Analysis of Benthic Environment Trends in Biscayne National Park

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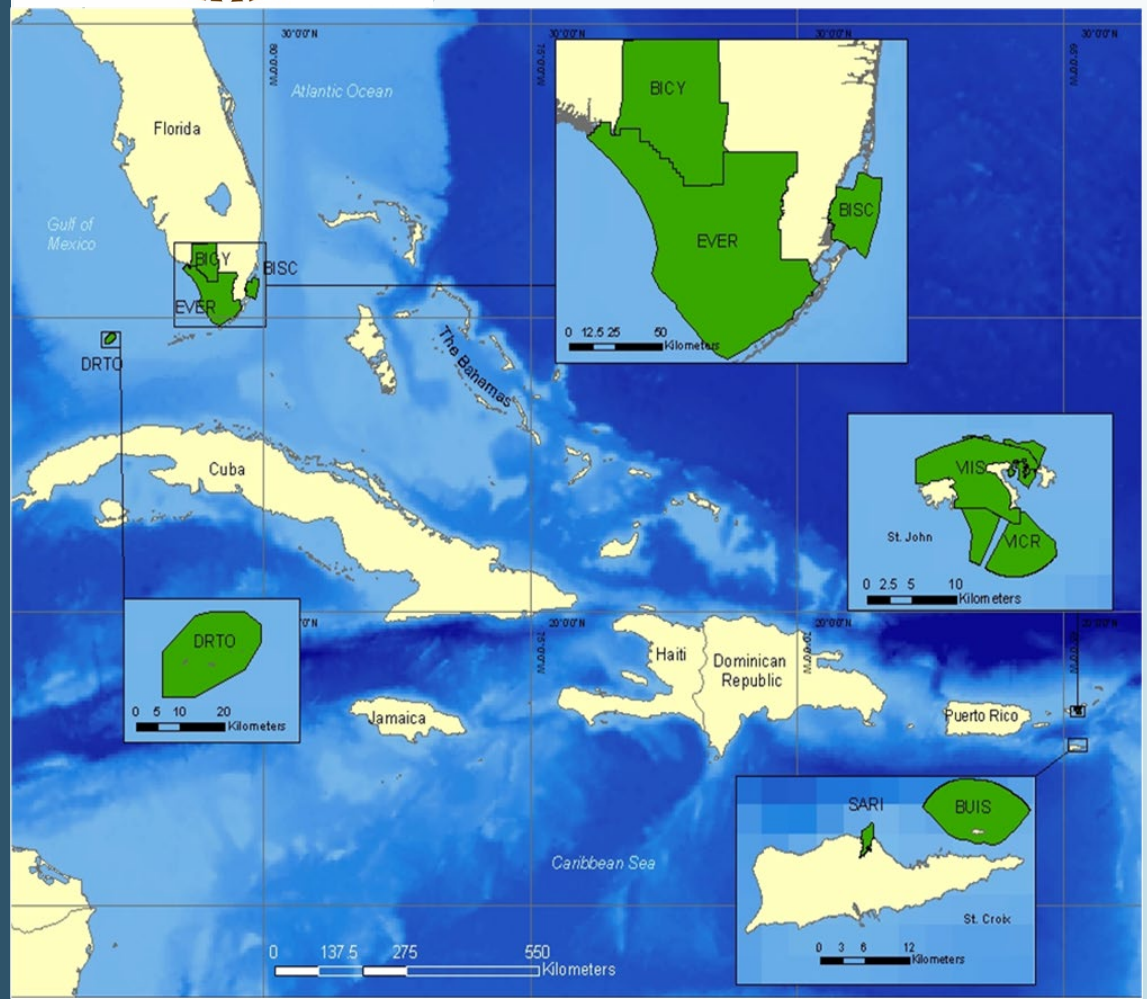
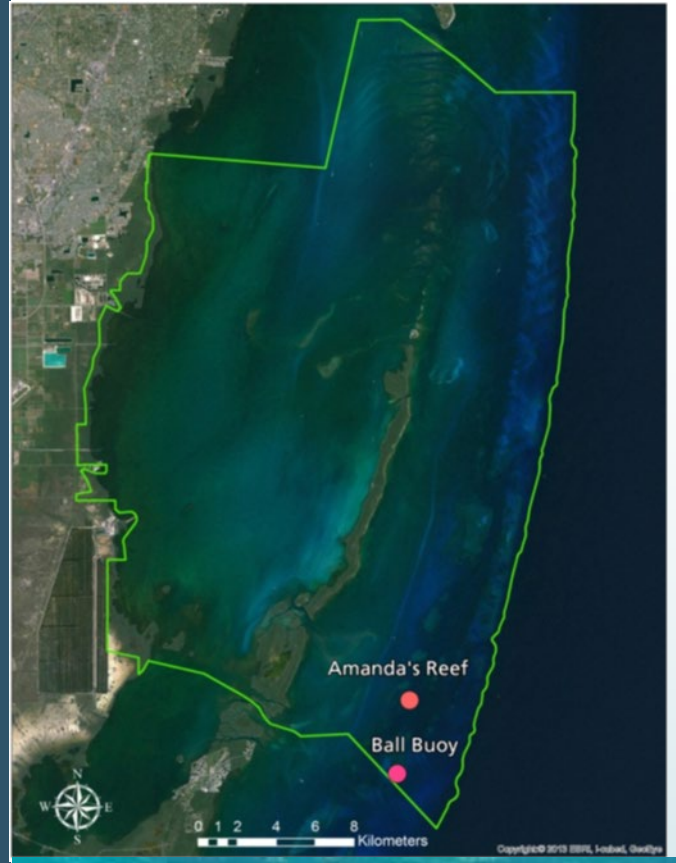
Internship Organization and Background

