



Disturbance Response Monitoring: Two decades of documenting stressors impacting coral populations across Florida's Coral Reef

Cailin Harrell, Jennifer Stein, Rob Ruzicka
Florida Fish & Wildlife Research Institute
Coral Research Program
Cailin.Harrell@myfwc.com

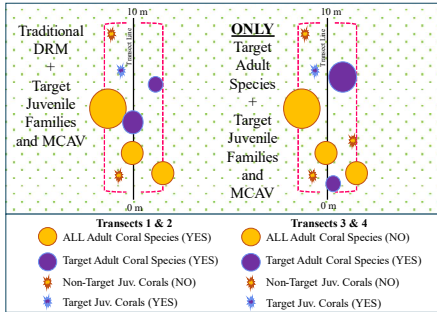
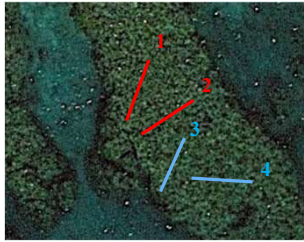


Background:

The Disturbance Response Monitoring (DRM) program, made up of an extensive network of collaborating partners throughout Florida's Coral Reef (FCR), has been documenting the severity of coral bleaching and disease for the past 20 years. During its tenure, the DRM program has surveyed 5,174 sites across FCR, documenting the bleaching status and health conditions of over 290,000 coral colonies. DRM methods have been adapted multiple times to document the extent and severity of the changing stressors on the reef, especially in the wake of extreme marine heatwaves and the stony coral tissue loss disease (SCTLD) outbreak. These adaptations allowed the DRM program to provide stakeholders with an understanding of how bleaching severity can impact coral populations and which coral species have been resilient to bleaching and SCTLD.



DRM Methods:



Coral Bleaching

- The number of days when average sea surface temperature was above 30.5°C and 32°C at 20-24 Coral Reef Evaluation & Monitoring Program (CREMP) long-term monitoring sites were compared from 2012-2024.
- The number of sites where bleaching prevalence was considered moderate (21-50% bleaching prevalence) or severe (>50% bleaching prevalence) were pooled by year in each region.
- Across all survey years, 2023 had more days above both temperature thresholds than any other year, with 75.1 ± 1.3 days above 30.5°C and 14.0 ± 3.0 days above 32°C. These significantly high temperatures correlate with an increased average number of sites categorized as moderately or severely bleached (76.8% of sites surveyed in 2023).
- The average number of sites recorded with moderate or severe bleaching appears to be strongly influenced by the number of days in the year with average temperatures above 32°C.

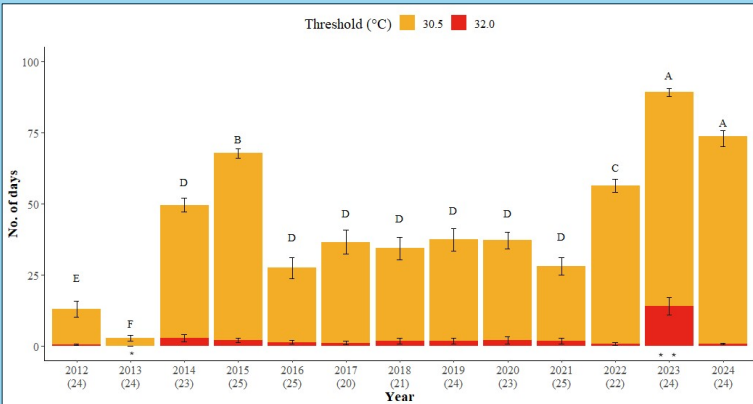


Figure 1. Mean number of days with temperatures over the coral mortality threshold of 32°C (red) and the bleaching threshold of 30.5°C (orange, inclusive of days over the mortality threshold) from 2011 to 2023 at 20-25 CREMP sites throughout the Florida Keys. Significant differences among the years are indicated by the letters above the bars for the 30.5°C threshold and by asterisks below the bars for the 32°C threshold.

