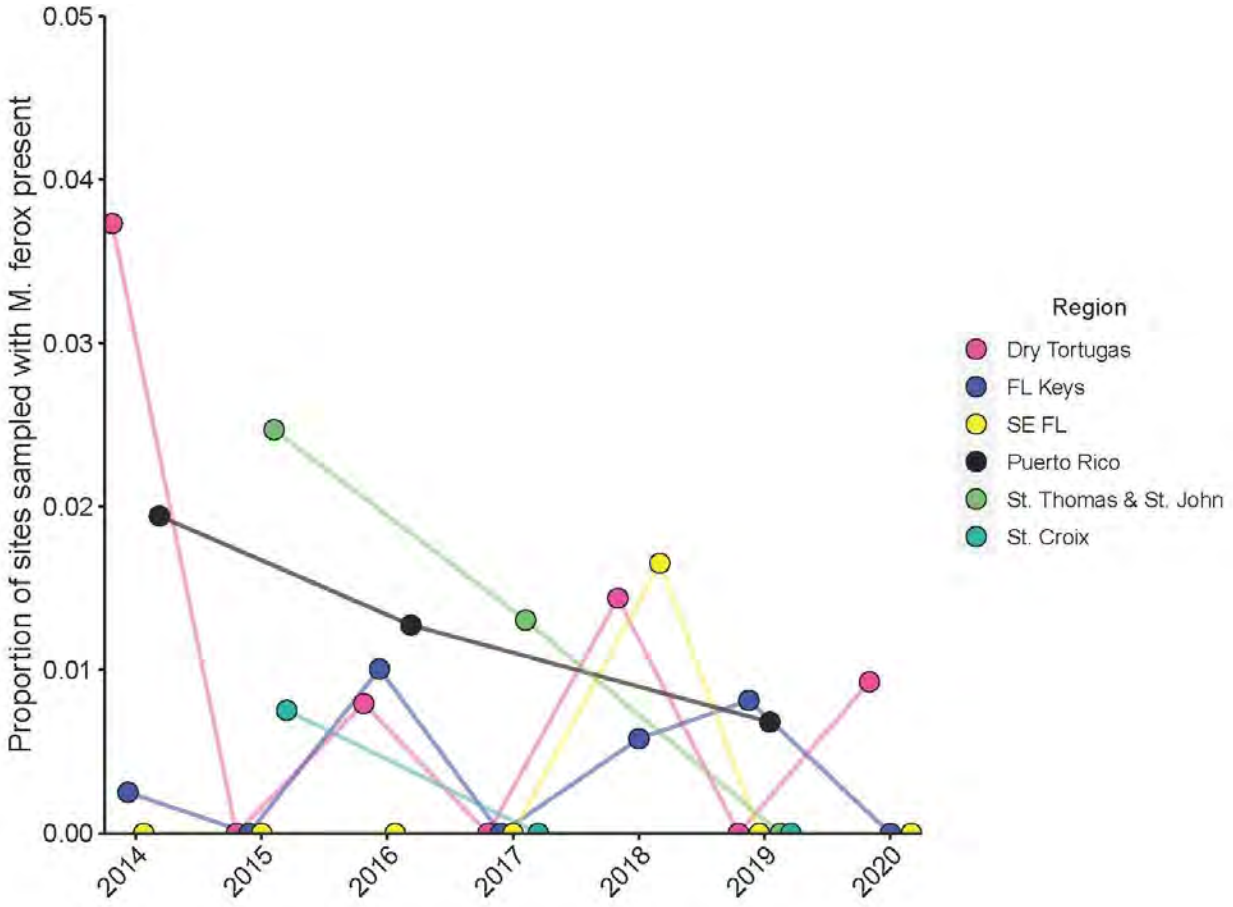

Figure 131. Proportion of all sites surveyed where *Mycetophyllia ferox* was present for each year and region surveyed by NCRMP and DRM from 2014 to 2020.