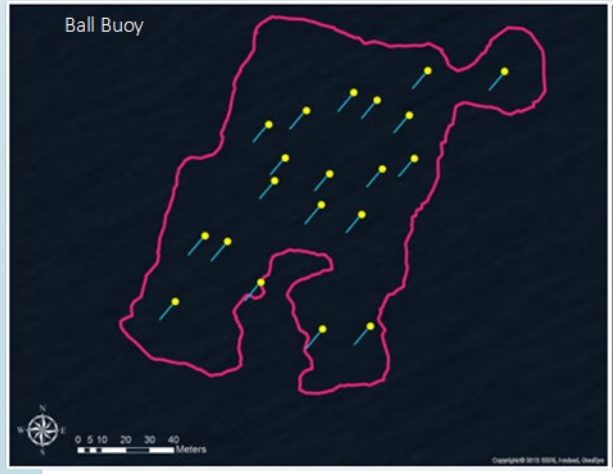


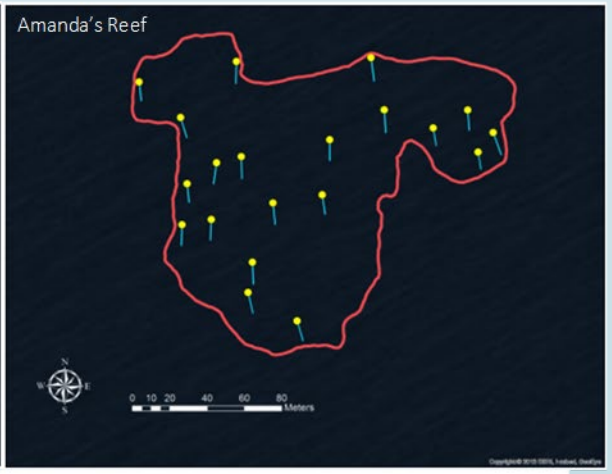
- The South Florida/Caribbean Network (SFCN)
  - 1 of 32 networks within the National Park Service's (NPS) Inventory and Monitoring division
  - Goal of these networks is to collect vital environmental information that is used for future park management resources.
- Marine Division
  - Seagrass, Fish, Coral Benthic, and Lobster
  - Marine benthic communities are ranked priority one out of the 44 vital signs identified and monitored by the network.

Biscayne National Park



- Biscayne National Park (BISC), was designated as a national park in 1980. Ninety-five percent of the park's 700 km^2 area are aquatic environments.
- The park is heavily used by boaters and both commercial and sport fishing are allowed within park boundaries
  - Fishing activities are managed by the state of Florida.
- The SFCN has annually monitored two reef sites since 2004
  - Ball Buoy reef study site is a 14,136 m^2 area and approaches a maximum depth of 12 meters
  - Amanda's Reef study site is a 20,240 m^2 patch reef with average depths of less than 3 meters.

