

Supplemental Information

Coral mortality in a mass bleaching event influenced by proximity to diseased tissue and reef topography

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Table S1 Photographic sampling dates at Horseshoe Reef, Florida.

Year	Date	Plots	Photographic Method
2022	5-Jul	4	Video (30 frames per second)
	7-Jul	2	
	8-Jul	3	
	12-Jul	1	
	28-Nov	1, 3	
2023	11-Jul	1, 4	1-second intervalometer photos
	13-Jul	2, 3	
	14-Jul	1, 3, 4	
	20-Jul	4	
	22-Jul	1, 2, 3	
	24-Jul	4	
	25-Jul	1, 2, 3	

Table S2 Comparison of Cox mixed-effects models evaluating coral tissue survival (n = 1,606 intervals; 400 events).

Model	AIC	Variable	HR	SE	z	p	SD _{Colony}
Base (tissue type)	144.7	Tissue:disease	3.778	0.138	9.63	p ≤ 0.001	0.714
		Tissue: neighbor	1.533	0.116	3.69	p ≤ 0.001	
× Proportion diseased	147.3	Tissue:disease	4.133	0.251	5.65	p ≤ 0.001	0.669
		Tissue:neighbor	1.393	0.211	1.57	NS	
		Proportion diseased	1.066	0.030	2.12	p ≤ 0.05	
		Tissue:disease × Proportion diseased	0.986	0.033	-0.41	NS	
		Tissue:neighbor × Proportion diseased	1.015	0.027	0.55	NS	
+ Proportion diseased	150.5	Tissue:disease	3.796	0.138	9.67	p ≤ 0.001	0.667
		Tissue:neighbor	1.535	0.116	3.71	p ≤ 0.001	
		Proportion diseased	1.069	0.025	2.69	p ≤ 0.01	
+ Lesion size + proportion diseased	152.8	Tissue:disease	3.782	0.138	9.64	p ≤ 0.001	0.611
		Tissue:neighbor	1.532	0.116	3.69	p ≤ 0.001	
		Lesion size	1.034	0.016	2.09	p ≤ 0.05	
		Proportion diseased	1.030	0.029	1.05	NS	
+ Colony size	153.1	Tissue:disease	3.794	0.138	9.66	p ≤ 0.001	0.630
		Tissue:neighbor	1.535	0.116	3.70	p ≤ 0.001	
		Colony size	1.001	0.000	3.17	p ≤ 0.01	
+ Lesion size	153.5	Tissue:disease	3.771	0.138	9.62	p ≤ 0.001	0.610
		Tissue:neighbor	1.530	0.116	3.67	p ≤ 0.001	
		Lesion size	1.045	0.013	3.33	p ≤ 0.001	
x Lesion size	153.7	Tissue:disease	4.833	0.183	8.59	p ≤ 0.001	0.614
		Tissue:neighbor	1.664	0.154	3.30	p ≤ 0.001	
		Lesion size	1.056	0.015	3.68	p ≤ 0.001	
		Tissue:disease × Lesion size	0.970	0.015	-1.97	p ≤ 0.05	

Model	AIC	Variable	HR	SE	z	p	SD _{Colony}
		Tissue:neighbor × Lesion size	0.990	0.011	-0.84	NS	
× Colony size	155.9	Tissue:disease	6.982	0.278	7.00	p ≤ 0.001	0.637
		Tissue:neighbor	1.747	0.240	2.32	p ≤ 0.05	
		Colony size	1.001	0.000	3.53	p ≤ 0.001	
		Tissue:disease × Colony size	0.999	0.000	-2.47	p ≤ 0.05	
		Tissue:neighbor × Colony size	1.000	0.000	-0.60	NS	
+ Colony size + lesion size	157.4	Tissue:disease	3.785	0.138	9.65	p ≤ 0.001	0.570
		Tissue:neighbor	1.532	0.116	3.69	p ≤ 0.001	
		Colony size	1.001	0.000	2.35	p ≤ 0.05	
		Lesion size	1.034	0.013	2.53	p ≤ 0.05	

Table S3 Results of Firth's logistic regression models for the effect of reef structural metrics on survival. Each model included reef site as a covariate. Effect sizes are the coefficients with profile penalized likelihood 95% confidence intervals. Likelihood ratio tests show the comparison to the site-only model.

Reef Structure Variable	β (log-odds)	SE	Odds Ratio	95% CI (OR)	Likelihood Ratio $\chi^2(1)$	<i>p</i>
Distance to Nearest Edge (m)	-1.05	0.51	0.35	0.03, 0.82	7.81	0.005
Coral Depth (m)	-0.09	0.25	0.91	0.68, 1.96	0.05	>0.05
Spur Height (m)	-0.18	0.37	0.84	0.30, 1.45	0.40	>0.05
Sand Channel Depth (m)	-0.16	0.26	0.85	0.27, 1.66	0.30	>0.05

Table S4 Firth's logistic regression model results for the effect of site of survival after accounting for distance to nearest reef edge, the only reef structure metric we found to be significant.

