FROM CRYPTOFAUNA TO CLEANERS:

EFFECTS OF MISSION: ICONIC REEF RESTORATION ON INVERTEBRATES AND FISH

CLEMSON

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OBJECTIVES

Research aims to contribute knowledge to coral reef recovery and management, including:

1) Objective 4.1 of the National Oceanic and Atmospheric Administration (NOAA) Office of National Marine Sanctuaries' 5-year Strategy: Conduct baseline ecosystem assessments to increase understanding of sanctuary resources.[1]
2) Objective 3 of the NOAA Coral Reef Conservation Program 2021-2026 Resilience Action Plan for Florida's Coral Reef: Conduct research to support coral reef restoration by examining relationships between stony coral populations, coral reef condition, and key reef associated species.[2]
3) Mission: Iconic Reefs (M:IR) 5-Year Report's priority research and monitoring need: Conduct research to understand how restoration affects reef fish recruitment and productivity.[3]

STUDY SITES

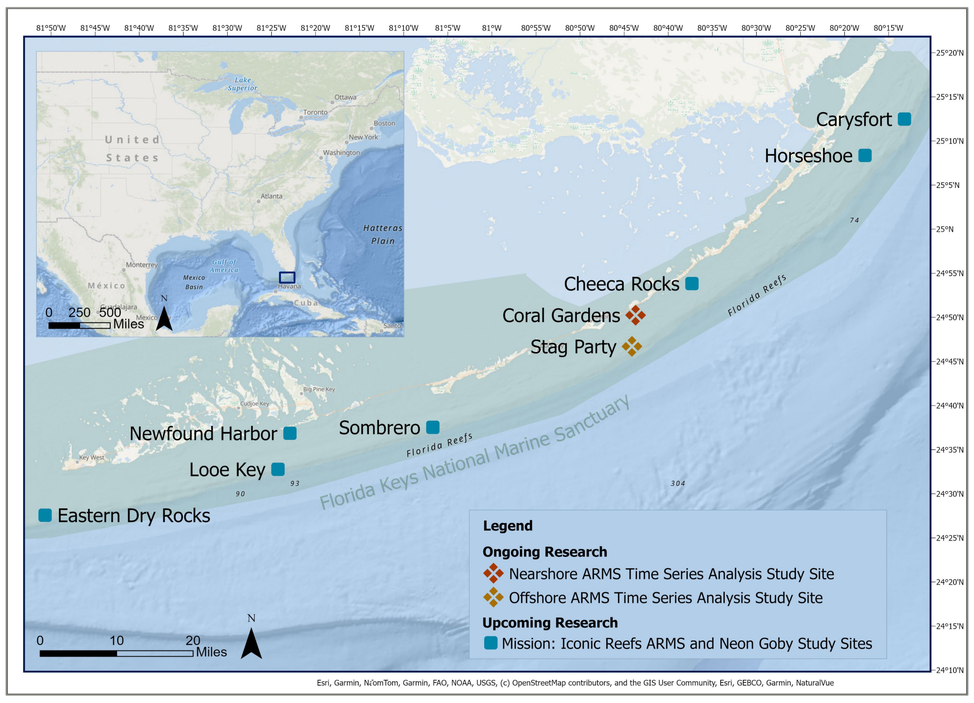

Figure 1: Map of Ongoing and Upcoming Research in the Florida Keys

COMPLETED RESEARCH

Research recently completed by the Childress Lab at 28 reefs in the Middle Florida Keys found:

- Nearshore reefs (≤2 km from shore) had higher coral cover, rugosity, and heat load, and lower turf algae than offshore reefs (5–9 km from shore).
- Total motile cryptofauna biomass was highest offshore and increased with the 2023 heat wave.[4]
- Worm species richness, diversity, and biomass increased with distance from shore.
- Cryptofauna community composition may be a sensitive indicator of reef health.

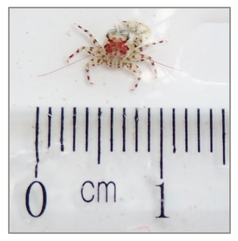

Figure 2: Measuring Cryptofauna to Calculate Biomass[4]

Figure 3: Weighing Cryptofauna to Calculate Biomass[4]

ONGOING RESEARCH

Background & Methods

- Cryptofauna are a critically important foundation of coral reef food webs.
- Goals: 1) Conduct a time series analysis to identify pioneer and successional species.
  2) Assess if reef location (nearshore vs. offshore) affects settlement patterns.