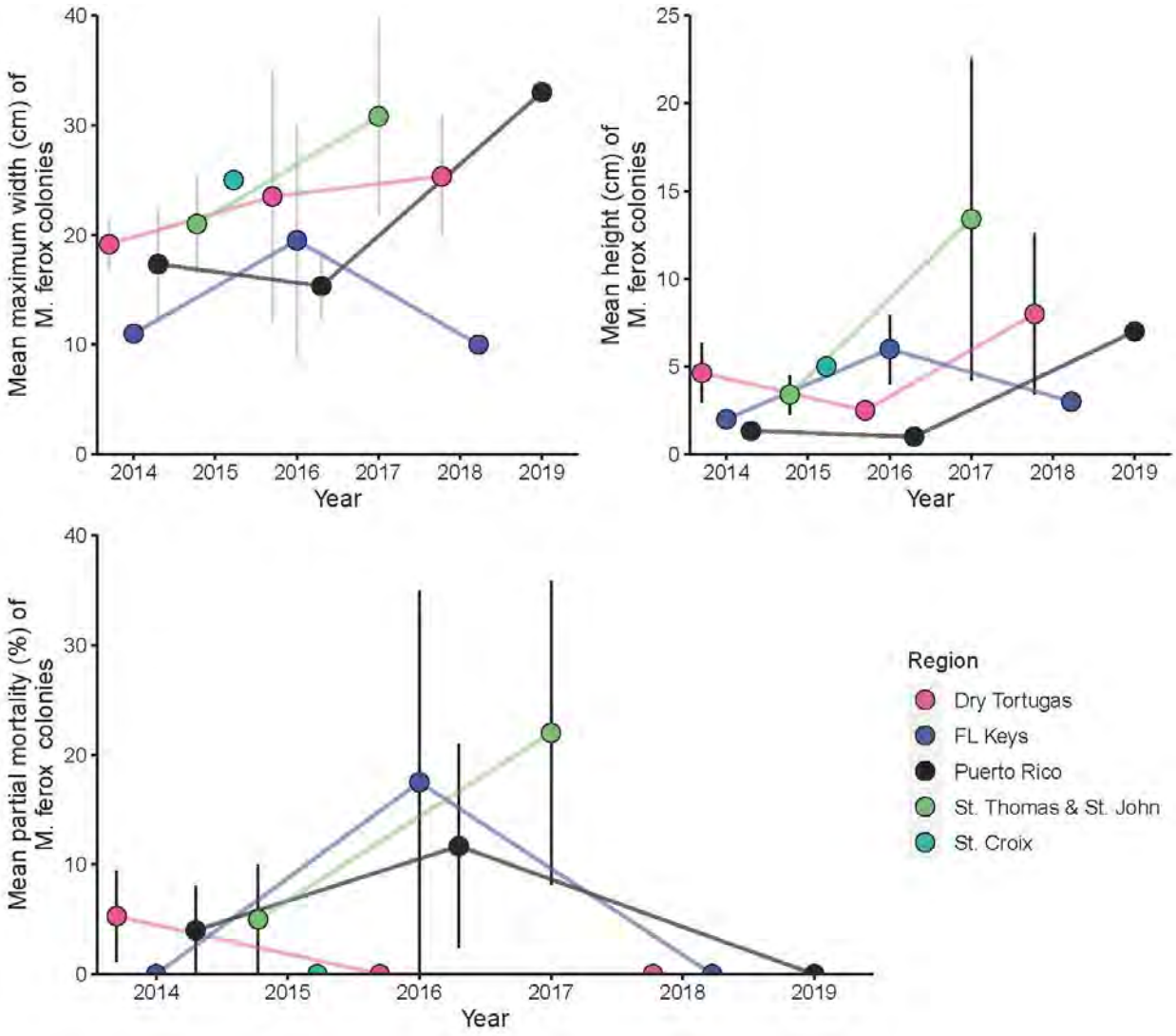

Figure 132. (Top Left) Mean maximum diameter (cm), (Top Right) mean height (cm), and (Bottom) mean partial colony mortality (%) of *Mycetophyllia ferox* colonies surveyed on each transect for each region surveyed by NCRMP and DRM (see table above for number of sites surveyed in each region per year). Data presented are means ±SE.