Site Comparison	β (log-odds)	SE	Odds Ratio	95% CI (OR)	Likelihood Ratio $\chi^2(1)$	<i>p</i>
Intercept (Elbow)	4.51	2.15	91.4	3.39, 6.25x10 ⁶	10.74	0.001
Horseshoe vs. Elbow	-4.56	2.36	0.0105	<0.001, 0.751	4.32	0.04
Looe vs. Elbow	-6.12	2.51	0.0022	<0.001, 0.124	13.01	<0.001
Sombrero vs. Elbow	-4.51	2.44	0.0109	<0.001, 0.764	4.42	0.04

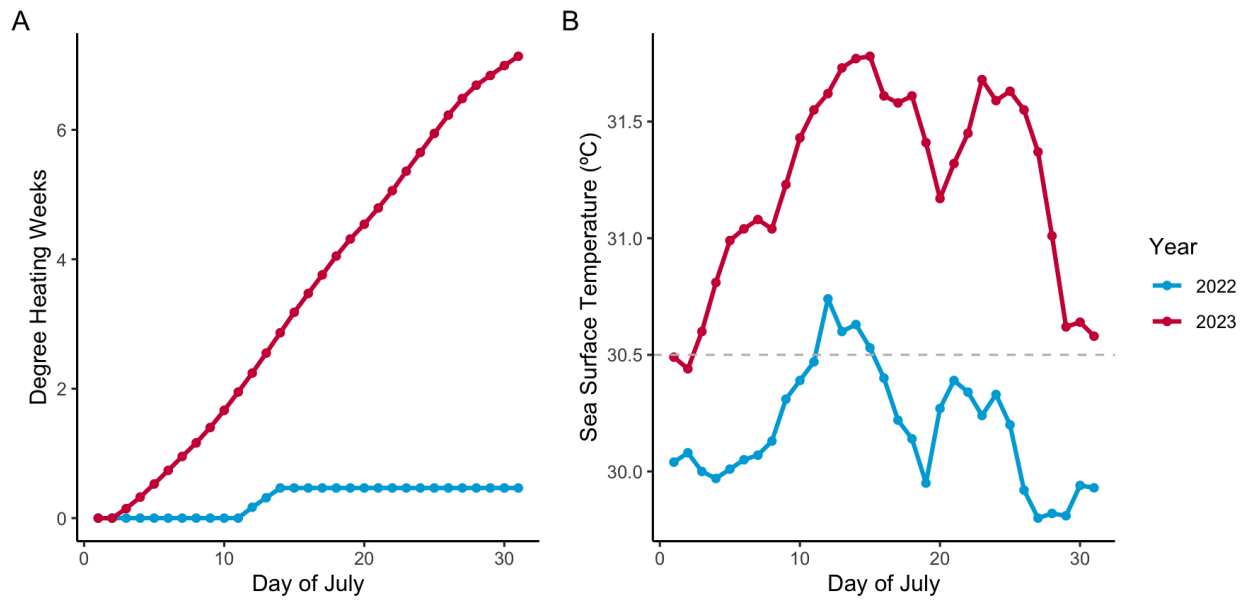


Fig. S1 Thermal stress at Horseshoe Reef, Florida showing (A) degree heating weeks and (B) sea surface temperatures with the *Acropora palmata* bleaching threshold (horizontal dashed line) for July 2022 and 2023. Temperatures were measured by satellite by NOAA Coral Reef Watch (NOAA Coral Reef Watch 2019).