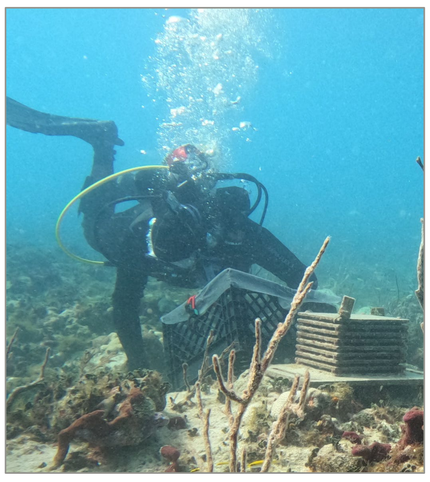

Figure 4: An ARMS Being Retrieved Offshore in Accordance With Smithsonian Institute Protocols[5]

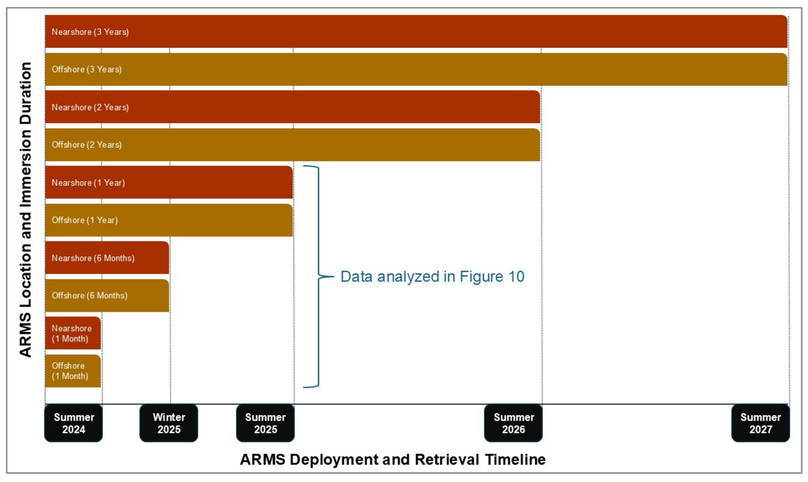

Figure 5: Retrieval Schedule at 1 Month, 6 Months, 1 Year, 2 Years, and 3 Years for 10 ARMS Deployed in Summer 2024 (5 Each on Nearshore and Offshore Reefs)

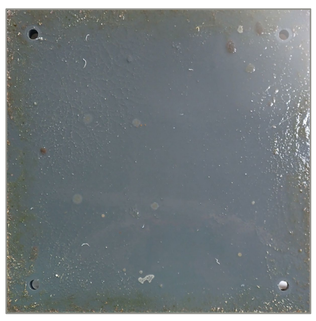

Figure 6: Offshore 1 Month Plate

Figure 7: Offshore 6 Month Plate

Figure 8: Offshore 1 Year Plate

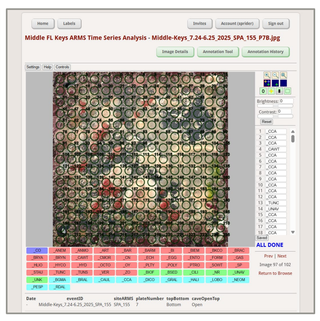

Figure 9: Plate Annotations in CoralNet

Hypotheses & Predictions

- H1: ARMS immersed for 1 month, 6 months, or 1 year will have disproportionately high ratios of pioneer to successional taxa.
- H2: ARMS immersed for 3 years will have insignificant differences in measures of biodiversity compared to ARMS immersed for 2 years. We predict this will indicate 2 years as the optimum ARMS immersion duration to reach community maturation.
- H3: Biodiversity of nearshore and offshore ARMS will vary significantly, with offshore percent cover of calcareous worm tubes and biomass of motile worms significantly larger than biomass of other taxagroups in years 2 and 3.