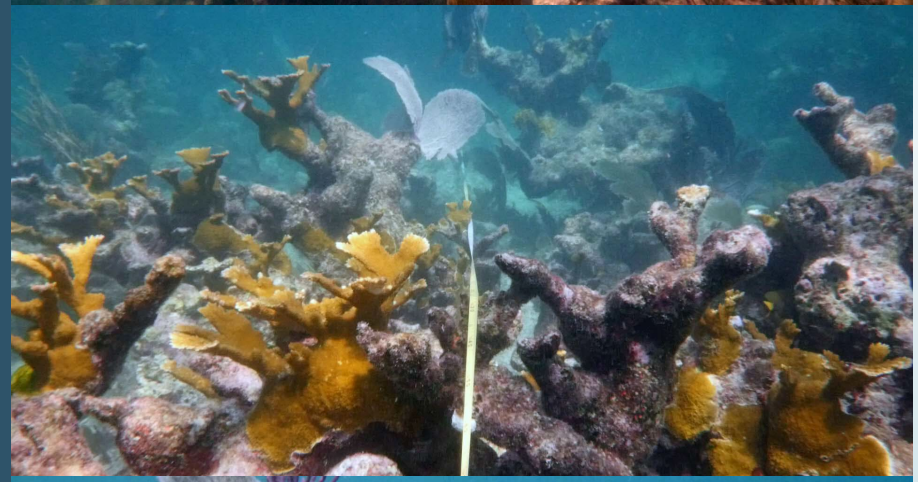


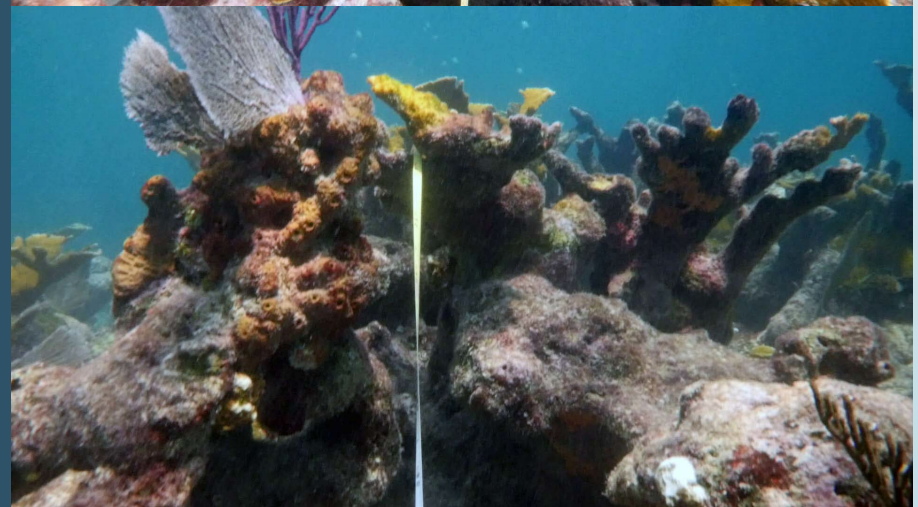


Project Objectives

For SFCN monitoring sites in Biscayne National Park determine:

- Percent coverage trends of biotic factors
  - Algae, Coral, Gorgonian, Sponge, Zoanthid
- Coral functional group coverage
- Percent cover by coral species
- Percent cover by algae species
- Coral bleaching & disease prevalence
- *Diadema antillarum* abundance trends