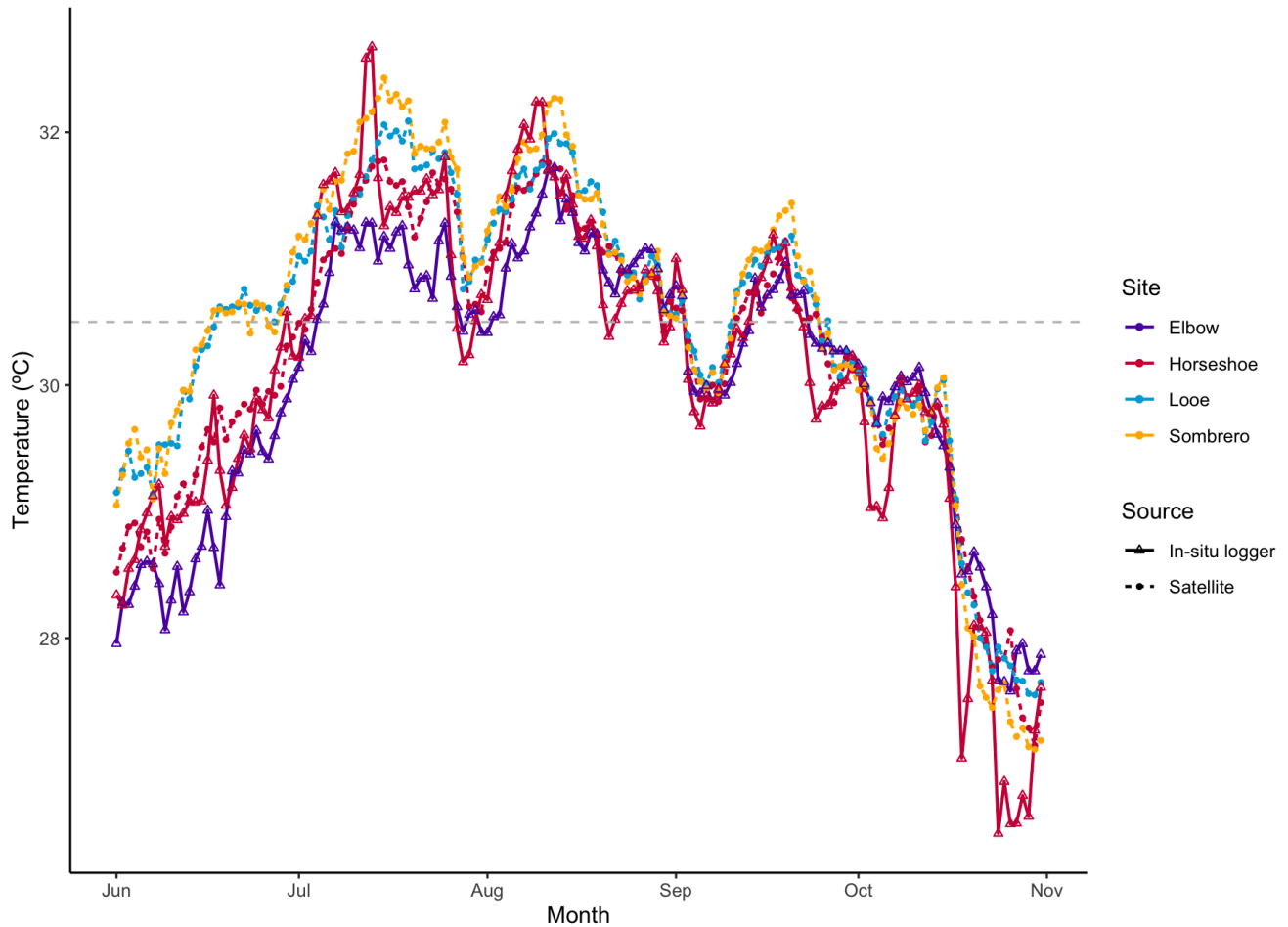


Fig. S2 Water temperatures for the four focal reefs throughout the bleaching period. Looe Key, Sombrero Reef, and Horseshoe Reefs data were obtained from satellite virtual stations (NOAA Coral Reef Watch 2019). Data for Elbow and Horseshoe Reefs are daily medians from in-situ loggers attached to the substrate (Williams and Miller 2015). The horizontal line at 30.5°C shows the bleaching threshold for the Florida Keys (Manzello 2015).

Overall, southern reefs were hotter than northern reefs. From the satellite data, we see that temperatures on Sombrero and Looe exceeded those recorded by the same method at Horseshoe. The temperature spike recorded by the benthic temperature logger at Horseshoe indicates that temperatures experienced by the corals may be hotter than what was recorded by satellites of the surface. This spike could be due to water stagnation on this shallow patch reef. From the in-situ loggers, Elbow was generally cooler than Horseshoe, which is expected as it is farther offshore.

We found that distance to reef edge significantly differed by site ($\chi^2(3) = 14.81$, $p = 0.002$). Corals at Horseshoe were significantly farther from the edge than Elbow or Sombrero. Coral depth

also differed by site ($\chi^2(3) = 24.40$, $p < 0.001$), where Elbow, Horseshoe and Looe all significantly differed from each other, but not Sombrero. Sand channel depth also differed by reef ($\chi^2(3) = 16.10$, $p = 0.001$). Looe was significantly deeper than Horseshoe, though neither differed from Elbow or Sombrero (**Figure S3, Table S3**).