Puerto Rico CREMP (PR CREMP)

Data used in the figures below was provided by The Puerto Rico Coral Reef Monitoring Program (Miguel G Figuerola Hernandez, University of Puerto Rico, to Mark Ladd. Nov 24, 2020) and is publicly available at https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.nodc:0204647.

Benthic data collection and description (Copied from NCEI website): Data files include raw data (by transect) for 86 stations where substrate cover by sessile-benthic categories and fish, and motile megabenthic invertebrate taxonomic composition and densities have been characterized from 1999-2020. At present, 42 permanent stations are surveyed biannually (21 per year). For the benthic characterization, a set of five 10-meter-long permanent transects are surveyed at each station. Sessile-benthic reef communities are characterized by the continuous intercept chain-link method, following the Caribbean Coastal Marine Productivity (CARICOMP) (1994) protocol. The PRCREMP data files also include a site classification spreadsheet with descriptors for each monitoring station, some of which can be used as spatial and temporal factors for statistical analyses. These descriptors include information about depth, habitat type, distance from shore, marine protected areas attributes, coordinates, and other metadata.

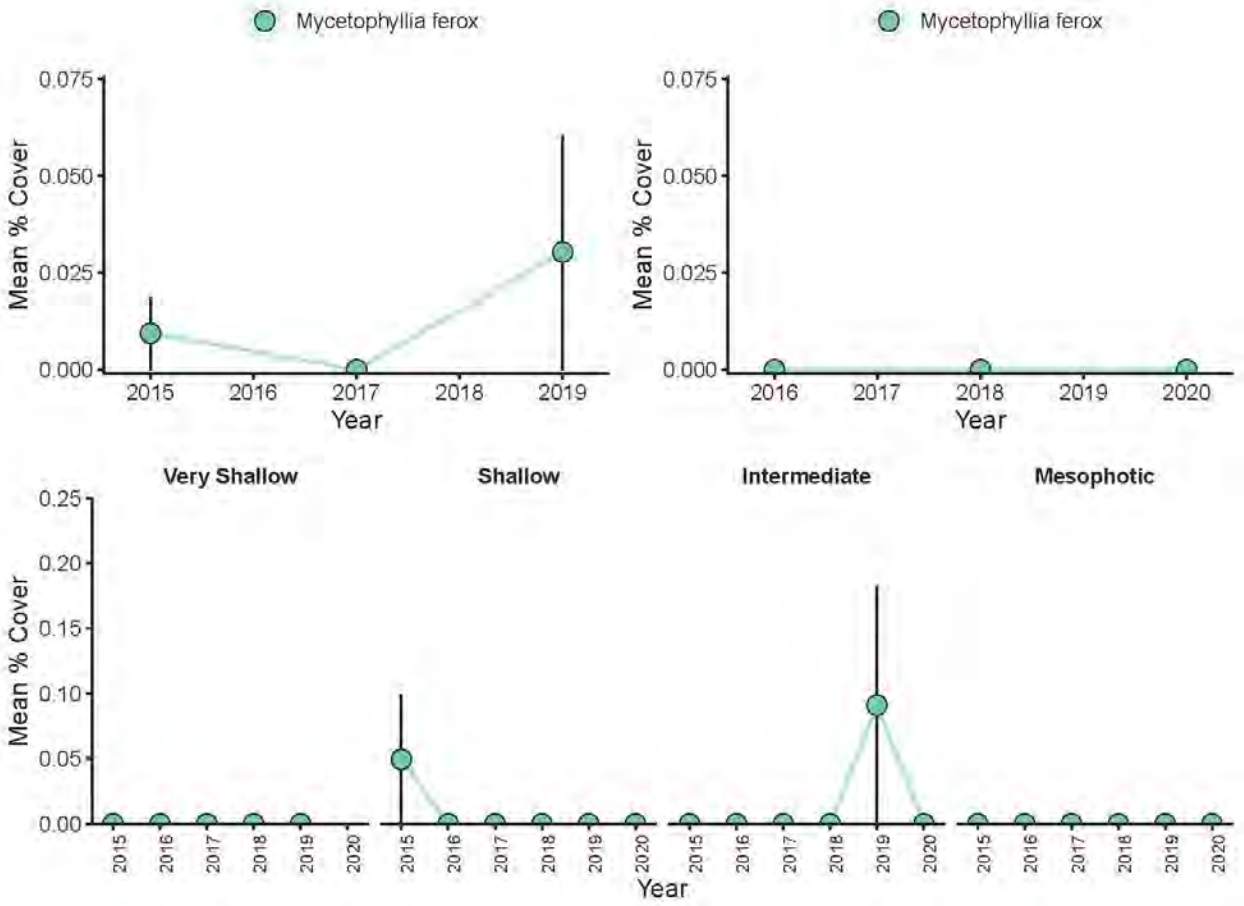

Figure 133. Mean percent cover of *Mycetophyllia ferox* from 2015 to 2020 at sites monitored by Puerto Rico CREMP. (Top left panel) Mean percent cover of *M. ferox* averaged across all transects at sites surveyed by PR CREMP in 2015, 2017, and 2019. (Top right panel) Mean percent cover of *M. ferox* averaged across all transects at sites surveyed by PR CREMP in 2016, 2018, and 2020 (21 sites surveyed in 2016 and 2018, only 3 sites included for 2020). (Bottom panels) Mean percent cover of *M. ferox* at all sites surveyed by PR CREMP broken down by site depth (21 sites surveyed 2015 to 2019, only 3 sites included for 2020).