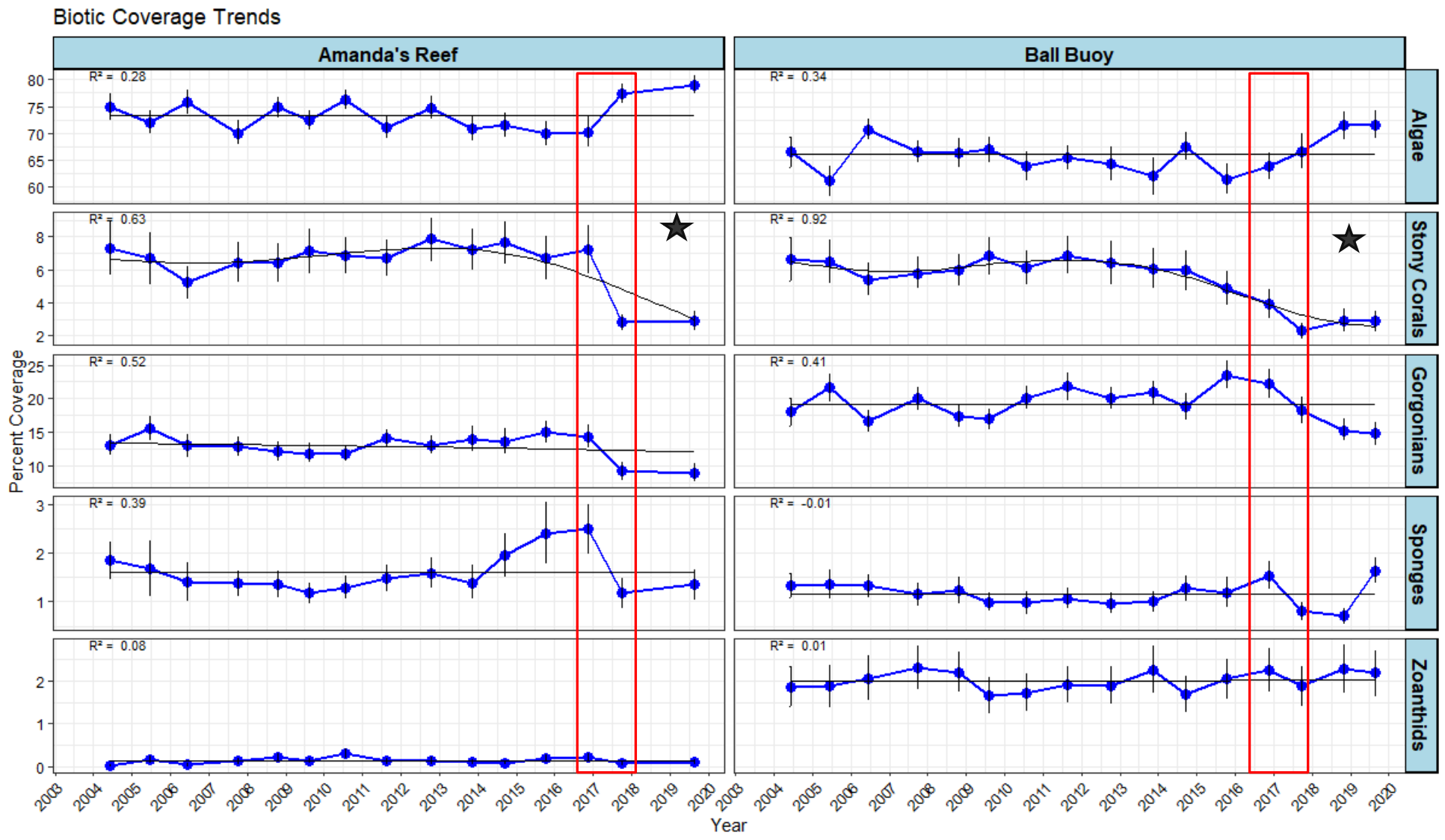




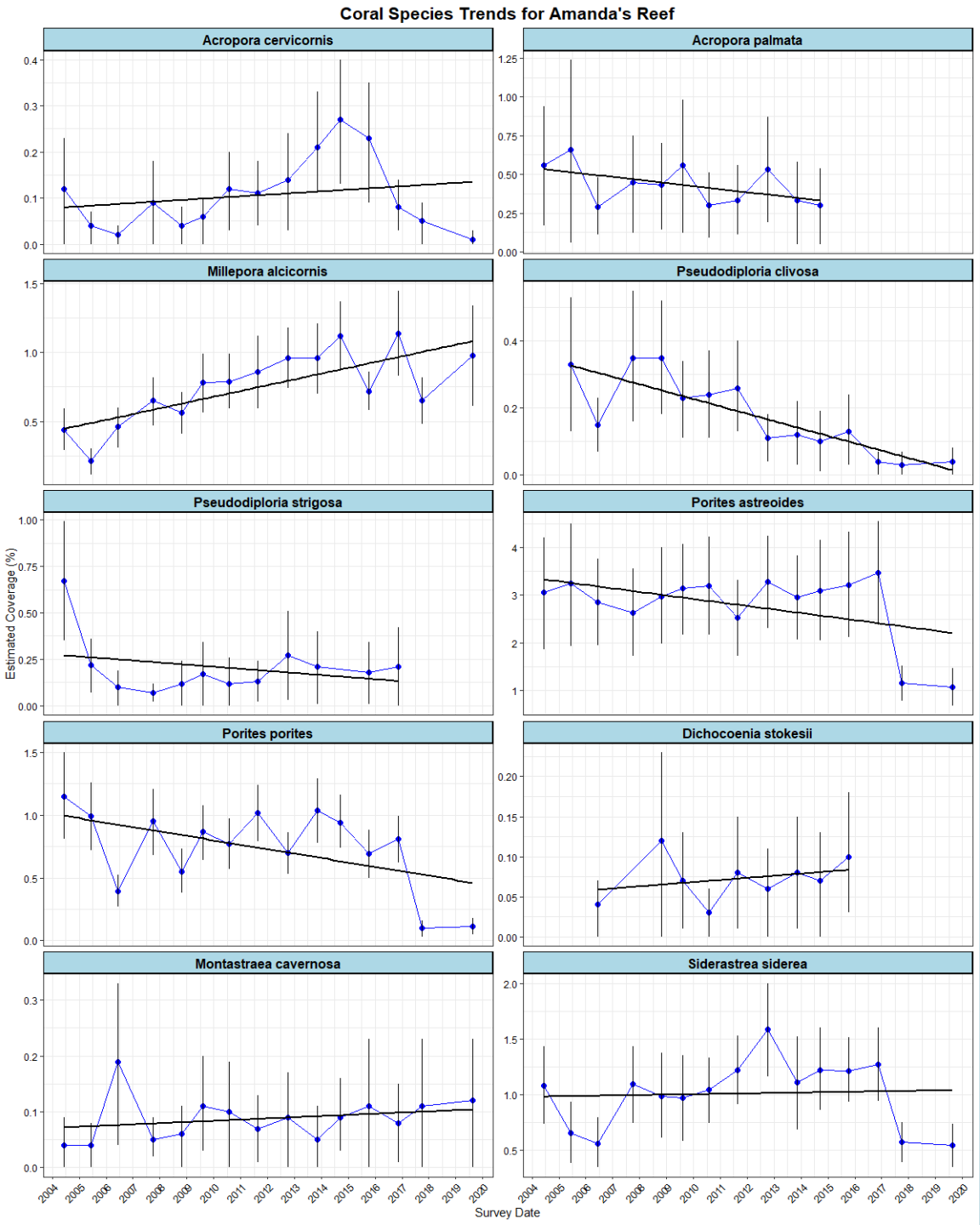
Methods

- Field collection: Long-term data collected annually from 2004-2019
  - Coral colony counts
  - Coral species list
  - Bleached coral counts
  - Diseased coral counts
  - *Diadema antillarum* counts
- Videography of each transect is recorded
  - Dot analysis to determine percent covers
- R studio (Cranberry Hibiscus)
  - Coral Dashboard to obtain percent cover
  - Shapiro Normality testing
  - Data transformation
  - Linear Regression modeling (Parametric)/General Additive modeling (nonparametric)
  - Wilcoxon Signed Rank Test (nonparametric)