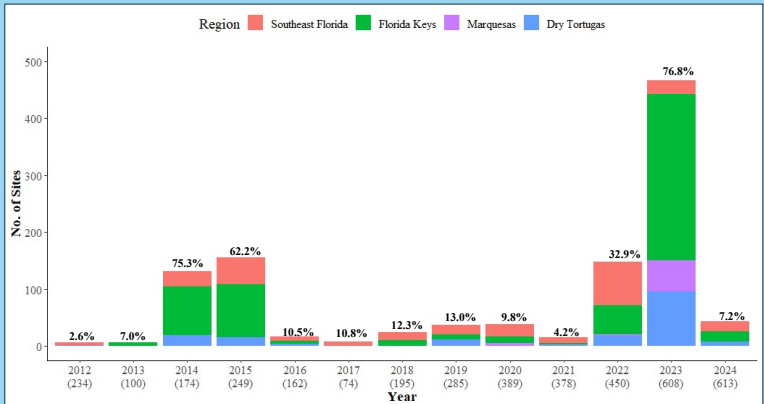


Figure 2. The number of sites in each region categorized as moderately or severely bleached from 2012-2024. The values at the top of each bar represent the percentage of the total number of sites surveyed each year (in parentheses on x-axis) that were categorized as moderately or severely bleached.

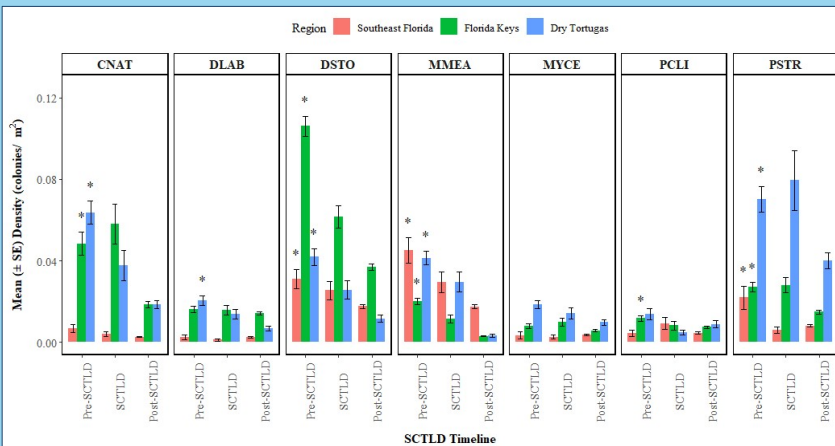


Figure 3. Average density values of each SCTLD-susceptible species pre-SCTLD, during SCTLD, and post-SCTLD. The SCTLD epidemic stage spread throughout FCR at different times depending on the region (Southeast Florida: 2015-2016; Florida Keys 2017-2019; Dry Tortugas: 2021-2022). An asterisk indicates a significantly higher density value for the species during the pre-SCTLD period compared to the post-SCTLD period. All Mycetophyllia spp. are grouped together (MYCE) due to low individual species abundance throughout FCR.

Coral Disease

- Density values for ten target species (see right) were calculated by pooling the total count of the target species across all four belt transects and dividing by 40 m².
- After being grouped by region and year, the density values for each species were analyzed via T-tests or Wilcoxon non-parametric tests to determine if density values post-SCTLD were still significantly lower than pre-SCTLD values.
- While some species had higher density values post-SCTLD than during the disease outbreak, all species density values were significantly lower post-SCTLD than prior to the disease outbreak, indicating that disease recovery has not occurred rapidly across FCR.



Figure 4. Ten target SCTLD-susceptible coral species (*Colpophyllia natans*, *Dichocoenia stokesii*, *Diploria labyrinthiformis*, *Meandrina meandrites*, *Mussa angulosa*, *Mycetophyllia aliciae*, *Mycetophyllia ferox*, *Mycetophyllia lamarckiana*, *Pseudodiploria clivosa*, *Pseudodiploria strigosa*)

Management Applications and Conclusions:

The DRM program has documented the impacts of major disturbances across FCR on coral species populations and coral live tissue area for 20 years. While the 30.5°C temperature threshold has traditionally been accepted as the threshold to trigger a bleaching event in Florida, the 32°C threshold may prove better at predicting the severity of bleaching events in a future where ocean temperatures are on the rise. In the aftermath of unprecedented disease outbreaks, recovery periods for highly susceptible coral species populations may be prolonged for over a decade, likely due to limited natural recruitment.

Acknowledgements:

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