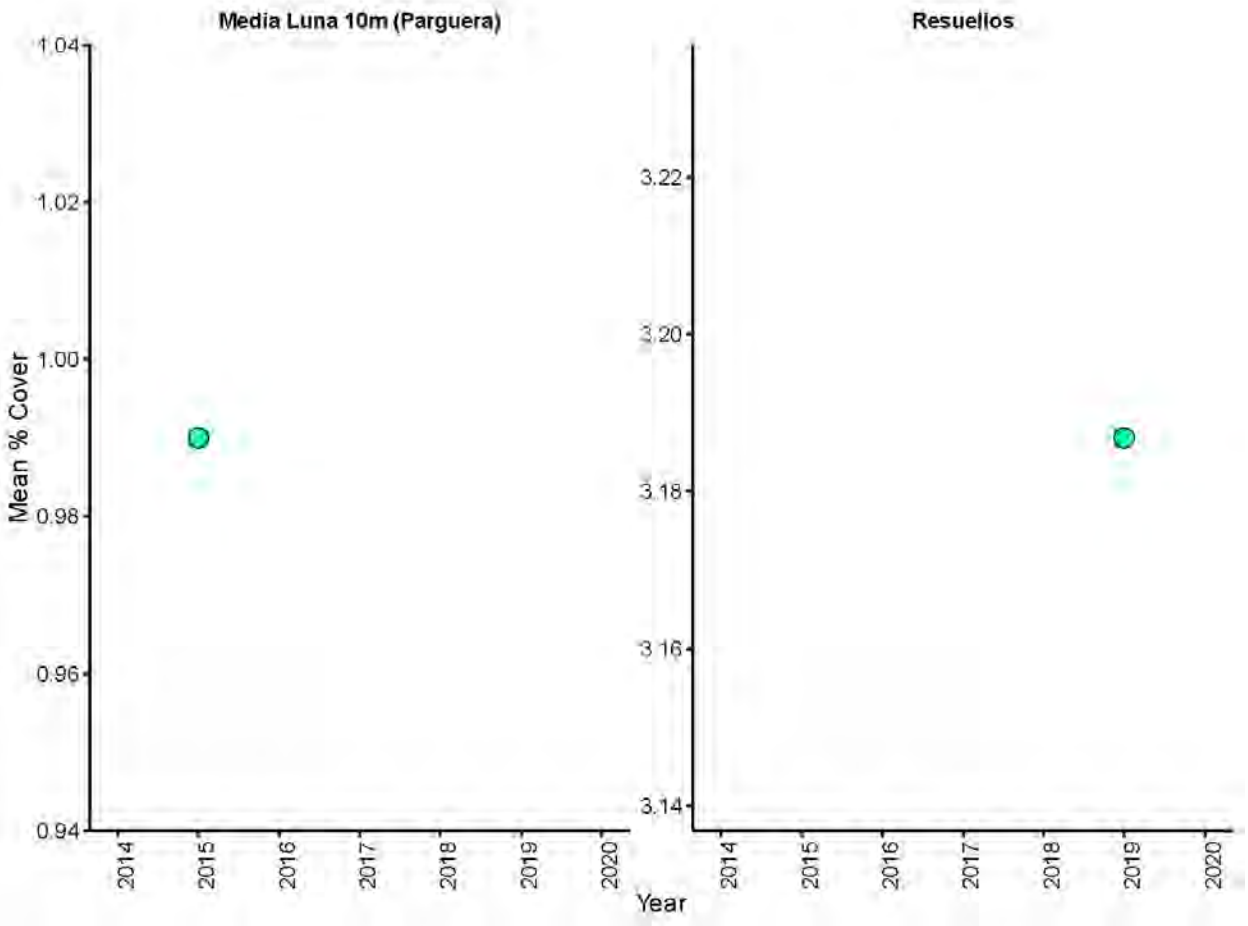

Figure 134. Mean percent cover of *Mycetophyllia ferox* at individual sites where *M. ferox* was recorded on at least one transect between 2015 and 2019 in PR CREMP surveys. For bottom panels data is only presented for years when *M. ferox* was present. Note different y-axis values for each plot. Data presented are means ±SE. 21 sites were surveyed from 2015 to 2019, only data from 3 sites was provided for 2020.

Puerto Rico FEMA surveys

Monitoring was conducted in coral reef habitat at six subregions of Puerto Rico in 2018. These surveys were conducted in March of 2018, following Hurricane Irma, which affected the area in the fall of 2017. Two types of surveys were conducted to collect two types of data: (1) presence-absence data and (2) density data. Both presence-absence and density data were collected via a combination of roving diver surveys and transect surveys. The total number of surveys conducted in 2018 within each subregion of Puerto Rico is provided in the table below. Density surveys were conducted at a subset of sites where presence-absence surveys were conducted. The area covered by roving diver surveys ranged from 157 m^2 to 1,702 m^2, whereas transect areas ranged from 50 m^2 to 1000 m^2.

Table 35. Number of surveys conducted in Puerto Rico in 2018 broken down by Subregion, roving surveys, and transects surveys.

Survey Type	Subregion	Roving surveys	Transect surveys	Total surveys
Presence - Absence Surveys	North	11	9	20
Presence - Absence Surveys	Northeast	52	65	117
Presence - Absence Surveys	Southeast	8	8	16
Presence - Absence Surveys	Southwest	14	12	26
Presence - Absence Surveys	West	16	13	29
Presence - Absence Surveys	Vieques	19	21	40
Presence - Absence Surveys	**Total**	**120**	**128**	**248**
Density Surveys	North	11	9	20
Density Surveys	Northeast	52	56	108
Density Surveys	Southeast	8	7	15
Density Surveys	Southwest	14	10	24
Density Surveys	West	15	12	27
Density Surveys	Vieques	19	18	37
Density Surveys	**Total**	**119**	**112**	**231**