Results Biotic Cover

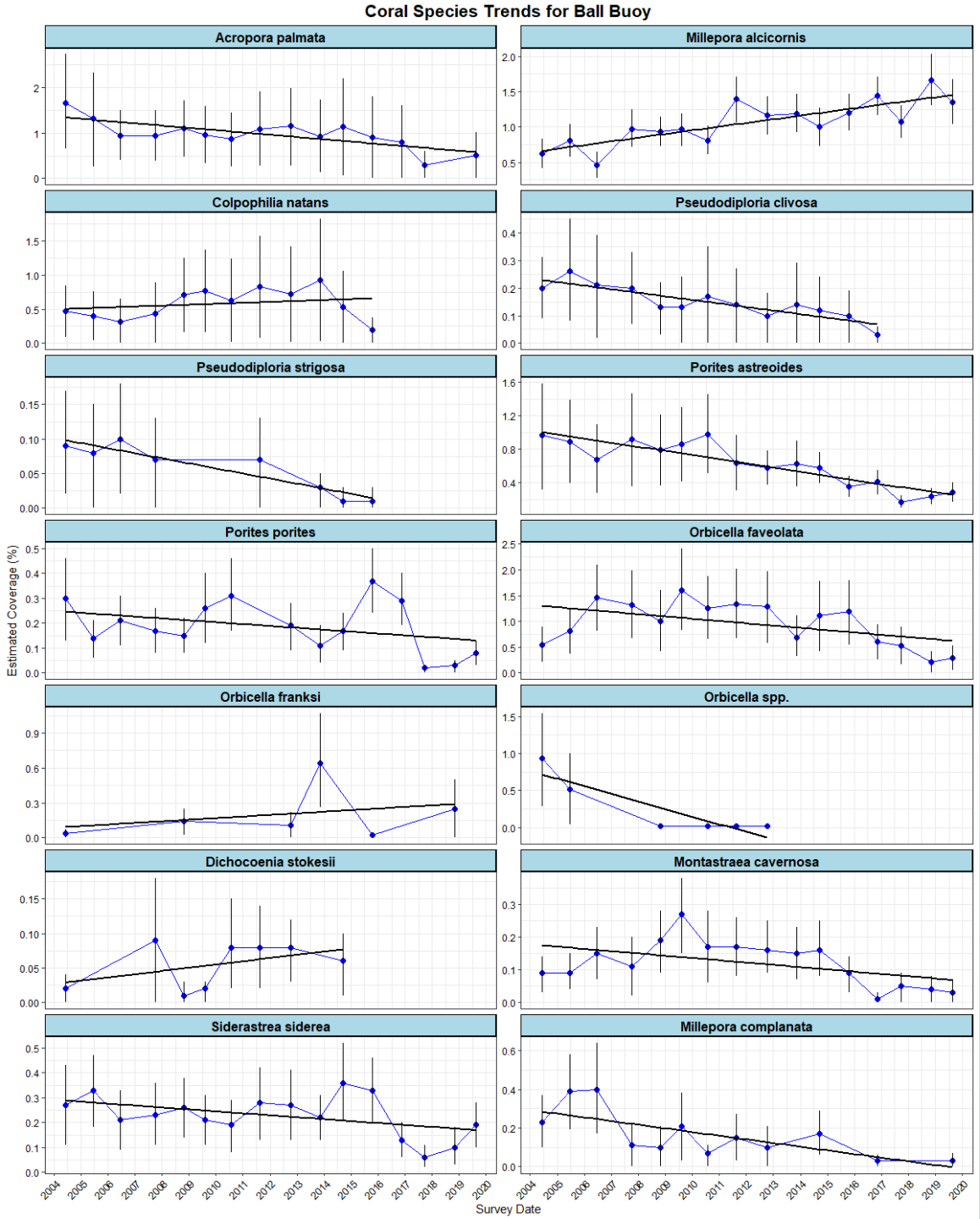


- Significant declines in coral cover at both reefs (Amanda's p=0.00496 Ball Buoy p=0.0000495)
- Nonsignificant increase in algal cover at both reefs
- Notable impact from Hurricane Irma



Results: Coral Species Amanda's Reef

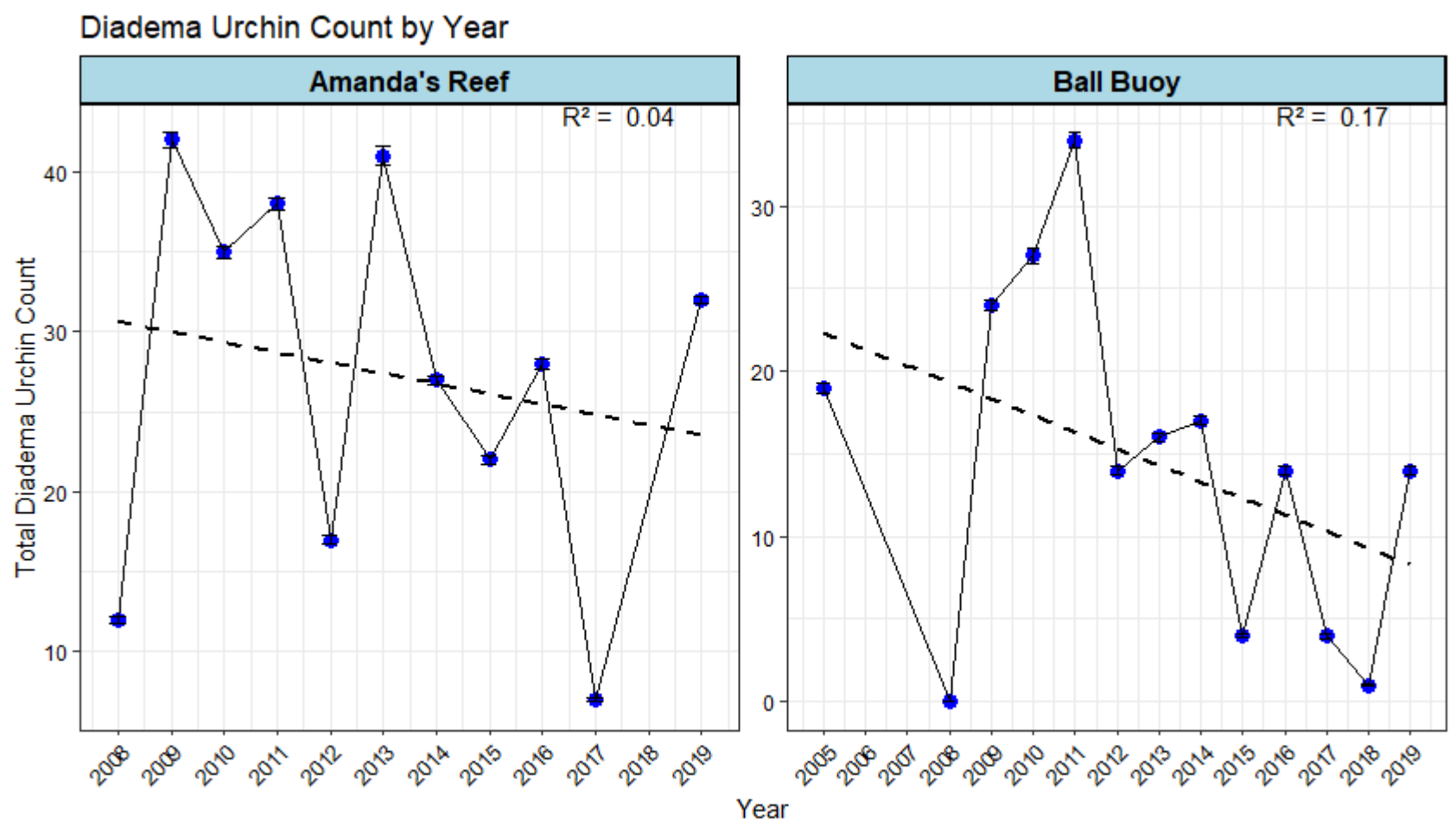
- Amanda's Reef is dominated by the stony coral genus *Porites* and species *Siderastrea siderea.*
- Growing population of hydrocoral *Millepora alcicornis*.
- Federally threated *A. cervicornis* cover decreased by 70%, while *A. palmata* has completely disappeared from monitoring.



