

Characterizing and Forecasting Ecosystem Responses to Multiple Stressors Across the Florida Keys National Marine Sanctuary

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The Florida Keys are a dynamic patchwork of interconnected ecosystems that are critically important to the local economy and highly sensitive to human influence. As part of the four-year, multi-institution Florida Regional Ecosystems Stressors Collaborative Assessment (FRESCA), we comprehensively characterize water quality throughout the Florida Keys National Marine Sanctuary via bi-monthly cruises over nearly three decades, supplemented by periodic satellite observations. These long-term records are then integrated into a regional biogeochemical model (MOM6-SIS-COBALT) to forecast future conditions under different management scenarios. In parallel, we apply a novel high-resolution modeling approach to trace water movement through the Keys as it is influenced by the local benthos. Using these data and a new state-of-the-art experimental system that allows us to simultaneously manipulate dissolved oxygen, pH, and temperature in real time, we explore the sensitivities of seventeen key habitat-altering species, including corals, bioeroders, seagrass, and algae. Next, we employ annotated large area imagery and a novel automated data pipeline to calculate carbonate budgets at Mission Iconic Reef sites. Finally, we synthesize projected stressor distributions, unique species sensitivities, and carbonate budget models to forecast coral reef persistence into the future under different management and coral restoration strategies. Throughout, we will focus on high-level project outputs, data integration and availability, as well as relevance to local management scenarios.