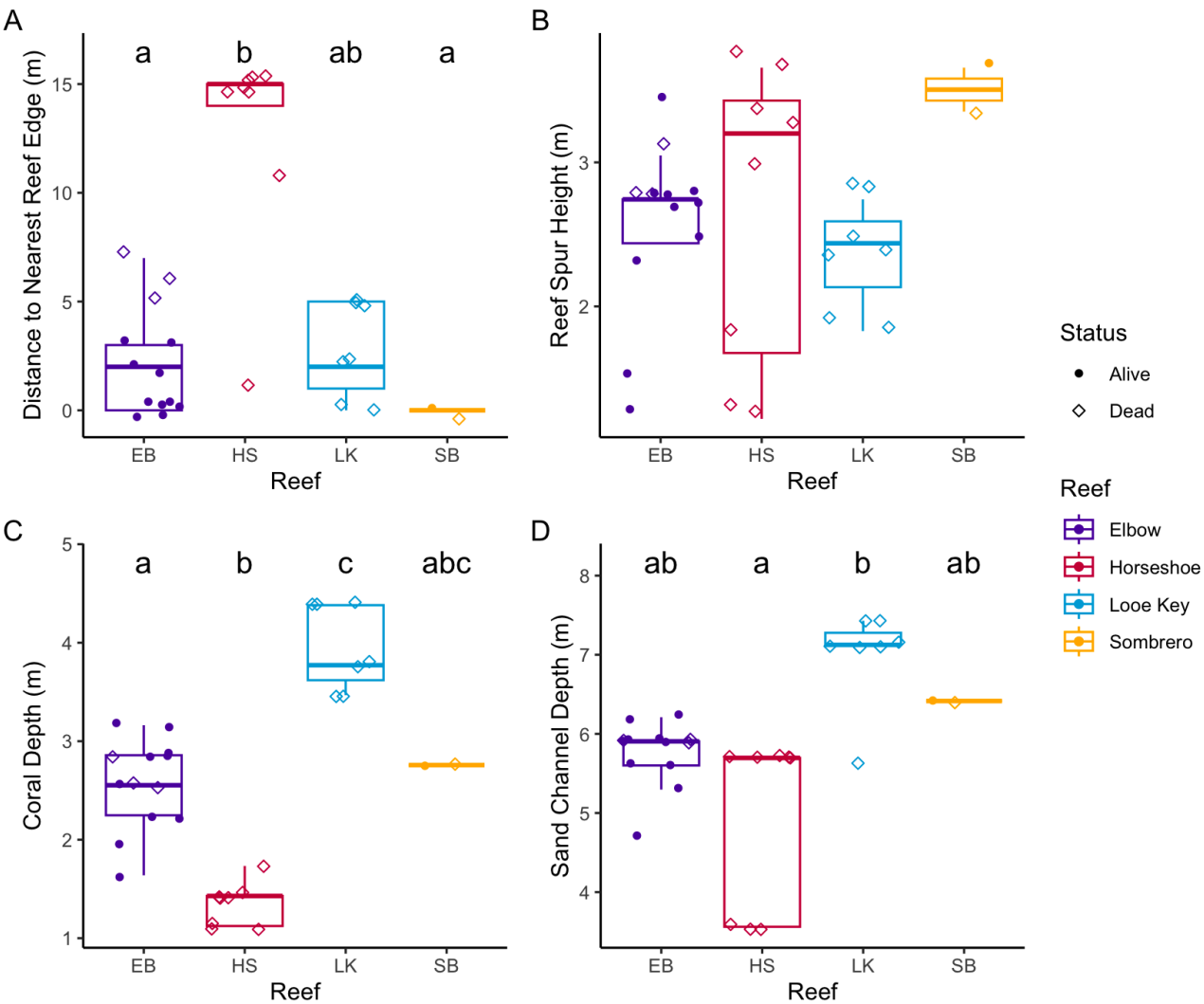


Fig. S3 Reef structural metrics by reef. Letters indicate significant differences between sites from Kruskal Wallis with Dunn’s multiple-comparison test (see Table S5 for statistics).

Table S5. Results of Dunn’s multiple comparison tests (with Bonferroni adjustment). Significant comparisons are in bold. Reefs are abbreviated as HS: Horseshoe, EB: Elbow, SB: Sombrero, and LK: Looe Key.

Variable	Reefs	Z	p-adjust
Distance to edge	EB-HS	3.34	0.005
	EB-LK	0.42	1.000
	EB-SB	-1.01	1.000
	HS-LK	-2.52	0.070
	HS-SB	-2.87	0.024
	LK-SB	-1.20	1.000
Reef Spur Height	NS	NS	NS
Coral Depth	EB-HS	-2.85	0.026
	EB-LK	2.71	0.040
	EB-SB	0.098	1.000
	HS-LK	4.93	<0.001
	HS-SB	1.71	0.520
	LK-SB	-1.49	0.811
Sand Channel Depth	EB-HS	-1.69	0.548
	EB-LK	2.53	0.068
	EB-SB	1.40	0.967
	HS-LK	3.76	0.001
	HS-SB	2.31	0.127
	LK-SB	-0.153	1.000