Results: Coral Species Ball Buoy Reef

- There has been an over 70% loss of the *A. palmata* population, with an equivalent loss in dominating *Porites* spp. since 2016.
- Boulder brain corals, *Diploria* spp., *Pseudodiploria* spp., and *C. natans* have not been observed post 2016.
- Endangered *Orbicella* spp have also seen a substantial decline at this reef.
- Ball Buoy also saw an increase in *Millepora alcicornis*.

Results: *Diadema*

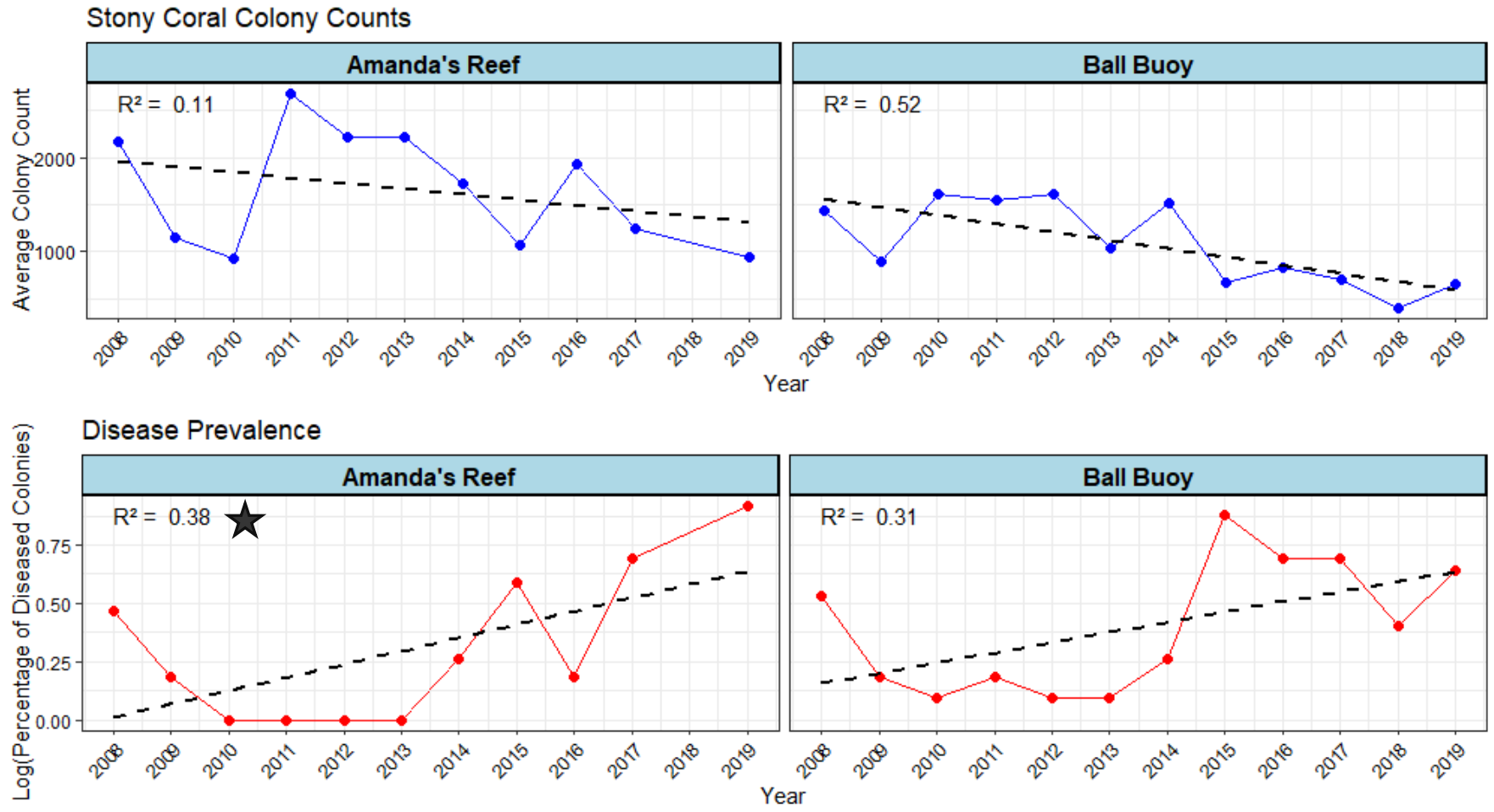


- *Diadema antillarum* (long-spined sea urchin) is significant marine herbivore
- Suffered from a mass mortality event in the 1980s.
- *Diadema* can have substantial effects on macroalgal cover on coral reefs, which affects larval settlement and overall coral recruitment (Miller et al., 2017).
- Nonsignificant negative trends in *Diadema antillarum* counts at both reefs