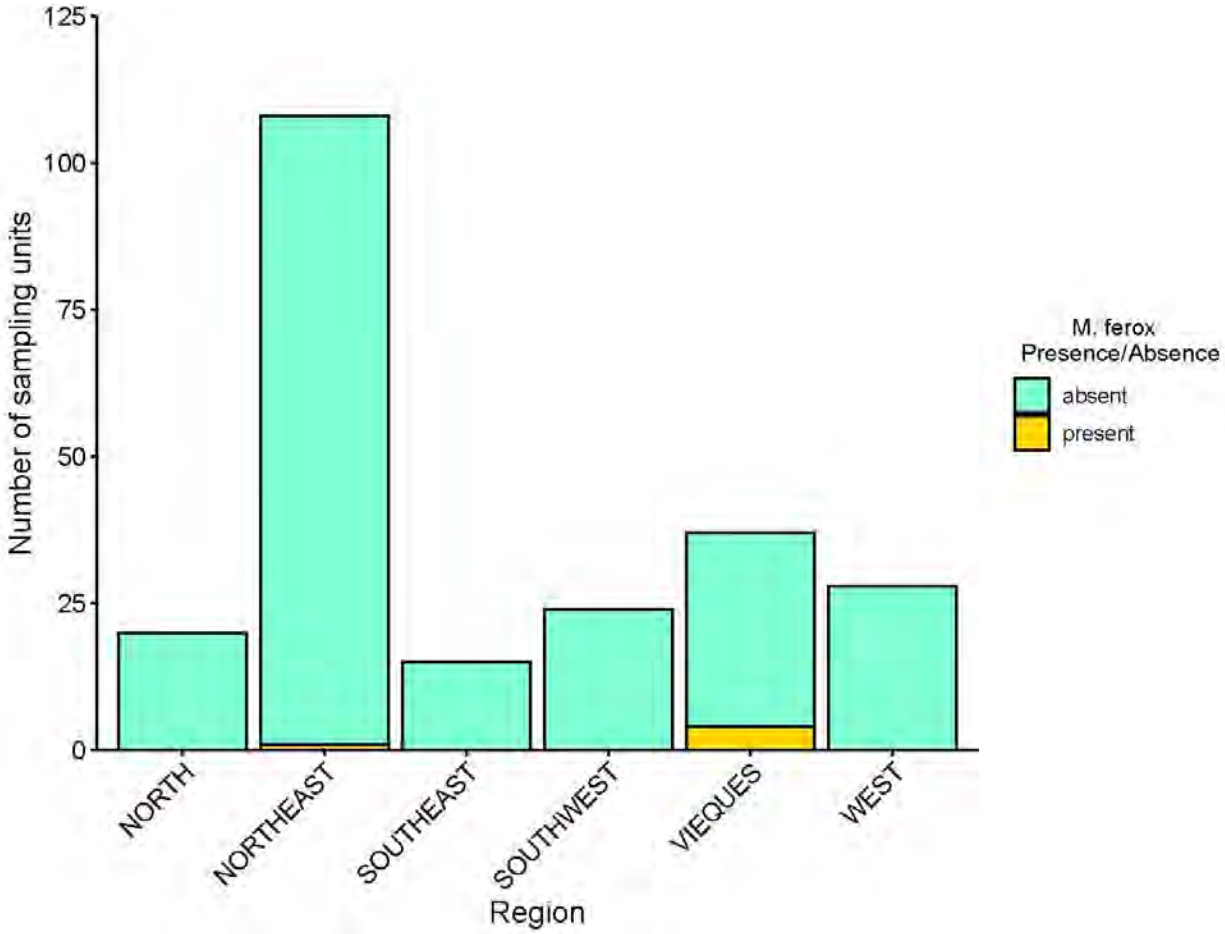

Figure 135. Number of surveys where *Mycetophyllia ferox* was present (gold) or absent (teal) in each subregion of Puerto Rico. Surveys were conducted in March of 2018 and were a mix of transect and roving diver surveys.