Preliminary Data

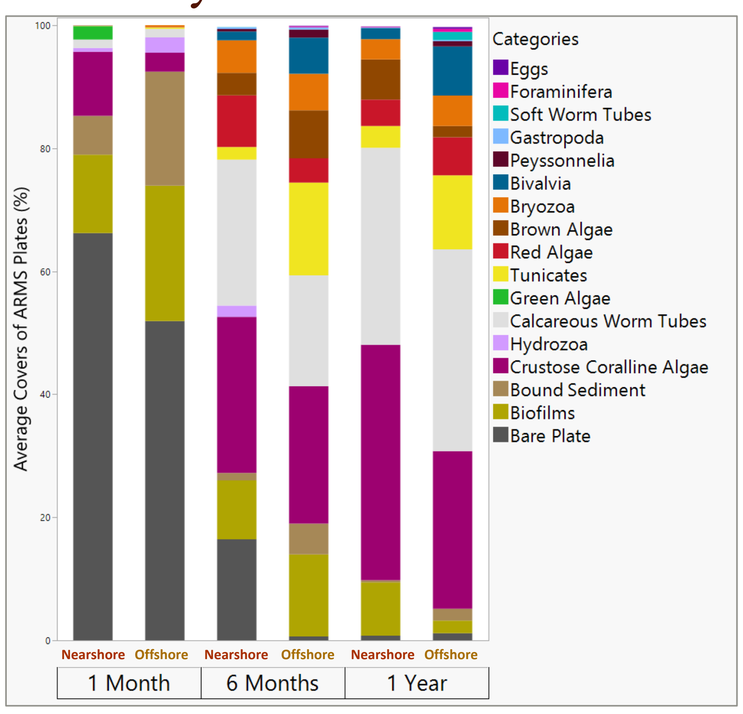

Figure 10: Average Percent Covers of Sessile Cryptofauna by Immersion Duration and Location

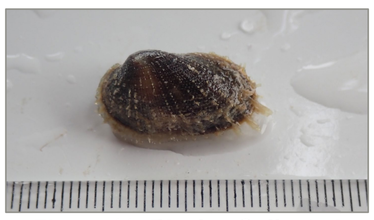

Figure 11: Bivalve Collected from an ARMS

Future Directions

- Process motile data.
- Retrieve remaining ARMS in 2026 & 2027.
- Statistical analysis on abundance, richness, evenness, Shannon diversity, multivariate Analysis of Similarities, and Principal Coordinate Analysis.

UPCOMING RESEARCH

Effects of Coral Restoration on Cryptofauna

- Deploy 14 ARMS to assess cryptofauna biodiversity at M:IR restoration vs. control reefs.
- Apply a ratio-based cryptofauna health index to evaluate underlying reef health and restoration impacts.

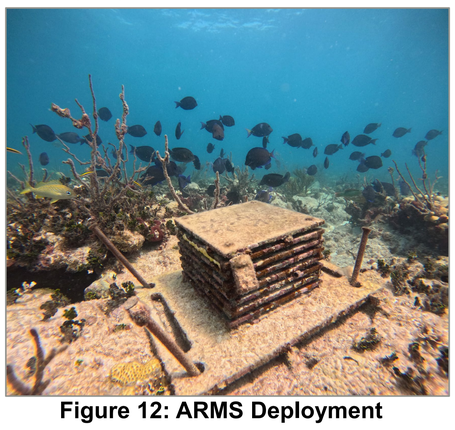

Figure 12: ARMS Deployment

Neon Goby Mutualistic Cleaning Behaviors

- Studying cleaner fish-client mutualism can provide insights into reef fish biodiversity, trophic dynamics, and reef health.
- We will assess neon goby occurrence and behavior at 14 M:IR sites to evaluate plasticity in selection of coral host and client size and species, cleaning rates, and conspecific behavioral dynamics on restoration vs. control reefs.

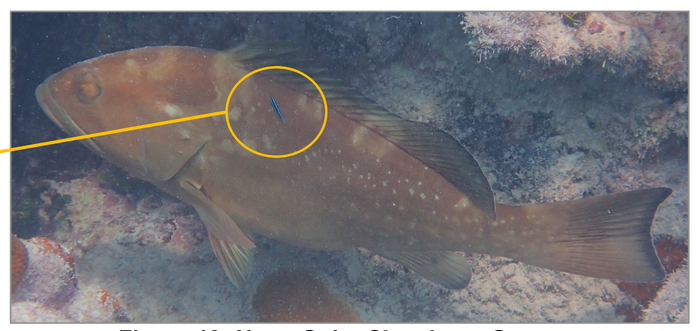

Figure 13: Neon Goby Cleaning a Grouper

REFERENCES & ACKNOWLEDGMENTS

[1] NOAA (2022). A Five-Year Strategy for the National Marine Sanctuary System 2022-2027.

[2] The Nature Conservancy (2021). Resilience Action Plan for Florida's Coral Reef 2021-2026.

[3] NOAA (2024). Mission: Iconic Reefs Five-Year Report. Office of National Marine Sanctuaries, Florida Keys National Marine Sanctuary.

[4] Payton, T.G., Metzger, A.M., Childress, M.J. (2024). Marine debris harbor unique, yet functionally similar cryptofauna communities. Integrative and Comparative Biology, 64(4):1102–1114.

[5] Smithsonian Institute (2025). National Museum of Natural History Global ARMS Program. Accessed 01 October 2025. https://naturalhistory.si.edu/research/global-arms-program.

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