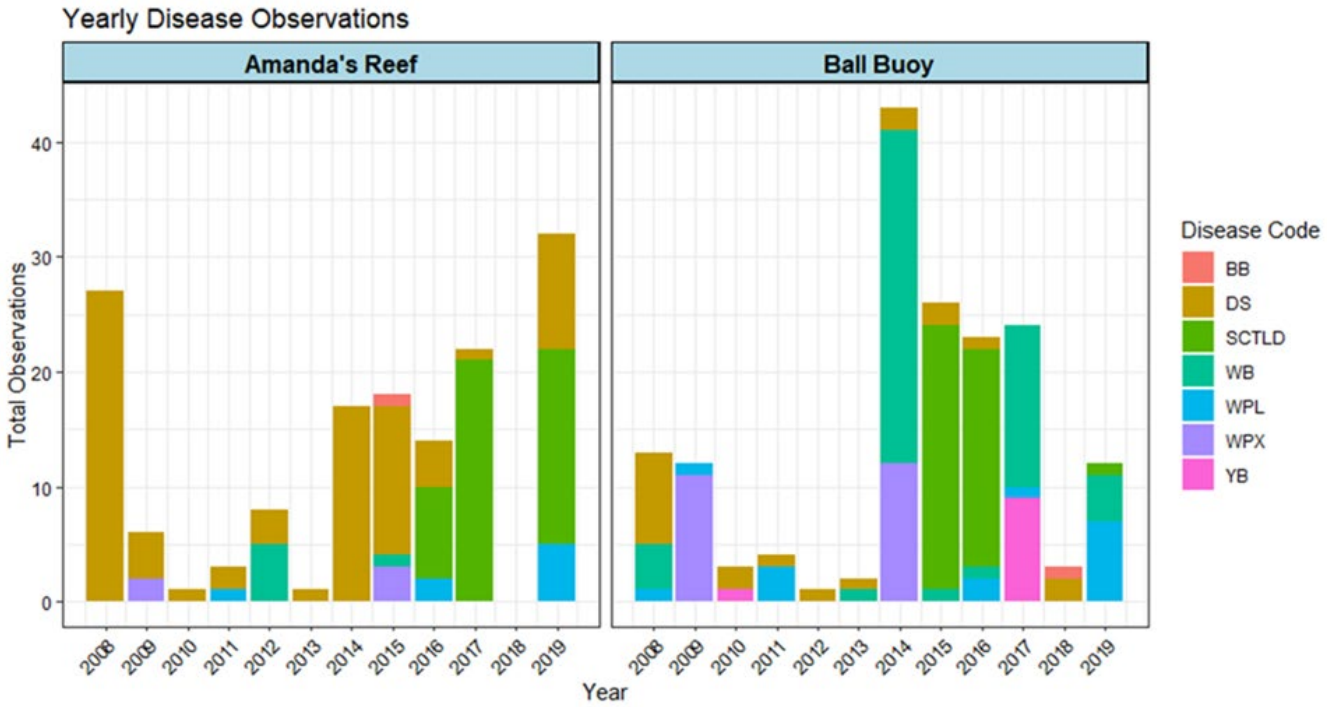
Results: Bleaching

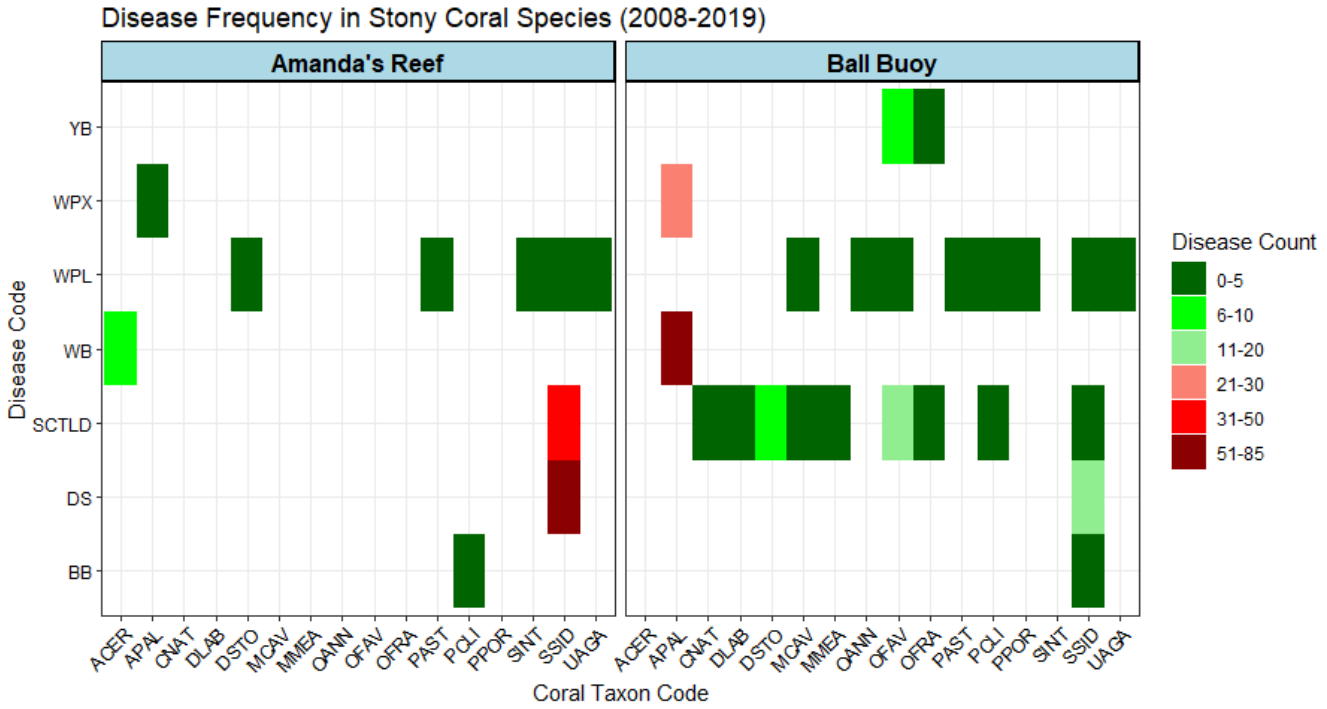
- Large increase in bleaching during 2014/15 at both reefs
- Increased days over the threshold at Amanda's

Results: Disease



- Significant increase in disease prevalence at Amanda's (Amanda's Reef:R^2 =0.3732 ,p = 0.046 Ball buoy: R^2 = 0.3197, p = 0.055)
- Regression modeling of the data found statistically significant relationships between disease prevalence and DCA (Dead Coral Turf Algae) cover at both reefs (*Amanda's Reef*: p = 0.030; *Ball Buoy*: p = 0.041)





Results: Disease

- Stony Coral Tissue Loss Disease(SCTLD) first characterized in 2014
  - SSID heavily afflicted at Amanda's
  - Wider impact at Ball Buoy
- Dark Spot also heavily impacted SSID at Amanda's
- White Band impacting APAL at Ball Buoy

Discussion

Site	Coral Cover Change (2004-2019)	Algal Cover Change (2004-2019)	Dominant Stony Coral Species 2004	Dominant Stony Coral Species 2019
Amanda's Reef	-4.39%	+4.19%	*P. astreoides* (3.06%) *P. porites* (1.15%)	*P. astreoides* (1.07%) *S. siderea* (0.54%)
Ball Buoy	-3.73%	+5.05%	*A. palmata* (1.66%) *Orbicella spp. (1.51%)*	*A. palmata* (0.53%) *Orbicella spp.* (0.29%)

Conclusion