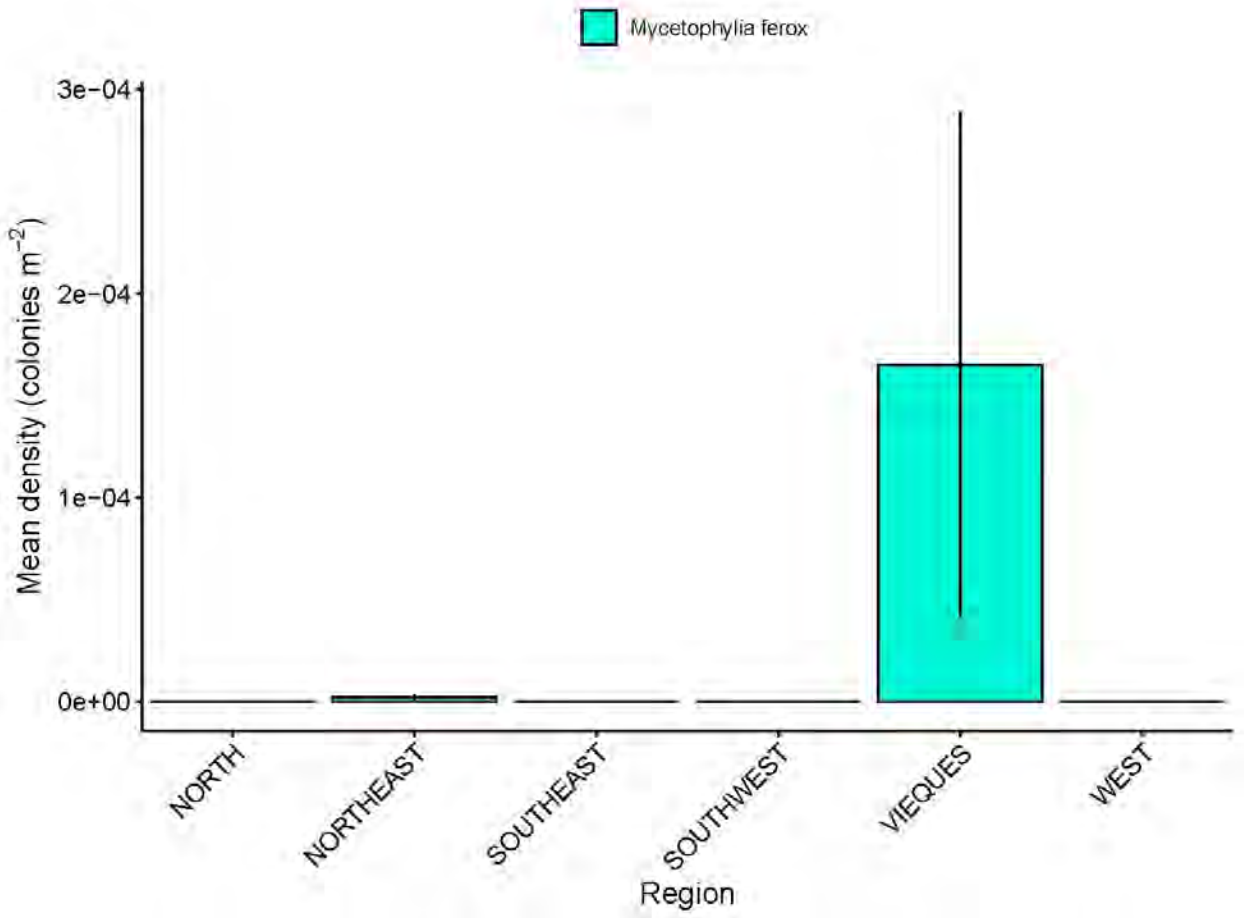

Figure 136. Density of Mycetophyllia *ferox* colonies (corals m^{-2}) in each subregion of Puerto Rico. Surveys were conducted in March of 2018 and were a mix of transect and roving diver surveys. Data presented are means ±SE.

USVI CREMP

Benthic cover data collection and description from website: At each site, benthic cover surveys are conducted annually along six 10 m long permanent transects marked with steel or brass rods. Video sampling consists of one diver traversing each transect videotaping the benthic cover using a high definition digital video recorder. After taping, images from each transect are captured and imported into RStudio where twenty randomly allocated points are superimposed on each image. Analysis consists of identifying the substrate located under each point. For each transect, the percent cover of coral, epilithic algae (EAC), macroalgae, sponges, gorgonians, and sand/sediment are calculated by dividing the number of random dots falling on that substrate type by the total number of dots for that transect.

The USVI CREMP program monitors 34 sites. However, not all sites were surveyed each year. Number of sites surveyed for each year included in this review were: 2015: n = 33; 2016: n = 32; 2017: n = 11; 2018: n = 34; 2019: n = 33; 2020: n = 19. In 2018 and 2019 some sites were surveyed twice in one year and thus there are 12 instead of 6 transects total for those sites.