Algal Dominated Reefs with declining coral cover

- Both reefs demonstrated significant declining trends in coral cover. (Ball Buoy: $R^2 = 0.921$ $p = 4.95e\text{-}05$, Amanda's: $R^2 = 0.628$, $p = 0.00496$)
- Significant increase in DCA at Amanda's ($R^2 = 0.413$ $p=0.0178$)

Changes in Coral Species

- Decline of *Acropora* corals, *Porites*, and *Orbicella* corals
- Significant Increase in *Millepora* at both reefs (Amanda's Reef: $R^2 = 0.56$ $p=0.0014$ *Ball Buoy*: $R^2 = 0.6555$ $p= 0.00014$)

Increased Disease Prevalence

- Both reefs showed positives trends in disease prevalence. (Amanda's Reef:$R^2 =0.3732$,$p = 0.046$ Ball buoy: $R^2 = 0.3197$, $p = 0.055$)
- Significant relationship with DCA cover at both reefs (*Amanda's Reef*: $R^2 = 0.389$, $p = 0.030$; *Ball Buoy*: $R^2 = 0.387$, $p = 0.041$)

Negative Trends in Diadema

- Nonsignificant negative trend in *Diadema* at both reefs
- Significant relationship with DCA at Ball Buoy ($R^2 = 0.413$, $p=0.0178$)

Future Directions

- Continued analysis of trends with post 2019 data
- New monitoring site
- Compile with other studies to assess parkwide trends

Sources

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Thank you!
Questions?