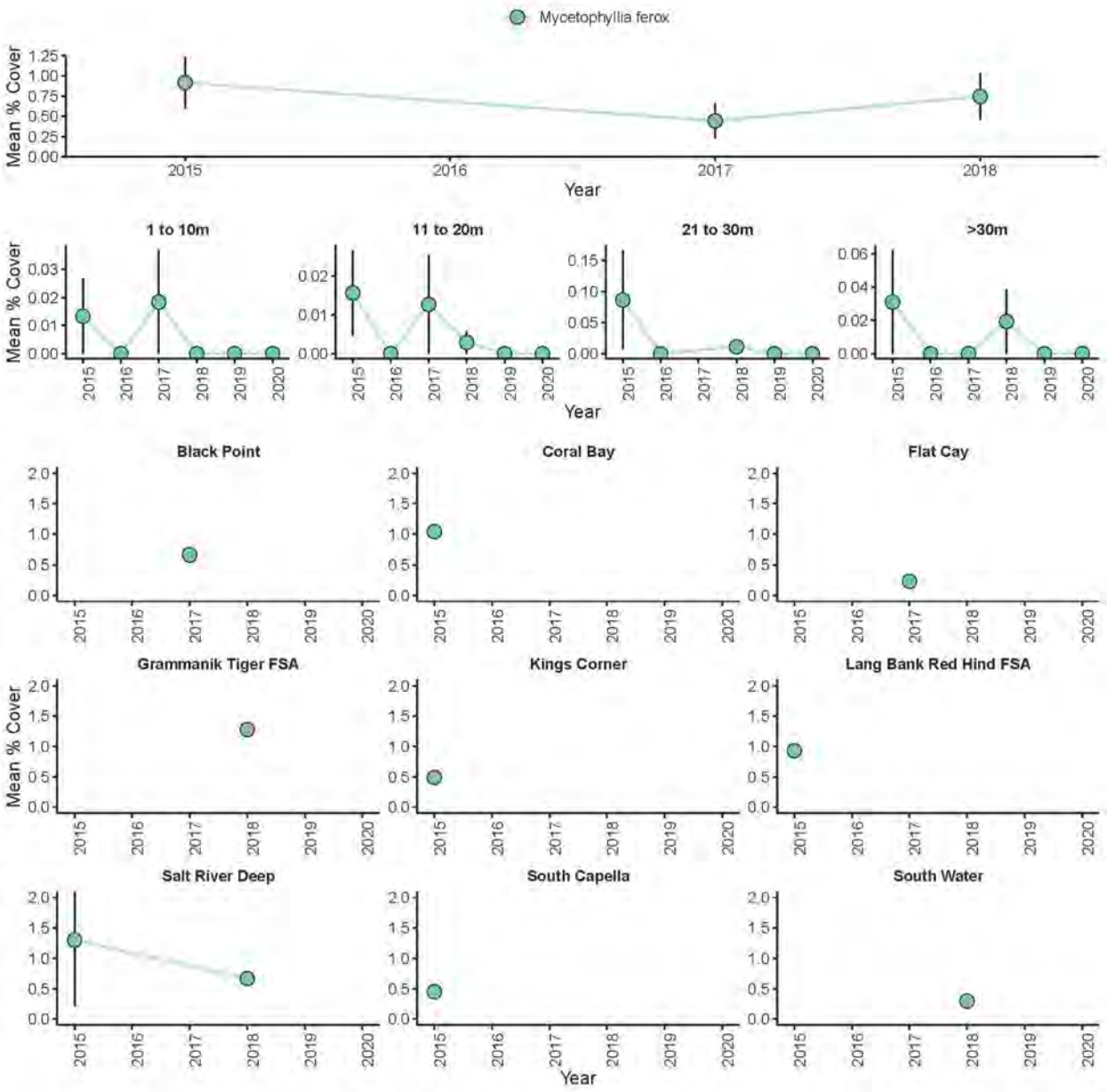

Figure 137. Mean percent cover of *Mycetophyllia ferox* from 2015 to 2020 at sites monitored by USVI CREMP. (Top panel) Mean percent cover of *M. ferox* averaged across all transects at sites surveyed by USVI CREMP (range: 11 to 34 sites per year). (Middle panel) Mean percent cover of *M. ferox* at all sites surveyed by USVI CREMP broken down by site depth. (Bottom rows) Mean percent cover of *M. ferox* at individual sites where *M. ferox* was recorded on at least one transect between 2015 and 2019. For bottom panels data is only presented for years when *M. ferox* was present. Note different y-axis values for each plot. Data presented are means ±SE.